92418456515 2037373.8780488 4561182684 29786819.66 152918525511 86284940.565217 138440768920 18423889.74359 387291782 16651515.977011 71517758858 9063939955 119854833560 20289645.133333 119312551792 17609080.957895 32897019980 41144293.5 73957701280 7561320.58 25406594307 21755502.981818 4680544088 69611143497 78601725252 65555657448 26512123.602564 4819730.2191781 122988018500 84490479710

Ansi c 7th edition pdf free online download pdf books

Contents

Introduction

There is no dearth of good C programming books in the market. However, I found that there is not much material which could help a C programmer to test his programming strengths, help improve his confidence and in the process hone his C skills. Hence this book.

This is not a text book on C. In fact it is far from it.

It contains a lot of questions segregated topic-wise according to my perception of the language. Almost all the questions are real one's asked by real people attempting to learn or program in C.

There is no reason why you should read the questions in the same order as they appear in this book. You can pick up any topic that you think you are good at (or poor at) and try to test your skills on that topic.

There is a good chance that if you are learning or using C and you have questions about C that aren't answered in any of the other books you've checked, you would find them answered here. It would be too much to expect that you would find in this book answer to every question you would have when you're programming in C. This is because many of the questions that may come up in your programming would have to do with your problem domain, whereas this book concentrates only on the C language. Also it doesn't cover every aspect of every operating system under which C is running. Problems specific to an operating systems, and general-purpose algorithms are properly discussed in books devoted to those topics.

At the end of each chapter you would find correct answers to the questions in that chapter. You would find some answers more elaborate than others. At first sight this may seem unnecessary. However, I have done this to give you the complete picture rather than oversimplifying or leaving out important details.

I have tried to avoid the questions whose answers are most obvious because the idea was not to increase the number of questions, but to present questions which would force the readers to think twice before answering. That's in tune with the spirit of C - be precise, brevity has its own importance.

So roll your sleeves and get on with the real questions. Good luck!!

Yashavant P. Kanetkar
Nov., 1996

Chapter 1

Declarations and Initializations

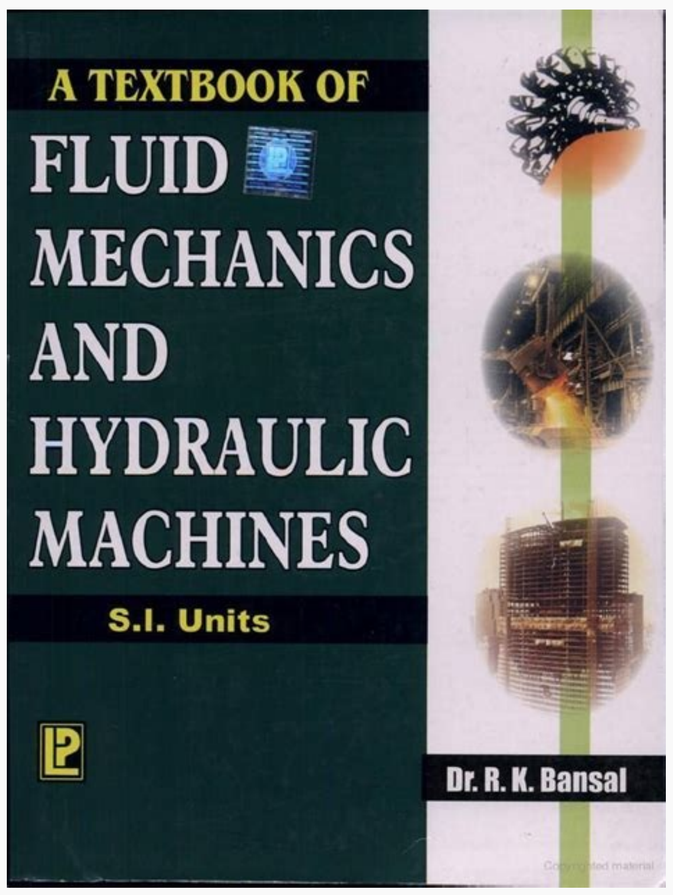
Q *1.1*

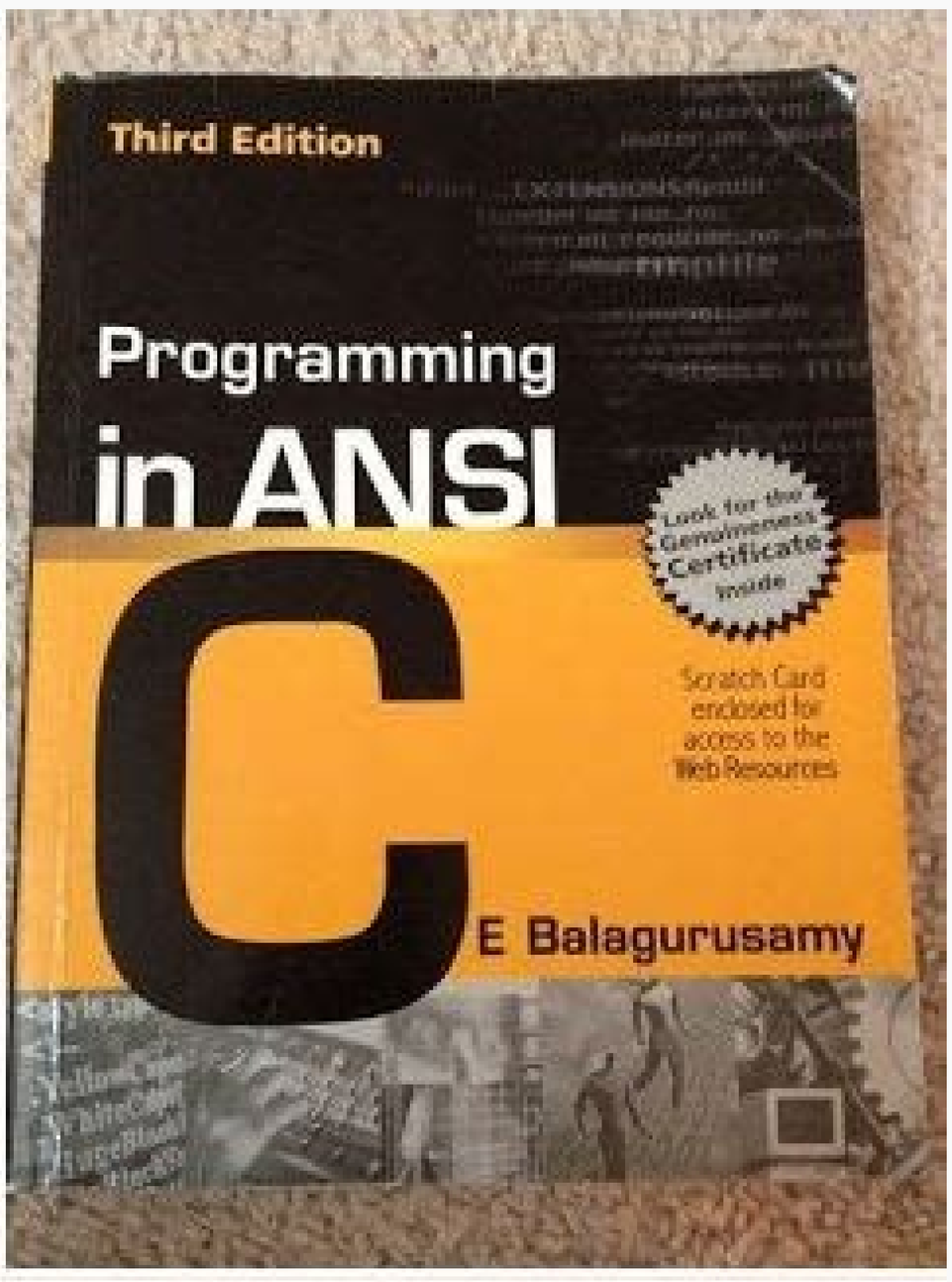
What would be the output of the following program?

```
main( )
{
    char far *s1, *s2 ;
    printf ( "%d %d", sizeof ( s1 ), sizeof ( s2 ) ) ;
}
```

Q *1.2*

What would be the output of the following program?





501 Word Analogy Questions

232. armor : combat ::
_____ : sewing
a. flag
b. needle
c. dueling
d. thimble

233. decoy : duck :: _____ : fish
a. hook
b. lure
c. pond
d. boat

234. barrack : base ::
_____ : desert
a. storm
b. tank
c. test
d. adobe

235. scythe : grass ::
_____ : beard
a. hair
b. face
c. skin
d. razor

236. Clementine : orange ::
monkey : _____
a. jungle
b. baby
c. ape
d. robot

237. lemon : _____ ::
chocolate : sweet
a. citrus
b. tart
c. lure
d. sauce

238. mean : average ::
kind : _____
a. hurtful
b. meaning
c. variety
d. kindness

239. moray : eel :: morel : _____
a. reel
b. slow
c. fungus
d. aquarium

240. stiff : supple :: fierce : _____
a. rigid
b. subtle
c. ferocious
d. tame

241. hilt : sword ::
needle : _____
a. tease
b. compass
c. dagger
d. kilt

242. often : seldom ::
obsolete : _____
a. antiquated
b. current
c. round
d. mixed

We present a section-by-section, bullet-list summary of the chapter. We hope you'll approach them with your own values, politics and beliefs. 1.3 | Data hierarchy. 12.8. (Part 2 of 2.) 12.5.1 Function push Function push (lines 76–91) places a new node at the top of the stack. Self-Review Exercises and Answers. Hence, the reflecting cell to s[1][1] would be s[10-1][10-1] or s[9][9]. For example, a program requiring 4-byte integers may use type int on one system and type long on another. Projects like this include operating systems, computer networking software, compilers, database systems and applications requiring high performance. This is the cause of many subtle logic and syntax errors. __LINE__ __FILE__ Section 13.10 Assertions • Macro assert—defined in the header—tests the value of an expression. using similar functions that do not, ensuring that pointers are always NULL or contain valid addresses, using C functions vs. Each link in the root node of a binary tree refers to a child. 49 83 28 18 40 71 97 11 19 32 44 69 72 92 99 Fig. Figure C.7 highlights the fact that lengthy binary numbers can be expressed concisely in number systems with higher bases than the binary number system. • The digits of the octal number system range from 0 to 7. 3.48 (Enforcing Privacy with Cryptography) The explosive growth of Internet communications and data storage on Internet-connected computers has greatly increased privacy concerns. Consider the following structure definition: struct bitCard { unsigned int face : 4; unsigned int suit : 2; unsigned int color : 1; }; // end struct bitCard which contains three unsigned int bit fields—face, suit and color—used to represent a card from a deck of 52 cards. 1. Recursively call outputTree with the current node's left subtree and totalSpaces + 5. A symbolic constant is a type of macro. Check out our Programming Projects Resource Center for lots of additional exercise and project possibilities (www.deitel.com/ProgrammingProjects/). Use your function in a test program that creates a list of integers. Triples Consider column 5 of Fig. C initially became widely known as the development language of the UNIX operating system. Each time you execute this application from the beginning (i.e., Step 3), it will choose the same numbers for you to guess. Write function power2 that takes two integer arguments number and pow and calculates number * 2pow Use the shift operator to calculate the result. • The bitwise operators are used to manipulate the bits of integral operands (char, short, int and long; both signed and unsigned). [Note: These formulas are estimates provided by the AHA. To run the executable file GuessNumber, type ./GuessNumber at the next prompt, then press Enter (Fig. For example, each of the following five-digit integers is a palindrome: 12321, 55555, 45554 and 11611. Packet Switching A primary goal for ARPANET was to allow multiple users to send and receive information simultaneously over the same communications paths (e.g., phone lines). • Function malloc is normally used with the sizeof operator. b) #elif, #else. The switch multiple-selection statement is introduced. (Part 2 of 2.) In Fig. a) Structures may contain variables of only one data type. 12.8. (Part 1 of 2.) 491 492 Chapter 12 C Data Structures ? l) The first node of a tree is the m) Each link in a tree node points to a(n) or of that node. For example, whenever a function call is made, the called function must know how to return to its caller, so the return address is pushed onto a stack. class Integer { public: Integer(int i = 0); // Integer default constructor ~Integer(); // Integer destructor void setInteger(int i); // functions to set Integer int getInteger() const; // function to return Integer private: int value; }; // end class Integer Fig. Terminology structure member operator 409 bitwise complement operator 423 aggregate 406 arrow operator (->) 409 bit field 426 bit field member name 426 bitwise AND (&) operator 417 bitwise assignment operator 425 bitwise complement operator (~) 423 bitwise exclusive OR (^) operator 417 bitwise inclusive OR (|) operator 417 CHAR_BIT symbolic constant 420 complement operator (~) 417 derived data type 406 enumeration 631 enumeration constants 429 left-shift operator () 417 self-referential structure 407 struct 407 structure 406 structure member (.) operator 409 structure pointer (->) operator 409 structure tag 407 structure type 407 typedef 411 union 415 unnamed bit field 427 unnamed bit field with a zero width 429 width of a bit field 426 Self-Review Exercises 10.1 Fill in the blanks in each of the following: a) A(n) is a collection of related variables under one name. The digits of the binary, octal, decimal and hexadecimal number systems are summarized in Figs. Instead, you can use the following preprocessor construct: 522 Chapter 13 C Preprocessor #if 0 code prevented from compiling #endif To enable the code to be compiled, replace the 0 in the preceding construct with 1. Assign (*topPtr)->data to popValue (line 100) to save the value in the top node. To run an application on the GNU C compiler, you must first compile it by typing gcc GuessNumber.c -o GuessNumber as in Fig. When programming in C you'll typically use the following building blocks: • C Standard Library functions • Functions you create yourself • Functions other people (whom you trust) have created and made available to you The advantage of creating your own functions is that you'll know exactly how they work. 14.2 Redirecting I/O In command-line applications, normally the input is received from the keyboard (standard input), and the output is displayed on the screen (standard output). f) #ifdef, g) Conditional compilation. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 // Fig. To modify the Command Prompt colors on your system, open a Command Prompt by selecting Start > All Programs > Accessories > Command Prompt, then right click the title bar and select Properties. ■ The different types of programming languages. Programming a Solution for "Easy" Sudokus The strategies we've shown—eliminating possibilities based on values already committed in a cell's row, column and 3×3 grid; and simplifying a puzzle using singletons, doubles (and hidden doubles) and triples (and hidden triples)—are sometimes sufficient to solve a puzzle. structure member operator 410 .h filename extension 603 " 391 * assignment suppression character 397 * multiplication operator 50, 88 *= multiplication assignment operator 95 / division operator 88 /*…*/ multi-line comment 42 // single-line comment 549 /= division assignment operator 95 \\ backslash-character escape sequence 43 \? If the compiler cannot find the file in the current directory, then it will search through the predesignated compiler and system directories. The directive normally is used to help make the messages produced by syntax errors and compiler warnings more meaningful. Computers process only 1s and 0s, so every character is represented as a pattern of 1s and 0s. Debugger Appendices. Law enforcement notifies TV and radio broadcasters and state transportation officials, who then broadcast alerts on TV, radio, computerized highway signs, the Internet and wireless devices. Through examples and exercises, Appendix E discusses the selection sort, insertion sort, recursive merge sort, recursive selection sort, bucket sort and recursive Quicksort. k) The l) The character indicates that the replacement text for a symbolic constant or macro continues on the next line. Using cloud computing services shifts the burden of managing these applications from the business to the service provider, saving businesses money. Typical hard drives on desktop and notebook computers can hold up to 2 TB (TB stands for terabytes; a terabyte is approximately one trillion bytes). A node with no children is called a leaf node. Try again." (Fig. Each code example is followed by one or more sample executions. Assign (*headPtr)->nextPtr to *headPtr (line 113) so that points to the new first node in the queue. Now that you are in the directory that contains the GuessNumber application, type the command GuessNumber (Fig. C.6 Negative Binary Numbers: Two's Complement Notation 915 C.6 Negative Binary Numbers: Two's Complement Notation The discussion so far in this appendix has focused on positive numbers. When debugging is completed, the #define directive is removed from the source file (or commented out) and the printf statements inserted for debugging purposes are ignored during compilation. 10.9 double x. Exercises 515 3) For each minute of the day: If the next customer arrives, Say so; Enqueue the customer; Schedule the arrival time of the next customer. The # operator causes a replacement text token to be converted to a string surrounded by quotes. Figure 12.11 illustrates function pop. C.7 Binary 1111 1010 1100 1110. For example, a bank-account object has a balance attribute that represents the amount of money in the account. In larger programs, it may be desirable to define several different symbolic constants that control the conditional compilation in separate sections of the source file. Non-Member Functions 19.12 Converting between Types 19.13 explicit Constructors 19.14 Building a String Class 19.15 Wrap-Up xv 715 716 719 727 727 729 731 732 20 Object-Oriented Programming: Inheritance 20.1 20.2 20.3 20.4 20.5 20.6 20.7 20.8 Introduction Base Classes and Derived Classes protected Members Relationship between Base Classes and Derived Classes 20.4.1 Creating and Using a CommissionEmployee Class 20.4.2 Creating a BasePlusCommissionEmployee Class Without Using Inheritance 20.4.3 Creating a CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy 20.4.4 CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy Using protected Data 20.4.5 CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy Using private Data Constructors and Destructors in Derived Classes public, protected and private Inheritance Software Engineering with Inheritance Wrap-Up 21 Object-Oriented Programming: Polymorphism 778 21.1 21.2 21.3 Introduction Introduction to Polymorphism: Polymorphic Video Game Relationships Among Objects in an Inheritance Hierarchy 21.3.1 Invoking Base-Class Functions from Derived-Class Objects 21.3.2 Aiming Derived-Class Pointers at Base-Class Objects 21.3.3 Derived-Class Member-Function Calls via Base-Class Pointers 21.3.4 Virtual Functions Type Fields and switch Statements Abstract Classes and Pure virtual Functions Case Study: Payroll System Using Polymorphism 21.6.1 Creating Abstract Base Class Employee 21.6.2 Creating Concrete Derived Class SalariedEmployee 21.6.3 Creating Concrete Derived Class CommissionEmployee 21.6.4 Creating Indirect Concrete Derived Class 779 780 780 781 784 785 787 793 793 795 796 800 802 21.4 21.5 21.6 BasePlusCommissionEmployee 21.6.5 Demonstrating Polymorphic Processing 743 744 744 747 747 748 752 758 763 766 771 771 772 773 804 806 xvi Contents 21.7 (Optional) Polymorphism, Virtual Functions and Dynamic Binding "Under the Hood" 21.8 Case Study: Payroll System Using Polymorphism and Runtime Type Information with Downcasting, dynamic_cast, typeid and type_info 21.9 Virtual Destructors 21.10 Wrap-Up 22 Templates 22.1 22.2 22.3 22.4 22.5 22.6 Introduction Function Templates Overloading Function Templates Class Templates Nontype Parameters and Default Types for Class Templates Wrap-Up 23 Stream Input/Output 23.1 23.2 Introduction Streams 23.2.1 Classic Streams vs. • A union may be initialized in a declaration with a value of the same type as the first union member. Along the way, you'll become more facile with manipulating two-dimensional arrays and with nested iteration structures. Suppose int value = 13; The 32-bit representation of value is 00000000 00000000 00000000 00001101 To form the negative of value we first form its one's complement by applying C's bitwise complement operator (~): onesComplementOfValue = ~value; Internally, ~value is now value with each of its bits reversed—ones become zeros and zeros become ones, as follows: value: 00000000 00000000 00000000 00001101 ~value (i.e., value's ones complement): 11111111 11111111 11111111 11110010 To form the two's complement of value, we simply add 1 to value's one's complement. Use the source code we provide to run every program as you study it. 10.12 (Packing Characters into an Integer) The left-shift operator can be used to pack four character values into a four-byte unsigned int variable. Write a program that inputs four characters from the keyboard and passes them to function packCharacters. • The scope of a symbolic constant or macro is from its definition until it's undefined with #undef or until the end of the file. 1.12 Operating Systems Operating systems are software systems that make using computers more convenient for users, application developers and system administrators. In our car analogy, an object of class "convertible" certainly is an object of the more general class "automobile," but more specifically, the roof can be raised or lowered. 1.14). Positional values in the binary number system Binary digit Position name Positional value Positional value as a power of the base (2) 1 0 1 Fours Twos Ones 4 2 1 22 21 20 Fig. We believe that this book and its support materials will give you an informative, challenging and entertaining introduction to C. This encourages independent software vendors (ISVs) to provide class libraries for sale or license. , o) The three traversal algorithms (covered in this chapter) for a binary tree are and . Examine the function multiple, then determine X's value. b) Define symbolic constant NO to have the value 0. In case of a tie, look ahead one more placement. For book updates, visit www.deitel.com/books/chtp7/, join our communities on Facebook (www.deitel.com/ deitelfan), Twitter (@deitel) and Google+ (gplus.to/deitel), and subscribe to the Deitel ® Buzz Online newsletter (www.deitel.com/newsletter/subscribe.html). You, the user, are the most important aspect of Web 2.0—so important, in fact, that in 2006, TIME magazine's "Person of the Year" was "You."4 The article recognized the social phenomenon of Web 2.0—the shift away from a powerful few to an empowered many. Under tight deadlines, they scrutinized the text and the programs and provided countless suggestions for improving the presentation: Dr. John F. 1.4 | Levels of the data hierarchy. Database A database is an electronic collection of data that's organized for easy access and manipulation. The left child is the first node in the left subtree, and the right child is the first node in the right subtree. 22 Chapter 1 Introduction to Computers, the Internet and the Web (Fig. @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ^ _ ' a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~ del Fig. Performance Tip 13.1 In the past, macros were often used to replace function calls with inline code to eliminate the function-call overhead. You should always ensure that malloc did not return NULL before attempting to use the pointer that stores malloc's return value. If cell s[3][9] had originally contained only 135, then eliminating the 1 and the 5 would enable us to force the cell to the value 3. The private utility function totalAnnualSales (lines 48–56) totals the 12 monthly sales figures for the benefit of printAnnualSales. Entering your first guess. 12.6.2 Function dequeue Function dequeue (lines 106–122) receives the address of the pointer to the head of the queue and the address of the pointer to the tail of the queue as arguments and removes the first node from the queue. b) Define Part to be a synonym for the type struct part. Software Engineering Observations The Software Engineering Observations highlight architectural and design issues that affect the construction of software systems, especially large-scale systems. The application again displays "Too high. Structures are passed by value, so the array is passed by value. 1.10.5 Phase 6: Execution Finally, the computer, under the control of its CPU, executes the program one instruction at a time. Portability Tip 10.8 Bit-field manipulations are machine dependent. Support for the new standard varies by compiler. The new Chapter 1 engages students with intriguing facts and figures to get them excited about studying computers and computer programming. Information that will be used only internally in the class and will not be needed by clients of the class should be included in the unpublished source file. Binary number Octal equivalent Hexadecimal equivalent 100011010001 4321 8D1 To see how the binary number converts easily to octal, simply break the 12-digit binary number into groups of three consecutive bits each and write those groups over the corresponding digits of the octal number as follows: 100 4 011 3 010 2 001 1 The octal digit you have written under each group of three bits corresponds precisely to the octal equivalent of that 3-digit binary number, as shown in Fig. Supercomputers are already performing thousands of trillions (quadrillions) of instructions per second! In 2011, Fujitsu announced that its "K" supercomputer can perform over 10 quadrillion calculations per second (10 petaflops)! To put that in perspective, the K supercomputer can perform in one second more than 1,000,000 calculations for every person on the planet! And—these "upper limits" are growing quickly! Computers process data under the control of sequences of instructions called computer programs. 12.17)—trees whose nodes all contain two links (none, one, or both of which may be NULL). The new standard incorporates both C99 and the more recent C1X—now referred to as C11 or simply "the C standard" since its approval in 2011. Dr. Deitel has delivered hundreds of professional programming seminars to major corporations, academic institutions, government organizations and the military. Computers that might have filled large rooms and cost millions of dollars decades ago are now inscribed on silicon chips smaller than a fingernail, costing perhaps a few dollars each. C How to Program, 7/e is appropriate for CS1 and CS2 courses, and intermediatelevel C and C++ programming courses. What must happen before you can do this? Each of these algorithms requires only a single left-to-right pass of the expression. ALL SUCH DOCUMENTS AND RELATED GRAPHICS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND. • The right-shift operator shifts the bits in its left operand to the right by the number of bits specified in its right operand. For many decades, hardware costs have fallen rapidly. All rights reserved. We focus on good software engineering and stressing program clarity. This is done by the loader, which takes the executable image from disk and transfers it to memory. D.6. The dashed cells could already be committed or could have lists of possible values. These exercises are meant to increase awareness of important issues the world is facing. Exercises. —Plato Objectives In this chapter, you'll: ■ ■ ■ ■ ■ Use #include to develop large programs. This makes these constants stand out in a program and reminds you that enumeration constants are not variables. Visit the following website for the C Standard Library documentation: www.dinkumware.com/manuals/#Standard%20C%20Library C How to Program, 7/e encourages a building-block approach to creating programs. It has become the key programming language for the Mac OS X operating system and all iOS-based devices (such as iPods, iPhones and iPads). If the average arrival rate is larger than the average service rate, the queue will grow infinitely. Figure 10.16 (output shown in Fig. The most sophisticated games can cost as much as $100 million to develop. f) The pointer to the next node in a linked list is referred to as a(n) g) Function is used to reclaim dynamically allocated memory. For example, the binary number 110101 is converted to decimal 53, as shown in Fig. The #define directive format is #define identifier replacement-text When this line appears in a file, all subsequent occurrences of identifier that do not appear in string literals will be replaced by replacement text automatically before the program is compiled. Attributes and Instance Variables A car, besides having capabilities to accomplish tasks, also has attributes, such as its color, its number of doors, the amount of gas in its tank, its current speed and its record of total miles driven (i.e., its odometer reading). AMBER™ Alert The AMBER (America's Missing: Broadcast Emergency Response) Alert System is used to find abducted children. This would cause the computer to display an error message. Subsequent nodes are accessed via the link pointer member stored in each node. C.23 Convert hexadecimal FFFF to decimal. The tokens are sequences of characters separated by spaces. These services allow you to increase or decrease resources to meet your needs at any given time, so they can be more cost effective than purchasing expensive hardware to ensure that you have enough storage and processing power to meet your needs at their peak levels. 1.7. C programs typically go through six phases to be executed (Fig. If it returns 0, simply loop again, generating another nine randomly selected permutations of the digits 1 through 9 into the nine successive rows of the array Sudoku. 1.25 | Running the GuessNumber application. Many of today's leading operating systems are written in C and/or C++. Then swap the first digit with the third, and swap the second digit with the fourth. When we write an integer such as 227 or –63 in a program, the number is assumed to be in the decimal (base 10) number system. Common Programming Error 13.2 Inserting conditionally compiled printf statements for debugging purposes in locations where C currently expects a single statement. After every tenth asterisk, your program should print a newline character. It's important to read the Before You Begin section at www.deitel.com/books/chtp7/ to make sure that you've copied the book's examples to your hard drive correctly. 1.22). • With stacks, insertions and deletions are made only at the top. The #pragma directive #pragma tokens causes an implementation-defined action. 1.1 | A few uses for computers. Occasionally, a hexadecimal number spells a common word such as FACE or FEED—this can appear strange to programmers accustomed to working with numbers. The preceding infix expressions would appear in postfix notation as 3 4 + and 7 9 /, respectively. Rather, they should be assigned either NULL or the address of a valid item in memory. Computers can perform computations and make logical decisions phenomenally faster than human beings can. 10.18, the enumeration variable month is used in a for statement to print the months of the year from the array monthName. The declaration should be struct person d; f) Variables of different structure types cannot be assigned to one another. Appendices on the Web The following appendices are available as PDF documents from this book's Companion Website (www.pearsonhighered.com/deitel/): • Appendix E, Sorting: A Deeper Look • Appendix F, Introduction to the New C Standard • Appendix G, Using the Visual Studio Debugger • Appendix H, Using the GNU Debugger These files can be viewed in Adobe® Reader® (get.adobe.com/reader). (Part 3 of 3.) The numbers being placed in the tree are: 6 7 4 12 7dup 2 2dup 5 7dup 11 The preOrder traversal is: 6 4 2 5 7 12 11 Fig. We'll show an example of this in the Secure C Programming section. As you read the book, we would sincerely appreciate your comments, criticisms, corrections and suggestions for improving the text. Continue to play the game (Fig. CHANGES ARE PERIODICALLY ADDED TO THE INFORMATION HEREIN. Software Used in C How to Program, 7/e We wrote C How to Program, 7/e using Microsoft's free Visual C++ Express Edition (which can compile both C and C++ programs and can be downloaded from www.microsoft.com/ C++ IDE Resource Kit express/downloads/) xxv and the free GNU C and C++ compilers (gcc.gnu.org/install/ binaries.html), which are already installed on most Linux systems and can be installed on Mac OS X and Windows systems. You can develop applications in C for all four of the following key operating systems, including several of the latest mobile operating systems. d) Only characters may appear before a preprocessor directive on a line. C++ (Computer program language) 3. Before you can drive a car, it must be built from the engineering drawings that describe it. 21.12 | SalariedEmployee class implementation file. 815 Too high. b) Member lastName of the structure pointed to by customerPtr. Additional components from shared libraries that support the program are also loaded. 14.1 | stdarg.h variable-length argument-list type and macros. Section 13.9 Predefined Symbolic Constants • Constant is the line number (an integer) of the current source code line. To create a new node: Call malloc, assign the allocated memory location to newPtr (line 84), assign the value to be inserted in the queue to newPtr->data (line 87) and assign NULL to newPtr->nextPtr (line 88). 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 // Fig. Although assembly-language code is clearer to humans, it's incomprehensible to computers until translated to machine language. A Note About Secure C Programming xxi A Note About Secure C Programming Throughout this book, we focus on C programming fundamentals. Notice the doubles—the two cells s[1][9] and s[2][7] containing only the two possibilities 15. • A binary search tree facilitates duplicate elimination. Part (a) of the figure shows the stack and the new node before the push operation. C.20 Convert hexadecimal 765F to octal. Excellent! You guessed the number! Would you like to play again? We've created Resource Centers on most of these topics, with more on the way. One benefit of developing Android apps is the openness of the platform. The postOrder traversal of the tree in Fig. The function uses a modified inorder traversal to output the tree—it starts at the rightmost node in the tree and works back to the left. Such reflections are calculated by presenting the column, but determining the row by subtracting the initial row from 10. Thus, we first write: Positional values: 64 32 16 8 4 2 1 914 Appendix C Number Systems Then we discard the column with positional value 64, leaving: Positional values: 32 16 8 4 2 1 Next we work from the leftmost column to the right. The macro should receive the array and the number of elements in the array as arguments. "Making a Difference" Exercise Sets. We use the newer, more concise C++-style // comments in preference to C's older style /*...*/ comments. For this test-drive only, we've modified this application from the exercise you'll be asked to create in Chapter 5. 1 2 3 4 5 6 1 7 8 9 9 2 2 7 3 6 4 4 2 5 7 2 5 6 7 7 8 8 3 9 1 Fig. 13.8 (Printing a String) Write a program that defines and uses macro PRINT to print a string value. j) LIFO. At the heart of the book is the Deitel signature "live-code approach." We present concepts in the context of complete working programs, rather than in code snippets. This is true even today on the Internet, which facilitates communications of all kinds among the world's Internet users. For the Windows version of the test drive in this section, we've modified the background color of the Command Prompt window to make the Command Prompt windows more readable. 1.20 | Entering additional guesses and guessing the correct number. To understand binary arithmetic and how negative binary numbers are represented using two's complement notation. For example, suppose two cells of a row, column or 3×3 grid have possibles lists of 2467 and 257 and that no other cell in that row, column or 3×3 grid mentions 2 or 7 as a possible value. A class's private members are listed in the class definition in the header, so these members are visible to clients even though the clients may not access the private members. enables you to control the execution of preprocessor directives and the comg) pilation of program code. 76 ?: conditional operator 76, 95, 194 . 12.4 Write a statement or set of statements to accomplish each of the following. d) predicates. In the Terminal window, change to the completed GuessNumber application directory (Fig. Maximum and target heart rates may vary based on the health, fitness and gender of the individual. ~/examples/ch01/GuessNumber/GNU$ ./GuessNumber I have a number between 1 and 1000. The project used computer programs to analyze complex genetic data, determine the sequences of the billions of chemical base pairs that make up human DNA and store the information in databases which have been made available over the Internet to researchers in many fields. Figure 12.10 illustrates function push. 434 Chapter 10 C Structures, Unions, Bit Manipulation and Enumerations • The symbolic constant CHAR_BIT (defined in) represents the number of bits in a byte (normally 8). Consider the following macro definition: #define HELLO(x) puts("Hello, " #x); When HELLO(John) appears in a program file, it's expanded to puts("Hello, " "John"); The string "John" replaces #x in the replacement text. The memory unit also retains processed information until it can be placed on output devices by the output unit. Develop a means of demonstrating that a particular Sudoku puzzle has exactly one solution. • The bitwise AND, bitwise inclusive OR and bitwise exclusive OR operators compare their two operands bit by bit. For example, TOKENCONCAT(O, K) is replaced by OK in the program. The disadvantage is the time-consuming effort that goes into designing, developing and debugging new functions. j) union. (Part 2 of 3.) 12.7 Trees 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 // data to insert is greater than data in current node else if (value > (*treePtr)->data) { insertNode(&(*treePtr)->rightPtr), value); } // end else if else { // duplicate data value ignored printf("%s", "dup"); } // end else } // end else } // end function insertNode // begin inorder traversal of tree void inOrder(TreeNodePtr treePtr) { // if tree is not empty, then traverse if (treePtr != NULL) { inOrder(treePtr->leftPtr); printf("%3d", treePtr->data); inOrder(treePtr->rightPtr); } // end if } // end function inOrder // begin preorder traversal of tree void preOrder(TreeNodePtr treePtr) { // if tree is not empty, then traverse if (treePtr != NULL) { printf("%3d", treePtr->data); preOrder(treePtr->leftPtr); preOrder(treePtr->rightPtr); } // end if } // end function preOrder // begin postorder traversal of tree void postOrder(TreeNodePtr treePtr) { // if tree is not empty, then traverse if (treePtr != NULL) { postOrder(treePtr->leftPtr); postOrder(treePtr->rightPtr); printf("%3d", treePtr->data); } // end if } // end function postOrder Fig. For longer binary numbers, the next positions to the left would be the eights position (2 to the 3rd power), the sixteens position (2 to the 4th power), the thirty-twos position (2 to the 5th power), the sixty-fours position (2 to the 6th power) and so on. 1.18). Consider the following 12-digit binary number and its octal and hexadecimal equivalents. It's primarily used to add programmability to web pages—for example, animations and interactivity with the user. Bit field members must be declared as int or unsigned int. The address information allowed packets to be routed to their destinations. Positional values in the decimal number system Decimal digit Position name Positional value Positional value as a power of the base (10) 9 3 7 Hundreds Tens Ones 100 102 10 1 101 100 Fig. In the octal number system, the digits range from 0 to 7. Portability Tip 1.2 Using Standard C library functions instead of writing your own comparable versions can improve program portability, because these functions are used in virtually all Standard C implementations. h) bitwise exclusive OR (^). 526 Chapter 13 C Preprocessor • Directives #ifdef and #ifndef are provided as shorthand for #if defined(name) and #if !defined(name). The object code produced by the C compiler typically contains "holes" due to these missing parts. Traverse the right subtree inOrder. Structures are always passed to functions by value. These are spooled to disk where they wait in a queue until the printer becomes available. The index entries for these appendices have uppercase Roman numeral page numbers. 1.12.1 Windows—A Proprietary Operating System In the mid-1980s, Microsoft developed the Windows operating system, consisting of a graphical user interface built on top of DOS—an enormously popular personal-computer operating system that users interacted with by typing commands. • A linked list is accessed via a pointer to the first node. 1.12.2 Linux—An Open-Source Operating System The Linux operating system is perhaps the greatest success of the open-source movement. 13.5 Conditional Compilation Conditional compilation enables you to control the execution of preprocessor directives and the compilation of program code. (Part 2 of 2.) 12.7.1 Function insertNode The functions used in Fig. Good Programming Practice 10.5 Use only uppercase letters in enumeration constant names. hostName:GNU~ userFolder$ gcc GuessNumber.c -o GuessNumber hostName:GNU~ userFolder$ Fig. 438 Chapter 10 C Structures, Unions, Bit Manipulation and Enumerations o) Member zipCode of member personal of structure customerRecord. • Every #if construct ends with #endif. 10.3 Write code to accomplish each of the following: a) Define a structure called part containing unsigned int variable partNumber and char array partName with values that may be as long as 25 characters (including the terminating null character). The program generates 10 random numbers and inserts each in the tree, except that duplicate values are discarded. Section 13.7 # and ## Operators • The # operator causes a replacement-text token to be converted to a string surrounded by quotes. and the authors can be reached at: To learn more about Deitel's Dive Into® Series Corporate Training curriculum, visit: www.deitel.com/training/ To request a proposal for worldwide on-site, instructor-led training at your company or organization, e-mail Individuals wishing to purchase Deitel books and LiveLessons video training can do so through www.deitel.com. The book's Companion Website (www.pearsonhighered.com/deitel) contains source code for all the code examples and the following appendices in searchable PDF format: • Appendix E, Sorting: A Deeper Look • Appendix F, Introduction to the New C Standard xxii Preface • Appendix G, Using the Visual Studio Debugger • Appendix H, Using the GNU Debugger Dependency Charts Figures 1 and 2 show the dependencies among the chapters to help instructors plan their syllabi. d) white-space. Figure 1.6 introduces several other popular C-based programming languages. The stack is: 5 --> NULL ? Associate with every empty square a possibles list of the digits that can still be placed in that square. Directive #undef "undefines" the symbolic constant or macro name. Use conditional compilation to specify portions of a program that should not always be compiled (such as code that assists you in debugging). 2 hostName:GNU~ userFolder$ Fig. Pop (and discard) the left parenthesis from the stack. World Community Grid People worldwide can donate their unused computer processing power by installing a free secure software program that allows the World Community Grid (www.worldcommunitygrid.org) to harness unused capacity. 1.8 | Opening a Command Prompt window and changing the directory. Using this textbook, you'll learn how to command computers to perform those tasks. 12.9 (Creating a Linked List, Then Reversing Its Elements) Write a program that creates a linked list of 10 characters, then creates a copy of the list in reverse order. If the value is 0 (false), assert prints an error message and calls function abort to terminate program execution. If *treePtr is NULL (line 58), create a new node (line 59). Input the values from the keyboard. For longer hexadecimal numbers, the next positions to the left would be the fourthousand-and-ninety-sixes position (16 to the 3rd power), the sixty-five-thousand-fivehundred-and-thirty-sixes position (16 to the 4th power) and so on. Assign (*topPtr)->nextPtr to of the new top node. • The octal number system (base 8) and the hexadecimal number system (base 16) are popular primarily because they make it convenient to abbreviate binary numbers. 12.21 (Recursively Search a List) Write a function searchList that recursively searches a linked list for a specified value. This yields: Positional values: 32 Symbol values: 1 16 1 8 1 4 0 2 0 1 1 and thus decimal 57 is equivalent to binary 111001. Part (a) shows the queue and the new node before the operation. Function putchar of the header and the character-handling functions of the header often are implemented as macros as well. THE DOCUMENTS AND RELATED GRAPHICS CONTAINED HEREIN COULD INCLUDE TECHNICAL INACCURACIES OR TYPOGRAPHICAL ERRORS. 928 Appendix D Game Programming: Solving Sudoku Another approach is to empty the cells in a manner that leaves the resulting board symmetric. Customers arrive in random integer intervals of 1 to 4 minutes. void push(StackNodePtr *topPtr, char value) Push a value on the stack. Stacks are used by compilers in the process of evaluating expressions and generating machine-language code. The preOrder traversal of the tree in Fig. 13.9 Predefined Symbolic Constants Standard C provides predefined symbolic constants, several of which are shown in Fig. The level order traversal is not a recursive algorithm. We've integrated into the text (and appendices) in easy-toinclude-or-omit sections many of the new features implemented in leading compilers. Your loop should not terminate (i.e., you should create an infinite loop). 1 I have a number between 1 and 1000. 10.18: fig10_18.c // Using an enumeration #include // enumeration constants represent months of the year enum months { JAN = 1, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC }; // end enum months int main(void) { enum months month; // can contain any of the 12 months // initialize array of pointers const char *monthName[] = { "", "January", "February", "March", "April", "May", "June", "July", "August", "September", "October", "November", "December" }; // loop through months for (month = JAN; month) are used to access structure members. For example, to append the output from program random to file out created in the preceding command line, use the command line $ random >> out 14.3 Variable-Length Argument Lists It's possible to create functions that receive an unspecified number of arguments. Sentinels must be distinct from regular data items. • Each binary bitwise operator has a corresponding assignment operator. 500 Too low. To accommodate the growth in traffic, Zynga is adding nearly 1,000 servers each week (techcrunch.com/ 2010/09/22/zynga-moves-1-petabyte-of-data-daily-adds-1000servers-a-week/)! Fig. So we can commit cell s[6][6] to a 5 (Fig. 1.27). C.6 Convert binary 110101011000 to octal and to hexadecimal. Other data types are stored in larger numbers of bytes. Function free is used to reclaim the memory pointed to by tempPtr. At any point in solving a Sudoku, we can categorize the board by listing in each empty cell the digits from 1 to 9 which are still open possibilities for that cell. The macro takes one argument. (Part 2 of 2.) 1.5 Programming Languages Programmers write instructions in various programming languages, some directly understandable by computers and others requiring intermediate translation steps. C program file names should end with the .c extension. In 1988, NeXT licensed Objective-C from StepStone and developed an Objective-C compiler and libraries which were used as the platform for the NeXTSTEP operating system's user interface and Interface Builder—used to construct graphical user interfaces. The program should prompt the user for a value to locate in the list. Process the value in the node. We divide 64 into 103 and observe that there is one 64 in 103 with a remainder of 39, so we write 1 in the 64 column. The initial value of the control variable. For example, #error 1 - Out of range error contains 6 tokens. • To convert a hexadecimal number to a binary number, simply replace each hexadecimal digit with its four-digit binary equivalent. The method houses the program state- 1.9 Object Technology 15 ments that actually perform its tasks. After placing nine randomly selected permutations into the nine rows of your Sudoku array, run function validSudoku on the array. The ellipsis must always be placed at the end of the parameter list. At the prompt, enter 250 (Fig. BCPL was developed in 1967 by Martin Richards as a language for writing operating systems and compilers. The time the source file was compiled (a string literal of the form "hh:mm:ss"). The command cd is used to change directories. This standard was updated in 1999—its standards document is referred to as INCITS/ISO/IEC 9899-1999 and often referred to simply as C99. A macro commonly defined in the header is #define getchar() getc(stdin) The macro definition of getchar uses function

getc to get one character from the standard input stream. 3.47 (Target-Heart-Rate Calculator) While exercising, you can use a heart-rate monitor to see that your heart rate stays within a safe range suggested by your trainers and doctors. Constant __STDC__ indicates whether the compiler supports Standard C. On the downside, interpreted scripts
generally run slower than compiled code. Assign the string "Jones" to member lastName and the value 91.5 to member grade (use strcpy). Variable cPtr has been assigned the address of c. The Android operating system was developed by Android, Inc., which was acquired by Google in 2005. Programs designed for portability often use typedef to
create an alias for 4-byte integers such as Integer. We’ve included test-drives that show how to run a command-line C program on Microsoft Windows, Linux and Mac OS X. 1.11 Test-Driving a C Application in Windows, Linux and Mac OS X 25 Excellent! You guessed the number! Would you like to play again? Part (b) shows tempPtr pointing to the
dequeued node, and headPtr pointing to the new first node of the queue. You may also want to investigate the RSA scheme, which is widely used in industrial-strength applications.] 4 Who can control his fate? And not for the faint of heart—try fiendishly difficult Sudokus with tricky twists, a circular Sudoku and a variant of the puzzle with five
interlocking grids. k) The nodes of a(n) tree contain two link members. n) Member state of member personal of the structure pointed to by customerPtr. h) Define macro CUBE_VOLUME that computes the volume of a cube. This note also applies to operator '-'.] The arithmetic operations allowed in an expression are: + addition - subtraction *
multiplication / division ^ exponentiation % remainder The stack should be maintained with the following declarations: struct stackNode { int data; struct stackNode *nextPtr; }; typedef struct stackNode StackNode; typedef StackNode *StackNodePtr; The program should consist of main and six other functions with the following function headers: int
evaluatePostfixExpression(char *expr) Evaluate the postfix expression. Such phenomenal improvement is truly fostering the Information Revolution. c) False. 13.2 1 2 3 4 5 6 7 8 9 10 See below. The dotted arrows in part (b) illustrate Steps 2 and 3 of function enqueue that enable a new node to be added to the end of a queue that’s not empty. For
“easy” Sudokus, these techniques should generate a solution. In object-oriented programming languages, we create a program unit called a class to house the set of methods that perform the class’s tasks. 2 Chapter 1 Introduction to Computers, the Internet and the Web 1.1 Introduction 1.2 Computers and the Internet in Industry and Research 1.3
Hardware and Software 1.3.1 Moore’s Law 1.3.2 Computer Organization 1.4 1.5 1.6 1.7 1.8 1.9 1.10 Data Hierarchy Programming Languages The C Programming Language C Standard Library C++ and Other C-Based Languages Object Technology Typical C Program Development Environment 1.10.1 Phase 1: Creating a Program 1.10.2 Phases 2 and
3: Preprocessing and Compiling a C Program 1.10.3 Phase 4: Linking 1.10.4 Phase 5: Loading 1.10.5 Phase 6: Execution 1.10.6 Problems That May Occur at Execution Time 1.10.7 Standard Input, Standard Output and Standard Error Streams 1.11 Test-Driving a C Application in Windows, Linux and Mac OS X 1.11.1 Running a C Application from the
Windows Command Prompt 1.11.2 Running a C Application Using GNU C with Linux 1.11.3 Running a C Application Using GNU C with Mac OS X 1.12 Operating Systems 1.12.1 Windows—A Proprietary Operating System 1.12.2 Linux—An Open-Source Operating System 1.12.3 Apple’s Mac OS X; Apple’s iOS for iPhone®, iPad® and iPod Touch®
Devices 1.12.4 Google’s Android 1.13 The Internet and World Wide Web 1.14 Some Key Software Development Terminology 1.15 Keeping Up-to-Date with Information Technologies 1.16 Web Resources Terminology | Self-Review Exercises | Answers to Self-Review Exercises | Exercises Making a Difference 1.1 Introduction Welcome to C and C++! C
is a concise yet powerful computer programming language that’s appropriate for technically oriented people with little or no programming experience and for experienced programmers to use in building substantial software systems. • The bitwise operators are bitwise AND (&), bitwise inclusive OR (|), bitwise exclusive OR (^), left shift () and
complement (~). You may not make any changes other than inserting braces. Each union variable should be printed as a float, a double and a long double. For example, an executing program might attempt to divide by zero (an illegal operation on computers just as in arithmetic). You should try programming them, as well as creating and
programming your own. c) stack. Attribute Binary Octal Decimal Hexadecimal Base Lowest digit Highest digit 2 8 10 16 0 0 0 0 1 7 9 F Fig. For this purpose, we introduce Big O notation, which indicates how hard an algorithm may have to work to solve a problem. Then show the one’s complement of 779 and the two’s complement of 779. 4.2
Repetition Essentials Most programs involve repetition, or looping. To convert a number to decimal from another base, multiply the decimal equivalent of each digit by its positional value and sum these products. Converting a hexadecimal number to decimal Postional values: Symbol values: Products Sum: 4096 256 16 1 A D 3 B A*4096=40960
D*256=3328 3*16=48 B*1=11 = 40960 + 3328 + 48 + 11 = 44347 Fig. e) The f) The and directives are provided as shorthand notation for #if defined(name) and #if !defined(name). In the next exercise, you’ll write a version of the postfix-expression evaluation algorithm. 1 2 3 4 5 6 7 8 9 1 5 1 3 4 9 7 6 6 _ 2 8 9 2 4 6 8 3 7 9 2 4 2 5 9 6 3 7 7 8 1 8 1 9
6 8 4 2 Fig. m) child, subtree. If a series of function calls occurs, the successive return values are pushed onto 494 Chapter 12 C Data Structures the stack in last-in, first-out order so that each function can return to its caller. Sorting places data in order, based on one or more sort keys. It’s tedious for people to work with data in the low-level form of
bits. The C++ part of the book assumes that you’ve studied the C part. We’ve included an extensive index, which is especially useful when you use the book as a reference. Bulk orders by corporations, the government, the military and academic institutions should be placed directly with Pearson. For example, #define PI 3.14159 replaces all
subsequent occurrences of the symbolic constant PI with the numeric constant Symbolic constants enable you to create a name for a constant and use the name throughout the program. • A node can contain data of any type including other struct objects. Through Deitel & Associates, Inc., he has delivered hundreds of programming courses to
industry clients, including Cisco, IBM, Siemens, Sun Microsystems, Dell, Lucent Technologies, Fidelity, NASA at the Kennedy Space Center, the National Severe Storm Laboratory, White Sands Missile Range, Rogue Wave Software, Boeing, SunGard Higher Education, Stratus, Cambridge Technology Partners, One Wave, Hyperion Software, Adra
Systems, Entergy, CableData Systems, Nortel Networks, Puma, iRobot, Invensys and many more. State what previousPtr and currentPtr point to before each insertion. Section 10.6 typedef • The keyword typedef provides a mechanism for creating synonyms for previously defined types. A multiple-part conditional preprocessor construct may be tested
by using the #elif (the equivalent of else if in an if statement) and the #else (the equivalent of else in an if statement) directives. When you use free to deallocate dynamically allocated memory, the pointer passed to free is not assigned a new value, so it still points to the memory location where the dynamically allocated memory used to be. These
manipulations usually consist of including other files in the file to be compiled and performing various text replacements. The network was designed to operate without centralized control. An isFull predicate function might test a container-class object to determine whether it has no additional room. 12.21 is: 6 17 13 33 48 42 27 12.7.3 Duplicate
Elimination The binary search tree facilitates duplicate elimination. C.24 Convert decimal 299 to binary, to octal and to hexadecimal. • The memory allocated by malloc is not initialized. 13.3 #define Preprocessor Directive: Symbolic Constants 519 13.3 #define Preprocessor Directive: Symbolic Constants The #define directive creates symbolic
constants—constants represented as symbols—and macros—operations defined as symbols. The C Standard does not specify the wording for error messages issued by the compiler, so the error messages you see on your system may differ from those on other systems. c) #define. Other binary tree exercises include allow- 506 Chapter 12 C Data
Structures ing a binary search tree to contain duplicate values, inserting string values in a binary tree and determining how many levels are contained in a binary tree. e) FIFO. ■ Write functions that use variable-length argument lists. The application displays "Too high. The digits in the decimal number system are 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. (Part 1
of 2.) 1.5 Programming Languages Level Description Characters (cont.) that are composed of two bytes, each composed of eight bits. Robots Robots can be used for day-to-day tasks (e.g., iRobot’s Roomba vacuuming robot), entertainment (e.g., robotic pets), military combat, deep sea and space exploration (e.g., NASA’s Mars rover) and more.
Constant __TIME__ is the time the source file is compiled (a string). Function merge should receive pointers to the first node of each of the lists to be merged and return a pointer to the first node of the merged list. Part (a) shows the stack after the previous push operation. D.5), somewhat simplifying the puzzle. Print the values as integers and as bits.
The bitwise inclusive OR operator sets each bit in the result to 1 if the corresponding bit in either (or both) operand(s) is 1. Otherwise, the bits are set to zero. The CERT standards evolve as new security issues arise. This is a key to “keeping your options open.” Lookahead Heuristic This is simply an embellishment of our “keep your options open”
heuristic. A linker links the object code with the code for the missing functions to produce an executable image (with no missing pieces). 17.5–17.7 demonstrates the notion of a utility function (also called a helper function). Otherwise define FALSE as 1. Trivially, cell s[1][7] in Fig. 10.16 | Representing cards with bit fields in a struct. 1.10.6 Problems
That May Occur at Execution Time Programs do not always work on the first try. • To pass a structure by reference, pass its address. • New Chapter 1. void push(StackNodePtr *topPtr, int value) Push a value on the stack. These tips and practices represent the best we’ve gleaned from a combined seven decades of programming and teaching
experience. g) typedef. 1.10). The algorithm for creating a postfix expression is as follows: 1) Push a left parenthesis '(' onto the stack. The condition that tests for the final value of the control variable (i.e., whether looping should continue). To form the two’s complement of a value, simply add one to the value’s one’s complement. 1.17 | Running the
GuessNumber application. Finally, we divide 1 into 7 and observe that there are seven 1s in 7 with no remainder, so we write 7 in the 1 column. These identifiers and the defined identifier (used in Section 13.5) cannot be used in #define or #undef directives. Other languages similar in concept to PHP are Perl and Python. The URL (Uniform Resource
Locator) specifies the address (i.e., 1.14 Some Key Software Development Terminology 31 location) of the web page displayed in the browser window. For example, a car’s anti-lock brakes must respond immediately to slow or stop the car without skidding; game controllers used for video games should respond instantaneously to prevent any lag
between the controller and the action in the game, and to ensure smooth animations. Arrays of structures—like all other arrays—are automatically passed by reference. Business applications often are expensive, and require significant hardware to run them and knowledgeable support staff to ensure that they’re running properly and securely. Non-
Member Functions 19.12 Converting between Types 19.13 explicit Constructors 19.14 Building a String Class 19.15 Wrap-Up20 Object-Oriented Programming: Inheritance 20.1 Introduction 20.2 Base Classes and Derived Classes 20.3 protected Members 20.4 Relationship between Base Classes and Derived Classes 20.4.1 Creating and Using a
CommissionEmployee Class 20.4.2 Creating a BasePlusCommissionEmployee Class Without Using Inheritance 20.4.3 Creating a CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy 20.4.4 CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy Using protected Data 20.4.5 CommissionEmployee–
BasePlusCommissionEmployee Inheritance Hierarchy Using private Data 20.5 Constructors and Destructors in Derived Classes 20.6 public, protected and private Inheritance 20.7 Software Engineering with Inheritance 20.8 Wrap-Up21 Object-Oriented Programming: Polymorphism 21.1 Introduction 21.2 Introduction to Polymorphism: Polymorphic
Video Game 21.3 Relationships Among Objects in an Inheritance Hierarchy 21.3.1 Invoking Base-Class Functions from Derived-Class Objects 21.3.2 Aiming Derived-Class Pointers at Base-Class Objects 21.3.3 Derived-Class Member-Function Calls via Base-Class Pointers 21.3.4 Virtual Functions 21.4 Type Fields and switch Statements 21.5 Abstract
Classes and Pure virtual Functions 21.6 Case Study: Payroll System Using Polymorphism 21.6.1 Creating Abstract Base Class Employee 21.6.2 Creating Concrete Derived Class SalariedEmployee 21.6.3 Creating Concrete Derived Class CommissionEmployee 21.6.4 Creating Indirect Concrete Derived Class BasePlusCommissionEmployee 21.6.5
Demonstrating Polymorphic Processing 21.7 (Optional) Polymorphism, Virtual Functions and Dynamic Binding “Under the Hood” 21.8 Case Study: Payroll System Using Polymorphism and Runtime Type Information with Downcasting, dynamic_cast, typeid and type_info 21.9 Virtual Destructors 21.10 Wrap-Up22 Templates 22.1 Introduction 22.2
Function Templates 22.3 Overloading Function Templates 22.4 Class Templates 22.5 Nontype Parameters and Default Types for Class Templates 22.6 Wrap-Up23 Stream Input/Output 23.1 Introduction 23.2 Streams 23.2.1 Classic Streams vs. • A bit field is declared by following an unsigned int or int member name with a colon (:) and an integer
constant representing the width of the field. Identifier Explanation va_list A type suitable for holding information needed by macros va_start, va_arg and va_end. New nodes can be added to a stack and removed from a stack only at the top—referred to as a last-in, first-out (LIFO) data structure. 1.22 | Exiting the game. The typical Sudoku puzzle
provides many filled-in cells and many blanks, often arranged in a symmetrical pattern as is typical with crossword puzzles. Programming language Objective-C Visual C# Java Description Objective-C is an object-oriented language based on C. Use your function in a test program that creates a sorted list of integers and prints the list in reverse order.
Using Fonts for Emphasis. 3.42 What’s wrong with the following statement? k) tag name. 1.2 | Logical units of a computer. The software that contains the core components of the operating system is called the kernel. The C language was evolved from B by Dennis Ritchie at Bell Laboratories and was originally implemented in 1972. Note the pointers
to the head of the queue and the tail of the queue. 1.11 Test-Driving a C Application in Windows, Linux and Mac OS X 19 When we say that a program prints a result, we normally mean that the result is displayed on a screen. #include // function main begins program execution int main(void) { unsigned int counter = 1; // initialization while (counter
is"); displayBits(number1 >> 8); } // end main // display bits of an unsigned int value void displayBits(unsigned int value) { unsigned int c; // counter // declare displayMask and left shift 31 bits unsigned int displayMask = 1 >= -= *= ++ (postfix) -- (postfix) (type) ! & * ~ sizeof /= &= |= ^= = %= & ^ | && || ?: = += , Associativity Type left to right
right to left left to right left to right left to right left to right left to right left to right left to right left to right right to left right to left left to right highest unary multiplicative additive shifting relational equality bitwise AND bitwise XOR bitwise OR logical AND logical OR conditional assignment comma Fig. Computer scientists
normally draw trees from the root node down—exactly the opposite of trees in nature. • To pass an array by value, create a structure with the array as a member. Silicon-chip technology has made computing so economical that computers have become a commodity. Stacks support recursive function calls in the same manner as conventional
nonrecursive calls. • The #pragma directive causes an implementation-defined action. Get mobile device Sudoku games that can be installed on cell phones, Palm® devices, Game Boy® players and Java-enabled devices. A computer consists of various devices referred to as hardware (e.g., the keyboard, screen, mouse, hard disks, memory, DVD drives
and processing units). We’ll discuss various simple solution strategies, and suggest what to do when these fail. (Part 2 of 3.) left to right left to right left to right left to right left to right left to right left to right left to right left to right left to right left to right right to left Appendix A Operator Precedence Charts C++ Operator Type Associativity =
assignment addition assignment subtraction assignment multiplication assignment division assignment modulus assignment bitwise AND assignment bitwise exclusive OR assignment bitwise inclusive OR assignment bitwise left shift assignment bitwise right shift with sign comma right to left += -= *= /= %= &= ^= |= = , Fig. The carry keeps
moving leftward until it’s discarded from the leftmost bit, and thus the resulting number is all zeros. 17.5) declares an array of 12 monthly sales figures (line 17) and the prototypes for the class’s constructor and member functions that manipulate the array. So, 101 = 1 * 22 + 0 * 21 + 1 * 20 = 4 + 0 + 1 = 5. Section 12.5 Stacks • A stack can be
implemented as a constrained version of a linked list. Open-source software departs from the proprietary software development style that dominated software’s early years. p = c; Answers to Self-Review Exercises 10.1 a) structure. Defining occurrences of key terms are highlighted with a bold blue page number. • By convention, the link pointer in the
last node of a list is set to NULL to mark the end of the list. Human Genome Project The Human Genome Project was founded to identify and analyze the 20,000+ genes in human DNA. Experienced Java programmers can quickly dive into Android development. 1.2). 2) At the first customer’s arrival time: Determine customer’s service time (random
integer from 1 to 4); Begin servicing the customer; Schedule arrival time of next customer (random integer 1 to 4 added to the current time). 1.10.4 Phase 5: Loading The next phase is called loading. Performance Tips These tips highlight opportunities for making your programs run faster or minimizing the amount of memory that they occupy. More
important, it provides capabilities for object-oriented programming. C.14 Show the binary representation of decimal 417. Data may be output to devices such as disks and printers. Positional values in the octal number system Decimal digit Position name Positional value Positional value as a power of the base (8) 4 2 5 Sixty-fours Eights Ones 64 82 8 1
81 80 Fig. Doubles can be more subtle. This information hiding is crucial to good software engineering. As a minimum, printf must receive a string as its first argument, but printf can receive any number of additional arguments. • The bitwise complement operator sets all 0 bits in its operand to 1 and all 1 bits to 0 in the result. h) A(n) is a specialized
version of a linked list in which nodes can be inserted only at the start of the list and deleted only from the end of the list. The line numbers do not appear in the source file. Apple includes GNU C and C++ in their Xcode development tools, which Mac OS X users can download from developer.apple.com/ technologies/tools/xcode.html. Heuristic
Solution Strategies When we studied the Knight’s Tour in Exercises 6.24, 6.25 and 6.29, we developed a “keep your options open” heuristic. Try again.", because the value you entered is still greater than the number that the application chose. 1.7 C Standard Library As you’ll learn in Chapter 5, C programs consist of pieces called functions. C has
perhaps the largest installed base of "legacy code" of any modern programming language. ARPA proceeded to implement the ARPANET, which eventually evolved into today’s Internet. PHP is platform independent—implementations exist for all major UNIX, Linux, Mac and Windows operating systems. 908 Appendix C Number Systems C.1
Introduction C.2 Abbreviating Binary Numbers as Octal and Hexadecimal Numbers C.3 Converting Octal and Hexadecimal Numbers to Binary Numbers C.4 Converting from Binary, Octal or Hexadecimal to Decimal C.5 Converting from Decimal to Binary, Octal or Hexadecimal C.6 Negative Binary Numbers: Two’s Complement Notation Summary |
Terminology | Self-Review Exercises | Answers to Self-Review Exercises | Exercises C.1 Introduction In this appendix, we introduce the key number systems that programmers use, especially when they are working on software projects that require close interaction with machinelevel hardware. 1.23) by typing cd
Documents/examples/ch01/GuessNumber/GNU then pressing Enter. This is yet another example of the principle of least privilege. The company offers instructorled training courses delivered at client sites worldwide on major programming languages and platforms, including C, C++, Visual C++®, Java™, Visual C#®, Visual Basic®, XML®,
Python®, object technology, Internet and web programming, Android app development, Objective-C and iPhone app development and a growing list of additional programming and software development courses. The program of Figs. This occurs because it takes extra machine-language operations to access only portions of an addressable storage
unit. (Part 1 of 2.) 1.4 Data Hierarchy Logical unit Description Memory unit This rapid-access, relatively low-capacity “warehouse” section retains information that has been entered through the input unit, making it immediately available for processing when needed. Sun Microsystems in 1991 funded an internal corporate research project which
resulted in the C++-based object-oriented programming language called Java. If one of them works, then move on to the next cell. Print the value in bits both before and after the bits are reversed to confirm that the bits are reversed properly. —William Shakespeare The used key is always bright. There are 9! (i.e., 9·8·7·6·5·4·3·2·1 = 362,880) such
permutations. No memory available.", info); } // end else } // end function push // remove a node from the stack top int pop(StackNodePtr *topPtr) { StackNodePtr tempPtr; // temporary node pointer int popValue; // node value tempPtr = *topPtr; popValue = (*topPtr)->data; Fig. On a typical Linux system, the command to compile and link a
program is called gcc (the GNU C compiler). 1.3.2 Computer Organization Regardless of differences in physical appearance, computers can be envisioned as divided into various logical units or sections (Fig. The dequeue operation consists of six steps: 1. The authors and publisher shall not be liable in any event for incidental or consequential
damages in connection with, or arising out of, the furnishing, performance, or use of these programs. High-Level Languages To speed the programming process even further, high-level languages were developed in which single statements could be written to accomplish substantial tasks. We assume that the examples are located in your user
account’s Documents/examples folder. Print the resulting deck in twocolumn format as in Fig. (Part 3 of 3.) 1.3 Hardware and Software In use today are more than a billion general-purpose computers, and billions more embedded computers are used in cell phones, smartphones, tablet computers, home appliances, automobiles and more. [Note: Linux
commands are case sensitive; make sure that each c is lowercase and that the letters in the filename are in the appropriate case.] If the program compiles and links correctly, a file called a.out is produced. Each entry gradually advances to the front of the queue as users receive service. Phase 2: Preprocessor program processes the code. Member
color is included as a means of indicating the card color on a system that allows color displays. Let’s try this: a (i.e., 27) +(~value + 1) 00000000 00000000 00000000 00011011 +11111111 11111111 11111111 11110011 ----------------------------------00000000 00000000 00000000 00001110 which is indeed equal to 14. The application displays "Too low.
Brute Force Approach with Randomly Selected Row Permutations Every row, column, and 3×3 grid on a valid Sudoku contains a permutation of the digits 1 through 9. You can program all the functions that you need to form a C program, but most C programmers take advantage of the rich collection of existing functions called the C Standard Library.
[Hint: Count from 1 to 100. Section 10.8 Unions • A union is declared with keyword union in the same format as a structure. C++-Style // Comments. In 1983, the X3J11 technical committee was created under the American National Standards Committee on Computers and Information Processing (X3) to “provide an unambiguous and
machineindependent definition of the language.” In 1989, the standard was approved as ANSI X3.159-1989 in the United States through the American National Standards Institute (ANSI), then worldwide through the International Standards Organization (ISO). If the constant needs to be modified throughout the program, it can be modified once in
the #define directive. 12.22 is output as follows: 99 97 92 83 72 71 69 49 44 40 32 28 19 18 11 Note that the rightmost leaf node appears at the top of the output in the rightmost column, and the root node appears at the left of the output. Run the supermarket simulation for a 12-hour day (720 minutes) using the following algorithm: 1) Choose a
random integer between 1 and 4 to determine the minute at which the first customer arrives. 1.6 | Popular C-based programming languages. Free the memory pointed to by tempPtr (line 102). Let’s try this: 00000000 00000000 00000000 00001101 +11111111 11111111 11111111 11110011 ----------------------------------00000000 00000000 00000000
00000000 The carry bit coming out of the leftmost column is discarded and we indeed get 0 as a result. Section 1.7 references P.J. Plauger’s Dinkumware website (www.dinkumware.com/manuals/default.aspx) where students can find thorough searchable documentation for the C Standard Library functions. For example, if the data is stored in file
input, the command line $ sum < input executes the program sum; the redirect input symbol (). or the operator. For this reason, a queue is referred to as a first-in, first-out (FIFO) data structure. The program should compute the volume for spheres of radius 1 to 10 and print the results in tabular format. Software vulnerabilities often come from
simple programming issues. Figure 24.9 demonstrates a unique_ptr object that points to a dynamically allocated object of class Integer (Figs. b) What’s the longest wait any one customer experienced? Rapid improvements to computing and communications, decreasing costs and open-source software have made it much easier and more economical to
create a software-based business now than just a decade ago. This method is normally used to include programmer-defined headers. We divide 16 into 25 and observe that there is one 16 in 25 with a remainder of 9 and write 1 in the 16 column. Although our brute force approaches may seem ponderous, they will mechanically grind out solutions.
Suppose you want to drive a car and make it go faster by pressing its accelerator pedal. C.4 Hexadecimal. We begin by writing the positional values of the columns right to left until we reach a column whose positional value is greater than the decimal number. • MEM01-C/MEM30-C: Pointers should not be left uninitialized. Cell s[6][6] contains 257,
indicating that only the values 2, 5 or 7 can eventually be assigned to this cell. [Note: The last three puts statements are all part of a compound statement.] ##### $$$$$ &&&&& 3.32 (Square of Asterisks) Write a program that reads in the side of a square and then prints that square out of asterisks. C is mostly hardware independent—with careful
design, it’s possible to write C programs that are portable to most computers. 1.5 | Some popular performance-oriented C applications. // Fig. Triples can be more subtle. You would then return to the edit phase, make the necessary corrections and proceed through the remaining phases again to determine that the corrections work properly. For these
approaches you’ll need some utility functions. 1.7). The simple process will generate valid Sudokus. • A symbolic constant is a name for a constant. e) #undef. This was a serious problem for programmers who needed to develop code that would run on several 12 Chapter 1 Introduction to Computers, the Internet and the Web platforms. Write function
levelOrder to perform a level order traversal of a binary tree. Part (b) shows tempPtr pointing to the first node of the stack and topPtr pointing to the second node of the stack. 1.21 | Playing the game again. The opposite has been the case in the computer and communications fields, especially with regard to the costs of hardware supporting these
technologies. The modified application uses the same sequence of correct answers every time you execute the program (though this may vary by compiler), so you can use the same guesses we use in this section and see the same results. Teaching Approach C How to Program, 7/e, contains a rich collection of examples. Place the particular digit in the
particular square whose subsequent placement leaves the board count the highest after two moves out. We include an alphabetized list of the important terms defined in each chapter with the page number of each term’s defining occurrence for easy reference. Deitel & Associates, Inc. The macros and definitions of the variable arguments headers
(Fig. It has its roots in C, providing a number of features that “spruce up” the C language. This information is used to determine the exact location of the device. Most information is entered into computers through keyboards, touch screens and mouse devices. Thus s[6][6], the only cell in column 6 that lists 5 as a remaining possible value, must be 5.
The steps for a preOrder traversal are: 1. They provide services that allow each application to execute safely, efficiently and concurrently (i.e., in parallel) with other 28 Chapter 1 Introduction to Computers, the Internet and the Web applications. Enter your choice: 1 to add an item to the queue 2 to remove an item from the queue 3 to end ? • The
insert and remove operations for a queue are known as enqueue and dequeue. Iteration 5.17 Secure C Programming6 C Arrays 6.1 Introduction 6.2 Arrays 6.3 Defining Arrays 6.4 Array Examples 6.5 Passing Arrays to Functions 6.6 Sorting Arrays 6.7 Case Study: Computing Mean, Median and Mode Using Arrays 6.8 Searching Arrays 6.9
Multidimensional Arrays 6.10 Variable-Length Arrays 6.11 Secure C Programming7 C Pointers 7.1 Introduction 7.2 Pointer Variable Definitions and Initialization 7.3 Pointer Operators 7.4 Passing Arguments to Functions by Reference 7.5 Using the const Qualifier with Pointers 7.5.1 Converting a String to Uppercase Using a Non-Constant Pointer to
Non-Constant Data 7.5.2 Printing a String One Character at a Time Using a Non-Constant Pointer to Constant Data 7.5.3 Attempting to Modify a Constant Pointer to Non-Constant Data 7.5.4 Attempting to Modify a Constant Pointer to Constant Data 7.6 Bubble Sort Using Pass-by-Reference 7.7 sizeof Operator 7.8 Pointer Expressions and Pointer
Arithmetic 7.9 Relationship between Pointers and Arrays 7.10 Arrays of Pointers 7.11 Case Study: Card Shuffling and Dealing Simulation 7.12 Pointers to Functions 7.13 Secure C Programming8 C Characters and Strings 8.1 Introduction 8.2 Fundamentals of Strings and Characters 8.3 Character-Handling Library 8.3.1 Functions isdigit, isalpha,
isalnum and isxdigit 8.3.2 Functions islower, isupper, tolower and toupper 8.3.3 Functions isspace, iscntrl, ispunct, isprint and isgraph 8.4 String-Conversion Functions 8.4.1 Function strtod 8.4.2 Function strtol 8.4.3 Function strtoul 8.5 Standard Input/Output Library Functions 8.5.1 Functions fgets and putchar 8.5.2 Function getchar 8.5.3 Function
sprintf 8.5.4 Function sscanf 8.6 String-Manipulation Functions of the String-Handling Library 8.6.1 Functions strcpy and strncpy 8.6.2 Functions strcat and strncat 8.7 Comparison Functions of the String-Handling Library 8.8 Search Functions of the String-Handling Library 8.8.1 Function strchr 8.8.2 Function strcspn 8.8.3 Function strpbrk 8.8.4
Function strrchr 8.8.5 Function strspn 8.8.6 Function strstr 8.8.7 Function strtok 8.9 Memory Functions of the String-Handling Library 8.9.1 Function memcpy 8.9.2 Function memmove 8.9.3 Function memcmp 8.9.4 Function memchr 8.9.5 Function memset 8.10 Other Functions of the String-Handling Library 8.10.1 Function strerror 8.10.2 Function
strlen 8.11 Secure C Programming9 C Formatted Input/Output 9.1 Introduction 9.2 Streams 9.3 Formatting Output with printf 9.4 Printing Integers 9.5 Printing Floating-Point Numbers 9.6 Printing Strings and Characters 9.7 Other Conversion Specifiers 9.8 Printing with Field Widths and Precision 9.9 Using Flags in the printf Format Control String
9.10 Printing Literals and Escape Sequences 9.11 Reading Formatted Input with scanf 9.12 Secure C Programming10 C Structures, Unions, Bit Manipulation and Enumerations 10.1 Introduction 10.2 Structure Definitions 10.2.1 Self-Referential Structures 10.2.2 Defining Variables of Structure Types 10.2.3 Structure Tag Names 10.2.4 Operations
That Can Be Performed on Structures 10.3 Initializing Structures 10.4 Accessing Structure Members 10.5 Using Structures with Functions 10.6 typedef 10.7 Example: High-Performance Card Shuffling and Dealing Simulation 10.8 Unions 10.8.1 Union Declarations 10.8.2 Operations That Can Be Performed on Unions 10.8.3 Initializing Unions in
Declarations 10.8.4 Demonstrating Unions 10.9 Bitwise Operators 10.9.1 Displaying an Unsigned Integer in Bits 10.9.2 Making Function displayBits More Scalable and Portable 10.9.3 Using the Bitwise AND, Inclusive OR, Exclusive OR and Complement Operators 10.9.4 Using the Bitwise Left- and Right-Shift Operators 10.9.5 Bitwise Assignment
Operators 10.10 Bit Fields 10.11 Enumeration Constants 10.12 Secure C Programming11 C File Processing 11.1 Introduction 11.2 Files and Streams 11.3 Creating a Sequential-Access File 11.4 Reading Data from a Sequential-Access File 11.5 Random-Access Files 11.6 Creating a Random-Access File 11.7 Writing Data Randomly to a Random-Access
File 11.8 Reading Data from a Random-Access File 11.9 Case Study: Transaction-Processing Program 11.10 Secure C Programming12 C Data Structures 12.1 Introduction 12.2 Self-Referential Structures 12.3 Dynamic Memory Allocation 12.4 Linked Lists 12.4.1 Function insert 12.4.2 Function delete 12.4.3 Function printList 12.5 Stacks 12.5.1
Function push 12.5.2 Function pop 12.5.3 Applications of Stacks 12.6 Queues 12.6.1 Function enqueue 12.6.2 Function dequeue 12.7 Trees 12.7.1 Function insertNode 12.7.2 Traversals: Functions inOrder, preOrder and postOrder 12.7.3 Duplicate Elimination 12.7.4 Binary Tree Search 12.7.5 Other Binary Tree Operations 12.8 Secure C
Programming13 C Preprocessor 13.1 Introduction 13.2 #include Preprocessor Directive 13.3 #define Preprocessor Directive: Symbolic Constants 13.4 #define Preprocessor Directive: Macros 13.5 Conditional Compilation 13.6 #error and #pragma Preprocessor Directives 13.7 # and ## Operators 13.8 Line Numbers 13.9 Predefined Symbolic
Constants 13.10 Assertions 13.11 Secure C Programming14 Other C Topics 14.1 Introduction 14.2 Redirecting I/O 14.3 Variable-Length Argument Lists 14.4 Using Command-Line Arguments 14.5 Notes on Compiling Multiple-Source-File Programs 14.6 Program Termination with exit and atexit 14.7 Suffixes for Integer and Floating-Point Literals 14.8
Signal Handling 14.9 Dynamic Memory Allocation: Functions calloc and realloc 14.10 Unconditional Branching with goto15 C++ as a Better C; Introducing Object Technology 15.1 Introduction 15.2 C++ 15.3 A Simple Program: Adding Two Integers 15.4 C++ Standard Library 15.5 Header Files 15.6 Inline Functions 15.7 References and Reference
Parameters 15.8 Empty Parameter Lists 15.9 Default Arguments 15.10 Unary Scope Resolution Operator 15.11 Function Overloading 15.12 Function Templates 15.13 Introduction to C++ Standard Library Class Template vector 15.14 Introduction to Object Technology and the UML 15.15 Wrap-Up16 Introduction to Classes, Objects and Strings 16.1
Introduction 16.2 Defining a Class with a Member Function 16.3 Defining a Member Function with a Parameter 16.4 Data Members, set Functions and get Functions 16.5 Initializing Objects with Constructors 16.6 Placing a Class in a Separate File for Reusability 16.7 Separating Interface from Implementation 16.8 Validating Data with set Functions
16.9 Wrap-Up17 Classes: A Deeper Look, Part 1 17.1 Introduction 17.2 Time Class Case Study 17.3 Class Scope and Accessing Class Members 17.4 Separating Interface from Implementation 17.5 Access Functions and Utility Functions 17.6 Time Class Case Study: Constructors with Default Arguments 17.7 Destructors 17.8 When Constructors and
Destructors Are Called 17.9 Time Class Case Study: A Subtle Trap—Returning a Reference to a private Data Member 17.10 Default Memberwise Assignment 17.11 Wrap-Up18 Classes: A Deeper Look, Part 2 18.1 Introduction 18.2 const (Constant) Objects and const Member Functions 18.3 Composition: Objects as Members of Classes 18.4 friend
Functions and friend Classes 18.5 Using the this Pointer 18.6 static Class Members 18.7 Proxy Classes 18.8 Wrap-Up19 Operator Overloading; Class string 19.1 Introduction 19.2 Using the Overloaded Operators of Standard Library Class string 19.3 Fundamentals of Operator Overloading 19.4 Overloading Binary Operators 19.5 Overloading the
Binary Stream Insertion and Stream Extraction Operators 19.6 Overloading Unary Operators 19.7 Overloading the Unary Prefix and Postfix ++ and -- Operators 19.8 Case Study: A Date Class 19.9 Dynamic Memory Management 19.10 Case Study: Array Class 19.10.1 Using the Array Class 19.10.2 Array Class Definition 19.11 Operators as Member
Functions vs. This (a) *headPtr *tailPtr R (b) A D N *headPtr *tailPtr *tempPtr R Fig. The exercises explore several applications of stacks. Masks are used to hide some bits in a value while selecting other bits. ■ Dynamically allocate arrays and resize memory that was dynamically allocated previously. To obtain permission(s) to use material from this
work, please submit a written request to Pearson Education, Inc., Permissions Department, One Lake Street, Upper Saddle River, New Jersey 07458, or you may fax your request to 201-236-3290. A program might test isEmpty before attempting to read another item from the container object. Data is often output to stdout (the standard output
stream), which is normally the computer screen, but stdout can be connected to another stream. Every #if construct ends with #endif. Programming Tips. Almost every major newspaper now publishes a Sudoku puzzle daily. MICROSOFT AND/OR ITS RESPECTIVE SUPPLIERS MAKE NO REPRESENTATIONS ABOUT THE SUITABILITY OF THE
INFORMATION CONTAINED IN THE DOCUMENTS AND RELATED GRAPHICS PUBLISHED AS PART OF THE SERVICES FOR ANY PURPOSE. 10.10 (Right Shifting Integers) Write a program that right shifts an integer variable 4 bits. Expressions with side effects (i.e., variable values are modified) should not be passed to a macro because macro
arguments may be evaluated more than once. Compiling the GuessNumber application. Unsigned integers are normally used. The steps for an inOrder traversal are: 1. 13.8 Line Numbers The #line preprocessor directive causes the subsequent source code lines to be renumbered starting with the specified constant integer value. Assume that all the
manipulations occur in main (therefore, no addresses of pointer variables are needed), and assume the following definitions: struct gradeNode { char lastName[20]; double grade; struct gradeNode *nextPtr; }; typedef struct gradeNode GradeNode; typedef GradeNode *GradeNodePtr; a) Create a pointer to the start of the list called startPtr. // Print
the values of #include int main(void) { printf("__LINE__ = printf("__FILE__ = printf("__DATE__ = printf("__TIME__ = printf("__STDC__ = } the predefined macros %d", %s", %s", %s", %s", __LINE__ __FILE__ __DATE__ __TIME__ __STDC__););););); #ifndef. The highest digit in any base is one less than the base. • An unnamed bit field with a zero
width aligns the next bit field on a new storage unit boundary. Function outputTree should receive as arguments a pointer to the root node of the tree and an integer totalSpaces representing the number of spaces preceding the value to be output (this variable should start at zero so that the root node is output at the left of the screen). 12.5.3
Applications of Stacks Stacks have many interesting applications. • Linked list nodes are normally not stored contiguously in memory. This “administrative” section coordinates and supervises the operation of the other sections. int calculate(int op1, int op2, char operator) Evaluate the expression op1 operator op2. 13.9 (Printing an Array) Write a
program that defines and uses macro PRINTARRAY to print an array of integers. Companies that understand Web 2.0 realize that their products and services are conversations as well. Chapters 15–24 present a condensed treatment of C++ selected from our book C++ How to Program, 8/e. For example, the enumeration enum months { JAN, FEB,
MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC }; // end enum months creates a new type, enum months, in which the identifiers are set to the integers respectively. Computers actually perform a subtraction, such as x = a - value; by adding the two’s complement of value to a, as follows: x = a + (~value + 1); 916 Appendix C Number Systems
Suppose a is 27 and value is 13 as before. d) Functions that look at a linked list but do not modify it are referred to as e) A queue is referred to as a(n) data structure. Q 12.6 Queues 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 // Fig. A general
observation is that Sudokus tend to become more difficult as the empty cells increase (there are exceptions to this). Information in the memory unit is volatile—it’s typically lost when the computer’s power is turned off. c) The base of the number system. From a Linux shell, change to the completed GuessNumber application directory (Fig. If the tree
is tightly packed, each level contains about twice as many elements as the previous level. C.5). Our tables in Section C.1 express the positional values in decimal. C.8 Binary 111 011 001 110. Internet TV Internet TV set-top boxes (such as Apple TV, Google TV and TiVo) allow you to access an enormous amount of content on demand, such as games,
news, movies, television shows and more, and they help ensure that the content is streamed to your TV smoothly. [Hint: First convert 4FEC to binary, then convert that binary number to octal.] C.10 Convert binary 1101110 to decimal. If false, explain why. 12.17 (Binary Search Tree of Strings) Write a program based on the program of Fig. Copyright
© 2013, 2010, 2007, 2004, 2001 Pearson Education, Inc., publishing as Prentice Hall. Also, the variable c has been defined to be of type struct card and the variable cPtr has been defined to be of type pointer to struct card. d) Read a part number and a part name from the keyboard into the individual members of variable a. Many of the capabilities
discussed here are specific to particular operating systems, especially Linux/UNIX and Windows. If the current character in infix is an operator, Pop operators (if there are any) at the top of the stack while they have equal or higher precedence than the current operator, and insert the popped operators in postfix. 3 End of run. 1 2 3 4 5 6 7 8 9 10 11
12 13 14 15 16 17 18 19 20 21 22 23 // Fig. The ## operator must have two operands. No proprietary information is revealed—as would be the case if source code were provided. The program provides several options: insert a node in the queue (function enqueue), remove a node from the queue (function dequeue) and terminate the program. Brute
Force Approaches When personal computers appeared in the late 1970s, they processed tens of thousands of instructions per second. All the source code is available at www.deitel.com/books/chtp7/ and www.pearsonhighered.com/deitel. Copies may be ordered from the American National Standards Institute (www.ansi.org) at
webstore.ansi.org/ansidocstore. Instantiation Just as someone has to build a car from its engineering drawings before you can actually drive a car, you must build an object from a class before a program can perform the tasks that the class’s methods define. Harvey Deitel Deitel & Associates, Inc. b) Function c) A(n) is a specialized version of a linked
list in which nodes can be inserted and deleted only from the start of the list. newPtr->nextPtr = currentPtr; startPtr = newPtr; To insert "Thompson": previousPtr points to the last element in the list (containing "Smith") currentPtr is NULL. #include #include #include "SalesPerson.h" // include SalesPerson class definition using namespace std; //
initialize elements of array sales to 0.0 SalesPerson::SalesPerson() { for (int i = 0; i < monthsPerYear; ++i) sales[i] = 0.0; } // end SalesPerson constructor // get 12 sales figures from the user at the keyboard void SalesPerson::getSalesFromUser() { double salesFigure; for (int i = 1; i = 0.0) grossSales = sales; Fig. Stacks contain the space created
for automatic variables on each invocation of a function. printf("%s", hearts.face); 436 Chapter 10 C Structures, Unions, Bit Manipulation and Enumerations c) union values { char w; float x; double y; }; // end union values union values v = { 1.27 }; d) struct person { char lastName[15]; char firstName[15]; unsigned int age; } // end struct person
e) Assume rection. AMBER Alert recently partnered with Facebook, whose users can “Like” AMBER Alert pages by location to receive alerts in their news feeds. #include int multiple(int num); // prototype int main(void) { int y; // y will hold an integer entered by the user puts("Enter an integer between 1 and 32000: "); scanf("%d", &y); // if y is a
multiple of X if (multiple(y)) { printf("%d is a multiple of X", y); } // end if else { printf("%d is not a multiple of X", y); } // end else } // end main // determine whether num is a multiple of X int multiple(int num) { int i; // counter int mask = 1; // initialize mask int mult = 1; // initialize mult for (i = 1; i data = info; newPtr->nextPtr = *topPtr;
*topPtr = newPtr; } // end if else { // no space available printf("%d not inserted. D.7. The dashed cells could already be committed or could have lists of possible values. 1.24 | Compiling the GuessNumber application using the gcc command. Each time you execute this application from the beginning (i.e., Step 4), it will choose the same numbers for
you to guess. Each time a packet arrives at a network node, it must be routed to the next node on the network along the path to its final destination. Self-Review Exercises 435 c) The bits in the result of an expression using the operator are set to 1 if the corresponding bits in each operand are set to 1. In the octal number 425, we say that the 5 is
written in the ones position, the 2 is written in the eights position and the 4 is written in the sixty-fours position. To run an application on the GNU C++ compiler, you must first compile it by typing gcc GuessNumber.c -o GuessNumber as in Fig. Information packets also wait in queues in computer networks. For example, the octal number 653 is
converted to binary simply by writing the 6 as its 3-digit binary equivalent 110, the 5 as its 3-digit binary equivalent 101 and the 3 as its 3-digit binary equivalent 011 to form the 9-digit binary number 110101011. Communications systems need to route massive amounts of data to their destinations quickly to ensure that things such as audio and video
are delivered smoothly and without delay. • Computers represent negative numbers using two’s complement notation. III. For example, each car knows how much gas is in its own gas tank, but not how much is in the tanks of other cars. The player’s task is to fill in the blanks to complete the puzzle. Thus the decimal number 234 can be interpreted as
4 * 1 + 3 * 10 + 2 * 100. C How to Program, 7/e Reviewers We wish to acknowledge the efforts of our reviewers. To pack four characters into an unsigned int variable, assign the first character to the unsigned int variable, shift the unsigned int variable left by 8 bit positions and combine the unsigned variable with the second character using the
bitwise inclusive OR operator. 12.13 (Postfix Evaluator) Write a program that evaluates a postfix expression (assume it’s valid) such as 6 2 + 5 * 8 4 / - The program should read a postfix expression consisting of single digits and operators into a character array. 12.2 It’s possible to insert a node anywhere in a linked list and remove a node from
anywhere in a linked list. A macro without arguments is processed like a symbolic constant. C.9 | Converting an octal number to decimal. ■ Some basics of the Internet and the World Wide Web. Common Programming Errors Pointing out these Common Programming Errors reduces the likelihood that you’ll make them. Write a function void
permutations(int sudokuBoard[10][10]); that receives a 10×10 two-dimensional array and in the 9×9 portion of it that corresponds to a Sudoku grid fills each of the nine rows with a randomly selected permutation of the digits 1 through 9. Arithmetic and logic unit (ALU) Central processing unit (CPU) Secondary storage unit 7 Fig. Conditional
compilation is commonly used as a debugging aid. To confirm that the filled puzzle is a valid Sudoku, you can write a function to check that each row, column and 3×3 grid contains the digits 1 through 9 once and only once. Every time the count reaches a multiple of 100,000,000, print that number on the screen. 1.10.1 Phase 1: Creating a Program
Phase 1 consists of editing a file. P. If the printer is busy, other outputs may still be generated. Calculate y operator x. 12.19. Push the result of the calculation onto the stack. Syntax errors are also called compile errors, or compile-time errors. A key goal of Java is to enable the writing of programs that will run on a broad variety of computer systems
and computer-controlled devices. We include programming tips to help you focus on important aspects of program development. Machine languages generally consist of numbers (ultimately reduced to 1s and 0s). If this hap- 926 Appendix D Game Programming: Solving Sudoku pens, first save the state of the board, then generate the next move by
randomly choosing one of the possible values in any of the remaining cells. Kennedy Objectives In this chapter, you’ll learn: ■ Basic computer concepts. We eliminated the indentation from the following code to make the problem more challenging. 13.5 (Adding Two Numbers) Write a program that defines macro SUM with two arguments, x and y, and
use SUM to produce the following output: The sum of x and y is 13 13.6 (Smallest of Two Numbers) Write a program that defines and uses macro MINIMUM2 to determine the smallest of two numeric values. It’s provided with all major web browsers. It also contains the decision mechanisms that allow the computer, for example, to compare two items
from the memory unit to determine whether they’re equal. A pragma not recognized by the implementation is ignored. Dr. Deitel earned B.S. and M.S. degrees from MIT and a Ph.D. from Boston University. l) structure member, structure pointer. When you guess correctly, the application displays "Excellent! You guessed the number!" 24 Chapter 1
Introduction to Computers, the Internet and the Web ~/examples/ch01/GuessNumber/GNU$ ./GuessNumber I have a number between 1 and 1000. Apple’s Mac OS X operating system is a descendant of NeXTSTEP. 4 Invalid choice. 10.7 (Card Shuffling and Dealing Modification) Modify the program of Fig. b) A(n) is a collection of variables under one
name in which the variables share the same storage. In a payroll system, for example, the record for an employee might consist of the following fields (possible types for these fields are shown in parentheses): • Employee identification number (a whole number) • Name (a string of characters) • Address (a string of characters) • Hourly pay rate (a
number with a decimal point) • Year-to-date earnings (a number with a decimal point) • Amount of taxes withheld (a number with a decimal point) Thus, a record is a group of related fields. C.5 Fill in the missing values in this chart of positional values for the rightmost four positions in each of the indicated number systems: decimal hexadecimal
binary octal 1000 ... When any one of the strategies works, return to the beginning of your loop and reapply the strategies in order. As you’ve noticed, the defining occurrence of each key term is set in bold blue type. Section 13.4 #define Preprocessor Directive: Macros • The replacement text for a macro or symbolic constant is any text remaining on
the line after the identifier in the #define directive. Do not use #ifdef. The C preprocessor obeys special commands called preprocessor directives, which indicate that certain manipulations are to be performed on the program before compilation. For example, the structure definition struct example { unsigned int a : 13; unsigned int : 19; unsigned int
b : 4; }; // end struct example uses an unnamed 19-bit field as padding—nothing can be stored in those 19 bits. hostName:~ userFolder$ cd Documents/examples/ch01/GuessNumber/GNU hostName:GNU$ Fig. To understand multiple selection using the switch selection statement. 10.6 Given the following structure and variable definitions, struct
customer { char lastName[15]; char firstName[15]; unsigned int customerNumber; struct { char phoneNumber[11]; char address[50]; char city[15]; char state[3]; char zipCode[6]; } personal; } customerRecord, *customerPtr; customerPtr = &customerRecord; write an expression that can be used to access the structure members in each of
the following parts: a) Member lastName of structure customerRecord. For complex problems like solving a Sudoku puzzle, the number of possible placements of the digits 1–9 is enormous, so the hope in using a reasonable heuristic is that it will avoid wasting time on fruitless possibilities and instead focus on solution attempts much more likely to
yield success. This could be done with 81 nested for statements that each loop from 1 through 9. Wait a moment and try again. 1.16 | Compiling the GuessNumber application using the gcc command. (Part 2 of 3.) 12.6 Queues 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133
134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 // remove node from queue head char dequeue(QueueNodePtr *headPtr, QueueNodePtr *tailPtr) { char value; // node value QueueNodePtr tempPtr; // temporary node pointer value = (*headPtr)->data; tempPtr = *headPtr; *headPtr = (*headPtr)->nextPtr; // if queue is empty if (
*headPtr == NULL) { *tailPtr = NULL; } // end if free(tempPtr); return value; } // end function dequeue // return 1 if the queue is empty, 0 otherwise int isEmpty(QueueNodePtr headPtr) { return headPtr == NULL; } // end function isEmpty // print the queue void printQueue(QueueNodePtr currentPtr) { // if queue is empty if (currentPtr ==
NULL) { puts("Queue is empty."); } // end if else { puts("The queue is:"); // while not end of queue while (currentPtr != NULL) { printf("%c --> ", currentPtr->data); currentPtr = currentPtr->nextPtr; } // end while puts("NULL"); } // end else } // end function printQueue Fig. 30 Chapter 1 Introduction to Computers, the Internet and the Web
1.13 The Internet and World Wide Web The Internet—a global network of computers—was made possible by the convergence of computing and communications technologies. The routing node routes one packet at a time, so additional packets are enqueued until the router can route them. A great example is Facebook, which was launched from a
college dorm room and built with open-source software. Try again.", meaning that the value you entered is greater than the number the application chose as the correct guess (Fig. Computers are used to adjust the intensity of the Xrays, optimizing the scan for each type of tissue, then to combine all of the information to create a 3D image. root node
pointer B left subtree of node containing B A D C Fig. 2 Queue is empty. This command compiles the application and produces an executable file called GuessNumber. Good Programming Practice 13.2 By convention, symbolic constants are defined using only uppercase letters and underscores. Today, via the Internet, such attacks can be
instantaneous and global in scope. Use #define to create macros and macros with arguments. The value in each node is not printed until the values of its children are printed. Repeat this process for the third and fourth characters. 1.20) by entering values until you guess the correct number. So a binary search tree with n elements would have a
maximum of log2n levels, and thus a maximum of log2n comparisons would have to be made either to find a match or to determine that no match exists. A tree is a nonlinear, two-dimensional data structure with special properties. Also, each customer is serviced in random integer intervals of 1 to 4 minutes. introduces a structure declaration. Section
13.8 Line Numbers • The #line preprocessor directive causes the subsequent source code lines to be renumbered starting with the specified constant integer value. 3.37 (Detecting Multiples of 10) Write a program that prints 100 asterisks, one at a time. 4.1, which prints the numbers from 1 to 10. To use the break and continue statements to alter
the flow of control. Bit fields enable better memory utilization by storing data in the minimum number of bits required. Multiple satellites send timestamped signals to the GPS device, which calculates the distance to each satellite based on the time the signal left the satellite and the time the signal arrived. Write a program that inputs value of type
char, short, int and long and stores the values in union variables of type union integer. The program should include function concatenate that takes pointers to both lists as arguments and concatenates the second list to the first list. [Note: Due to the size of the descriptions for Exercises 12.25–12.30, we’ve posted them in a PDF document located at
www.deitel.com/books/chtp7/.] 13 C Preprocessor Hold thou the good; define it well. • Often, the bitwise AND operator is used with an operand called a mask—an integer value with specific bits set to 1. 532 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 w x y z Chapter 14 Other C
Topics // Fig. The members of separate structures can have the same names, but the members of the same structure must have unique names. What are the positional values of the rightmost four positions of any number in the base 12 number system? 12.5 (Binary Search Tree Traversals) Provide the inorder, preorder and postorder traversals of the
binary search tree of Fig. (a) *headPtr *tailPtr R (b) A *headPtr Fig. Section 12.4 Linked Lists • A linked list is a linear collection of self-referential structures, called nodes, connected by pointer links. You could also do the reflections by subtracting both the row and column of the cell you’re emptying from 10. In the next several sections, we suggest
brute force and heuristic Sudoku-solving strategies. To use the for and do…while repetition statements to execute statements repeatedly. Suppose we wish to convert decimal 57 to binary. C.22 Convert octal 426 to decimal. The names of the bit fields are the letters a to p. d) Members of different structures must have unique names. ■ Redirect screen
output to be placed in a file. Access is restricted to college instructors teaching from the book. … Simplify, simplify. If a portion of the network failed, the remaining working portions would still route packets from senders to receivers over alternative paths for reliability. (Part 2 of 2.) 12.6.1 Function enqueue Function enqueue (lines 79–103) receives
three arguments from main: the address of the pointer to the head of the queue, the address of the pointer to the tail of the queue and the value to be inserted in the queue. If a series of function calls occurs, the successive return values are pushed onto the stack in last-in, first-out order so that each function can return to its caller. mal or
hexadecimal is always c) The positional value of the digit to the left of the rightmost digit of any number in bi. *topPtr (line 101) so *topPtr contains address 4. Then combine the unsigned int with the mask 16711680 (00000000 11111111 00000000 00000000). 1.17). 1.12 | Entering additional guesses and guessing the correct number. We added more
function pointer exercises. If the replacement text for a macro or symbolic constant is longer than the remainder of the line, a backslash (\) is placed at the end of the line, indicating that the replacement text continues on the next line. Programmers who work in assembly languages and in high-level languages like C that enable programmers to reach
down to the machine level, find it cumbersome to work with binary numbers. It hides these statements from its user, just as a car’s accelerator pedal hides from the driver the mechanisms of making the car go faster. Web 2.0 is a conversation, with everyone having the opportunity to speak and share views. int pop(StackNodePtr *topPtr) Pop a value
off the stack. 808 Excellent! You guessed the number! Would you like to play again? The public member function setSales (lines 30–37) sets the sales figure for one month in array sales. 12.22 (Binary Tree Search) Write function binaryTreeSearch that attempts to locate a specified value in a binary search tree. If you reach a point where there are still
empty cells, but no possible digits for at least one of those cells, the program should abandon that attempt, restore the board state that you saved, and begin the random approach again. Common Programming Error 12.7 Not setting to NULL the links in leaf nodes of a tree can lead to runtime errors. But this approach does have the advantage that it
will eventually stumble onto every possible solution, some of which could show up fortuitously early on. The sequencing information helped in reassembling the packets—which, because of complex routing mechanisms, could actually arrive out of order—into their original order for presentation to the recipient. For more information, visit
www.securecoding.cert.org. [Note: You’ll also need to modify and incorporate the queue-processing functions of Fig. So, consider the following strategy: 1. Summary Bullets. If the value is false (0), assert prints an error message and calls function abort (of the general utilities library—) to terminate program execution. Your target heart rate is a
range that’s 50–85% of your maximum heart rate. These efforts include the development, research, and testing of the theories and programs to determine their effectiveness. Then show the one’s complement of 417 and the two’s complement of 417. 3. Special Section: Building Your Own Compiler In Exercises 7.27–7.29, we introduced Simpletron
Machine Language (SML), and you implemented a Simpletron computer simulator to execute SML programs. C.13 Decimal 177 to binary: 256 128 64 32 16 8 4 2 1 128 64 32 16 8 4 2 1 (1*128)+(0*64)+(1*32)+(1*16)+(0*8)+(0*4)+(0*2)+(1*1) 10110001 to octal: 512 64 8 1 64 8 1 (2*64)+(6*8)+(1*1) 261 to hexadecimal: 256 16 1 16 1 (11*16)+(1*1)
(B*16)+(1*1) B1 C.14 Binary: 512 256 128 64 32 16 8 4 2 1 256 128 64 32 16 8 4 2 1 (1*256)+(1*128)+(0*64)+(1*32)+(0*16)+(0*8)+(0*4)+(0*2)+(1*1) 110100001 One’s complement: 001011110 Two’s complement: 001011111 Check: Original binary number + its two’s complement Exercises 919 110100001 001011111 --------000000000 C.15 Zero.
5. d) Structure student that contains arrays firstName[15] and lastName[15] and variable homeAddress of type struct address from part (c). (Part 2 of 3.) 1.3 Hardware and Software Name Description Game programming Analysts expect global video game revenues to reach $91 billion by 2015 (www.vg247.com/2009/06/23/global-industry-
analystspredicts-gaming-market-to-reach-91-billion-by-2015/). We consider several algorithms and compare them with regard to their memory consumption and processor demands. The web is a relatively recent creation. A void * pointer may be assigned to a variable of any pointer type. right subtree of node containing B 12.7 Trees 501 In this
section, a special binary tree called a binary search tree is created. The function consists of three steps: 1. Tree nodes contain two or more links. j) Member address of member personal of the structure pointed to by customerPtr. • Because we’re accustomed to working in decimal, it’s convenient to convert a binary, octal or hexadecimal number to
decimal to get a sense of the number’s “real” worth. We use fonts to distinguish between features you see on the screen (e.g., the Command Prompt) and elements that are not directly related to the screen. 1 2 3 4 5 6 7 8 9 10 11 12 13 // Fig. • Linked lists are collections of data items “lined up in a row”—insertions and deletions are made anywhere in
a linked list. Use a for statement to count from 1 to totalSpaces and output spaces. 17.6: SalesPerson.cpp // SalesPerson class member-function definitions. This kit contains CD or DVD versions of: • Microsoft® Visual Studio 2010 Express Edition (www.microsoft.com/express/) • Dev C++ (www.bloodshed.net/download.html) • NetBeans
(netbeans.org/downloads/index.html) • Eclipse (eclipse.org/downloads/) • CodeLite (codelite.org/LiteEditor/Download) You can also download these software packages from the websites specified above. 20 Chapter 1 Introduction to Computers, the Internet and the Web 1.11.1 Running a C Application from the Windows Command Prompt 1. 47 25 11
77 43 31 44 65 68 Fig. Assign (*headPtr)->data to value to save the data (line 111). Standard Streams 23.2.2 iostream Library Headers 23.2.3 Stream Input/Output Classes and Objects Stream Output 23.3.1 Output of char * Variables 23.3.2 Character Output Using Member Function put Stream Input 23.4.1 get and getline Member Functions 23.4.2
istream Member Functions peek, putback and ignore 23.4.3 Type-Safe I/O Unformatted I/O Using read, write and gcount Introduction to Stream Manipulators 23.6.1 Integral Stream Base: dec, oct, hex and setbase 23.6.2 Floating-Point Precision (precision, setprecision) 23.6.3 Field Width (width, setw) 23.6.4 User-Defined Output Stream
Manipulators Stream Format States and Stream Manipulators 23.7.1 Trailing Zeros and Decimal Points (showpoint) 23.7.2 Justification (left, right and internal) 23.7.3 Padding (fill, setfill) 23.7.4 Integral Stream Base (dec, oct, hex, showbase) 23.7.5 Floating-Point Numbers; Scientific and Fixed Notation (scientific, fixed) 23.7.6 Uppercase/Lowercase
Control (uppercase) 23.7.7 Specifying Boolean Format (boolalpha) 23.7.8 Setting and Resetting the Format State via Member Function flags 23.3 23.4 23.5 23.6 23.7 810 813 817 817 823 824 824 827 828 834 835 839 840 841 841 842 842 845 845 845 846 846 849 849 850 851 853 854 856 856 857 859 860 861 862 862 863 Contents 23.8
Stream Error States 23.9 Tying an Output Stream to an Input Stream 23.10 Wrap-Up xvii 864 866 867 24 Exception Handling: A Deeper Look 24.1 24.2 24.3 24.4 24.5 24.6 24.7 24.8 24.9 24.10 24.11 24.12 Introduction Example: Handling an Attempt to Divide by Zero When to Use Exception Handling Rethrowing an Exception Processing Unexpected
Exceptions Stack Unwinding Constructors, Destructors and Exception Handling Exceptions and Inheritance Processing new Failures Class unique_ptr and Dynamic Memory Allocation Standard Library Exception Hierarchy Wrap-Up A Operator Precedence Charts 902 B ASCII Character Set 906 C Number Systems 907 C.1 C.2 C.3 C.4 C.5 C.6
Introduction Abbreviating Binary Numbers as Octal and Hexadecimal Numbers Converting Octal and Hexadecimal Numbers to Binary Numbers Converting from Binary, Octal or Hexadecimal to Decimal Converting from Decimal to Binary, Octal or Hexadecimal Negative Binary Numbers: Two’s Complement Notation D Game Programming: Solving
Sudoku D.1 D.2 D.3 D.4 D.5 D.6 Introduction Deitel Sudoku Resource Center Solution Strategies Programming Sudoku Puzzle Solvers Generating New Sudoku Puzzles Conclusion 876 877 877 883 884 885 886 888 888 889 892 894 896 908 911 912 912 913 915 920 920 921 921 925 926 928 Appendices on the Web 929 Index 930 xviii Contents
Appendices E through H are PDF documents posted online at the book’s Companion Website (located at www.pearsonhighered.com/deitel). d) False. • Data is stored in a linked list dynamically—each node is created as necessary. 788 Too low. E Sorting: A Deeper Look F Introduction to the New C Standard G Using the Visual Studio Debugger H
Using the GNU Debugger Preface Welcome to the C programming language—and to C++, too! This book presents leadingedge computing technologies for college students, instructors and software development professionals. To compile and link a program named welcome.c, type gcc welcome.c at the Linux prompt and press the Enter key (or Return
key). 910 Appendix C Number Systems In the binary number 101, the rightmost 1 is written in the ones position, the 0 is written in the twos position and the leftmost 1 is written in the fours position. directive discards symbolic constant and macro names. Sentinel-controlled repetition is sometimes called indefinite repetition because it’s not known in
advance how many times the loop will be executed. The process of doing this is called instantiation. We updated Chapters 15–24 on object-oriented programming in C++ with material from our textbook C++ How to Program, 8/e. For more details, see the section “A Note About Secure C Programming” in this Preface. In the program of 430 Chapter
10 C Structures, Unions, Bit Manipulation and Enumerations Fig. Logically, however, the nodes of a linked list appear to be contiguous. Macros may be defined with or without arguments. A syntax error occurs when the compiler cannot recognize a statement because it violates the 1.10 Typical C Program Development Environment Editor Disk
Preprocessor Disk Compiler Disk Linker Disk 17 Phase 1: Programmer creates program in the editor and stores it on disk. Using the stack functions implemented earlier in this chapter, the program should scan the expression and evaluate it. 3.41 (Diameter, Circumference and Area of a Cirle) Write a program that reads the radius of a circle (as a
float value) and computes and prints the diameter, the circumference and the area. Thus in hexadecimal we can have numbers like 876 consisting solely of decimal-like digits, numbers like 8A55F consisting of digits and letters and numbers like FFE consisting solely of letters. The digits at the left of the table are the left digits of the decimal
equivalent (0–127) of the character code, and the digits at the top of the table are the right digits of the character code. 1.11 Test-Driving a C Application in Windows, Linux and Mac OS X In this section, you’ll run and interact with your first C application. A car typically begins as engineering drawings, similar to the blueprints that describe the design
of a house. Then, place the particular digit in the particular empty square (of all those that remain) that leaves the board count the highest (in case of a tie, pick one at random). Additional Exercises. 1 Enter a character: A The queue is: A --> NULL ? Pearson has responded to that need by offering digital texts and course materials online through
CourseSmart. It contains downloads, tutorials, books, e-books and more that will help you master the game. Otherwise, the #define directive is skipped. 12.2 What are the differences between a linked list and a stack? Headers do contain some portions of the implementation and hints about others. • Searching a binary tree for a value that matches a

key value is fast. With input redirection, the input can be stored in a file. Corporate Training from Deitel & Associates, Inc. Entering 2 ends the application and returns you to the application's folder in the Terminal window (Fig. "); scanf("%u", &choice); // while user does not enter 3 while (choice != 3) { switch(choice) { // enqueue value case 1: printf("%s", "Enter a character: "); scanf("%c", &item); enqueue(&headPtr, &tailPtr, item); printQueue(headPtr); break; // dequeue value case 2: // if queue is not empty if (!isEmpty(headPtr)) { item = dequeue(&headPtr, &tailPtr); printf("%c has been dequeued.", item); } // end if Fig. Assembly Languages Programming in machine language was simply too slow and tedious for most programmers. Keep looping until a solution is found. Use strtok to tokenize the text. 20.8 | BasePlusCommissionEmployee salary in addition to a commission. newPtr 3. Software Engineering Observation 17.6 Clients of a class do not need access to the class's source code in order to use the class. l) A structure member is accessed with either the m) The and operators are used to shift the bits of a value to the left or to the right, respectively. Bit fields are not "arrays of bits." Common Programming Error 10.12 Attempting to take the address of a bit field (the & operator may not be used with bit fields because they do not have addresses). 10.3). A queue is similar to a checkout line in a grocery store—the first person in line is serviced first, and other customers enter the line only at the end and wait to be serviced. 10.4 Find the error in each of the following: a) Assume that struct card has been defined containing two pointers to type char, namely face and suit. Consider the simple program shown in Fig. To number the months 1 to 12, use the following enumeration: 0 to 11, enum months { JAN = 1, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC }; // end enum months Because the first value in the preceding enumeration is explicitly set to 1, the remaining values are incremented from 1, resulting in the values 1 through 12. 1.11). To help you prepare for this, we discuss a number of those techniques in this chapter and recommend some newer techniques that can replace them. After the value in a given node is processed, the values in the left subtree are processed, then those in the right subtree are processed. When searching a (tightly packed) 1,000,000element binary search tree, no more than 20 comparisons need to be made because 220 > 1,000,000. This is the result of the postfix expression. Many development environments are available in which you can compile, build and run C applications, such as GNU C, Dev C++, Microsoft Visual C++, CodeLite, NetBeans, Eclipse, Xcode, etc. 4. The prompt in the shell on our system uses the tilde (~) character to represent the home directory, and each prompt ends with the dollar-sign ($) character. Doubles Consider the upper-right 3×3 grid in Fig. As the Internet evolved, organizations worldwide were implementing their own networks. This remarkable trend often is called Moore's Law, named for the person who identified it, Gordon Moore, co-founder of Intel—the leading manufacturer of the processors in today's computers and embedded systems. Traverse the right subtree postOrder. Create the function int validSudoku(int sudokuBoard[10][10]); which receives a Sudoku board as a two-dimensional array of integers (recall that we're ignoring row 0 and column 0). Bits vacated to the right are replaced with 0s; 1s shifted off the left are lost. NULL to *tailPtr *headPtr now (line 117) because the 5. PARTIAL SCREEN SHOTS MAY BE VIEWED IN FULL WITHIN THE SOFTWARE VERSION SPECIFIED. If none of them works, then move back up to the previous cell and try its next value. Strings separated by white space are concatenated during preprocessing, so the preceding statement is equivalent to puts("Hello, John"); The # operator must be used in a macro with arguments because the operand of # refers to an argument of the macro. To review, a heuristic is a guideline. nary, octal, decimal or hexadecimal is always equal to C.2 State whether each of the following is true or false. Unlike that of proprietary operating systems like Microsoft's Windows and Apple's Mac OS X, Linux source code (the program code) is available to the public for examination and modification and is free to download and install. 10.7 so it's portable between systems using 2-byte integers and systems using 4-byte integers. C.4). This makes it easier to modify programs—as far 634 Chapter 17 Classes: A Deeper Look, Part 1 as clients of a class are concerned, changes in the class's implementation do not affect the client as long as the class's interface originally provided to the client remains unchanged. 2) Append a right parenthesis ')' to the end of infix. D.1 | Partially completed 9×9 Sudoku grid. c) The lowest digit in any base is one less than the base. The function should return a pointer to the value if it's found; otherwise, NULL should be returned. Each of these positions is a power of the base (base 8) and that these powers begin at 0 and increase by 1 as we move left in the number (Fig. Figure 12.18 illustrates a binary search tree with 12 values. Not all popular C compilers support the new features. When attempting to solve a Sudoku, we reach a dead end when the number of possible digits that can be placed in an empty cell becomes zero. A.2 | C++ operator precedence chart. • The structure pointer operator accesses a structure member via a pointer to the structure. The first argument of average is always the number of values to be averaged. The value in each node is processed as the node is visited. When a #error directive is processed on some systems, the tokens in the directive are displayed as an error message, preprocessing stops and the program does not compile. If the digit you're attempting to place leaves the board in an invalid state, then try all other eight digits on that cell in order. In today's systems, the ALU is usually implemented as part of the next logical unit, the CPU. There are several ways to redirect input and output from the command line—that is, a Command Prompt window in Windows, a shell in Linux or a Terminal window in Mac OS X. Methods and Classes Let's use our car example to introduce some key object-oriented programming concepts. Deitel, Abbey. J. Records Several related fields can be used to compose a record. c) The tag name of a structure is optional. Please check the Instructor Resource Center to determine which exercises have solutions. In a C system, a preprocessor program executes automatically before the compiler's translation phase begins. World Wide Web, HTML, HTTP The World Wide Web allows you to execute web-based applications and to locate and view multimedia-based documents on almost any subject over the Internet. D.5 Generating New Sudoku Puzzles 927 Here's one way to generate a random permutation of the digits 1 through 9—for the first digit, simply choose a random digit from 1 through 9; for the second digit, use a loop to repeatedly generate a random digit from 1 through 9 until a digit different from the first digit is selected; for the third digit, use a loop to repeatedly generate a random digit from 1 through 9 until a digit different from the first two digits is selected; and so on. You'll use Mac OS X's Terminal window to perform this test dive. int precedence(char operator1, char operator2) Determine whether the precedence of operator1 is less than, equal to, or greater than the precedence of operator2. Characterize the state of the board by simply counting the number of possible placements for the entire board. e) If symbolic constant TRUE is defined, undefine it and redefine it as 1. @@@@@ c) Assuming x = 5 and y = 8, the following output is produced. 12.13 | Operating and maintaining a queue. 1.15) by typing cd examples/ch01/GuessNumber/GNU then pressing Enter. • The hexadecimal number system poses a problem because it requires 16 digits—a lowest digit of 0 and a highest digit with a value equivalent to decimal 15 (one less than the base of 16). The program should ignore spaces and punctuation. news.cnet.com/8301-13506_3-20074956-17/google-500000-android-devices-activatedeach-day/. Objectives. A slightly more intelligent version of this exhaustive brute-force approach would be to check each digit you're about to place to see if it leaves the board in a valid state. The stderr stream (normally connected to the screen) is used for displaying error messages. We use and explain many C library functions throughout this text. Open source also encourages more innovation. High-level languages allow you to write instructions that look almost like everyday English and contain commonly used mathematical expressions. Please type your first guess. Thus, we first write: Positional values: 512 64 8 1 Then we discard the column with positional value 512, yielding: Positional values: 64 8 1 Next we work from the leftmost column to the right. Software Engineering Observation 17.7 Information important to the interface of a class should be included in the header. Also, for the figures in this section, we use a bold font to point out the user input required by each step. Exercises C.16 Some people argue that many of our calculations would be easier in the base 12 number system because 12 is divisible by so many more numbers than 10 (for base 10). 3.44 (Sides of a Right Triangle) Write a program that reads three nonzero integers and determines and prints whether they could be the sides of a right triangle. 12.7.2 Traversals: Functions inOrder, preOrder and postOrder Functions inOrder (lines 88–96), preOrder (lines 99–107) and postOrder (lines 110– 118) each receive a tree (i.e., the pointer to the root node of the tree) and traverse the tree. These drawings include the design for an accelerator pedal. f) False. 1.2 Computers and the Internet in Industry and Research These are exciting times in the computer field. C.9 Binary 0 100 111 111 101 100; Octal 47754. Function insertNode (lines 55–85) receives the address of the tree and an integer to be stored in the tree as arguments. For this reason, you may prefer to use const variable declarations, such as 3.14159. • MEM32-C: Function malloc returns NULL if it's unable to allocate the requested memory. 1 Introduction to Computers, the Internet and the Web The chief merit of language is clearness. Steve Jobs left Apple in 1985 and founded NeXT Inc. Please address all correspondence to: About the Authors xxvii We'll respond promptly, and post corrections and clarifications on: www.deitel.com/books/chtp7/ We hope you enjoy working with C How to Program, Seventh Edition as much as we enjoyed writing it! Paul Deitel Harvey Deitel January 2012 About the Authors Paul Deitel, CEO and Chief Technical Officer of Deitel & Associates, Inc., is a graduate of MIT, where he studied Information Technology. Use the value 3.14159 for π. Windows is by far the world's most widely used operating system. Common Programming Error 1.1 Errors such as division-by-zero occur as a program runs, so they are called runtime errors or execution-time errors. e) Structure test containing 16 bit fields with widths of 1 bit. These printf statements can be enclosed in conditional preprocessor directives so the statements are compiled only while the debugging process is not completed. The line is a queue. Carole Snyder and Bob Engelhardt did a marvelous job managing the review and production processes, respectively. www.time.com/time/magazine/article/0,9171,1569514,00.html>. Member function printAnnualSales edits the sales figures into monetary format. • Whenever a function call is made, the called function must know how to return to its caller, so the return address is pushed onto a stack. i) The bitwise AND operator (&) is often used to bits—that is to select certain bits while zeroing others. Suit: 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 Color: 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 10.11 Enumeration Constants 429 An unnamed bit field with a zero width is used to align the next bit field on a new storage-unit boundary. This is referred to as a bit field. Every year or two, the capacities of computers have approximately doubled inexpensively. In Phase 3, the compiler translates the C program into machine-language code. For computers that have only a single processor, only one user at a time may be serviced. D.4 | Notation showing the complete sets of possible values for open cells. Entering another guess. Symbolic constants and macros can be discarded by using the #undef preprocessor directive. Traverse the left subtree inOrder. We divide 256 into 375 and observe that there is one 256 in 375 with a remainder of 119, so we write 1 in the 256 column. We also added a Fibonacci exercise project that improves the Fibonacci recursion example (tail recursion). We'll demonstrate running a C application using the Windows Command Prompt, a shell on Linux and a Terminal window in Mac OS X. The algorithm is as follows: 1) Insert the root node in the queue 516 Chapter 12 C Data Structures 2) While there are nodes left in the queue, Get the next node in the queue Print the node's value If the pointer to the left child of the node is not null Insert the left child node in the queue If the pointer to the right child of the node is not null Insert the right child node in the queue. • Internally, computers use the binary (base 2) number system. g) Member phoneNumber of member personal of structure customerRecord. The answer follows the numbers. Good Programming Practice 13.1 Using meaningful names for symbolic constants helps make programs self-documenting. ~/examples/ch01/GuessNumber/GNU$ gcc GuessNumber.c -o GuessNumber ~/examples/ch01/GuessNumber/GNU$ Fig. 2 B has been dequeued. The shape of the binary search tree that corresponds to a set of data can vary, depending on the order in which the values are inserted into the tree. Thus 1 and 5 can be eliminated from cell s[3][9] that contains the possible values 1357, so we can rewrite its contents as 37, simplifying the puzzle a bit. There are date objects, time objects, audio objects, video objects, automobile objects, people objects, etc. 24.8: Integer.cpp // Member function definitions of class Integer. 24.7–24.8). e) Keyword typedef is used to define new data types. A filename can be included in the #line directive. 24.7: Integer.h // Integer class definition. For more information on #error and #pragma, see the documentation for your C implementation. The compiler issues an error message to help you locate and fix the incorrect statement. The identifiers in an enumeration must be unique. 26 Chapter 1 Introduction to Computers, the Internet and the Web hostName:GNU~ userFolder$ ./GuessNumber I have a number between 1 and 1000. ing the c) The directive creates macros and symbolic constants. The steps for inserting a node in a binary search tree are as follows: 1. Function pop removes a node from the top of the stack, frees the memory that was allocated to the popped node and returns the popped value. Reuse of existing classes when building new classes and programs saves time and effort. 1 2 3 4 5 6 1 2 9 2 7 3 6 4 4 5 7 2 7 6 5 7 8 8 3 9 1 Fig. Use assertions to test whether the values of expressions are correct. printf("%s", *cPtr->face); b) Assume that struct card has been defined containing two pointers to type char, namely face and suit. (Part 1 of 3.) 4 Chapter 1 Introduction to Computers, the Internet and the Web Name Description Cloud computing Cloud computing allows you to use software, hardware and information stored in the "cloud"—i.e., accessed on remote computers via the Internet and available on demand—rather than having it stored on your personal computer. 10.13 (Unpacking Characters from an Integer) Using the right-shift operator, the bitwise AND operator and a mask, write function unpackCharacters that takes the unsigned int from Exercise 10.12 and unpacks it into four characters. Free the memory pointed to by tempPtr (line 120). For example, the statement area = CIRCLE_AREA(c + 2); is expanded to area = ((3.14159) * (c + 2) * (c + 2)); which evaluates correctly because the parentheses force the proper order of evaluation. directive causes the source code lines to be numbered from the indicated m) The value beginning with the next source code line. 1.24. Also, the array hearts[13] has been defined to be of type struct card. The Exercises 111 compiler ignores the indentation in a program. Then print the encrypted integer. Traverse the left subtree postOrder. When a strategy doesn't work, try the next. Section 10.9 Bitwise Operators • Computers represent all data internally as sequences of bits with the values 0 or 1. 12.18 | Binary search tree. We've tested every example and exercise program using Visual C++ and GNU gcc in Windows and Linux, respectively. 512 100 256 ... C Chapter Dependency Chart Introduction 1 Introduction to Computers, the Internet and the Web [Note: Arrows pointing into a chapter indicate that chapter's dependencies.] Intro to Programming 2 Intro to C Programming Control Statements, Functions and Arrays 3 Structured Program Development in C 4 C Program Control 5 C Functions 6 C Arrays Streams and Files Pointers and Strings 9 C Formatted Input/Output 7 C Pointers 11 C File Processing 8 C Characters and Strings Aggregate Types 10 C Structures, Unions, Bit Manipulations and Enumerations Data Structures Other Topics and the New C Standard 5.14–5.16 Recursion 12 C Data Structures 13 C Preprocessor 14 Other C Topics Fig. T. See Appendix B for more information on the ASCII (American Standard Code for Information Interchange) character set—the popular subset of Unicode that represents uppercase and lowercase letters, digits and some common special characters. We'll also present approaches for programming Sudoku puzzle creators and solvers in C. @@@@@ $$$$$ &&&&& b) Assuming x = 5 and y = 8, the following output is produced. (Part 2 of 2.) 17.4 Separating Interface from Implementation In Chapter 16, we began by including a class's definition and member-function definitions in one file. Running the GuessNumber application. C.7. C.3 Converting Octal and Hexadecimal Numbers to Binary Numbers In the previous section, we saw how to convert binary numbers to their octal and hexadecimal equivalents by forming groups of binary digits and simply rewriting them as their equivalent octal digit values or hexadecimal digit values.); The ellipsis (...) in the function prototype indicates that the function receives a variable number of arguments of any type. Linux has become extremely popular on servers and in embedded systems, such as Google's Android-based smartphones. To accommodate all of our readers, we placed the discussion of the new standard in optional, easy-to-useor-omit sections and in Appendix F, Introduction to the New C Standard. The value in each node is not processed until the values of its children are processed. 72 Booch, Grady 579 _Bool Data Type 136 bool primitive type (C++) 555 boolalpha stream manipulator 856, 862 boolean type 136 bounds checking 225, 259 braces ({}) 78, 615 branching instructions 331 break 128, 132, 133, 156 brittle software 765 browser window 31 brute force problem solving approach 925, 926 bubble sort 237, 268, 291, 293, 294, 309 bubble sort 243 bubble sort with pass by reference 291 buffer is filled 844 buffer is flushed 844 buffer overflow 259 buffered output 844 buffered standard error stream 842 buffering 866 building-block approach 12, 551 "building blocks" 578 business-critical computing 881 business publications 33 byte 9, 417 C C compiler 41 C development environment 17 C Environment 16 C language 10 C preprocessor 16, 42, 518 C program and sample execution for the class average problem with countercontrolled repetition 81 C program and sample execution for the class average problem with sentinelcontrolled repetition 85 C program and sample executions for examination results problem 91 C Resource Center 16 C standard document (INCITS/ISO/IEC 9899-1999) 12 C standard library 12, 16, 159, 174, 287 C standard library documentation 12 C# programming language 13 C++ 166 C++ keywords 556 C++ Resource Center 13 C++ Standard Library 551 file 592 class template vector 571 header files 552 header location 606 string class 591 C++0x unique_ptr class 892 C99 12 calculations 7, 48, 57 call a function 159, 160, 163, 590 call-by-reference 411 call-by-value 411 caller 160 calling function 160 calling function (caller) 589, 596 calloc 540 Camel case 588 capital letter 46 carbon footprint calculator 37 CarbonFootprint Abstract Class: Polymorphism 822 Card dealing program 307 card games 321 Card Shuffling and Dealing 693, 694 card shuffling and dealing simulation 304, 307, 412 caret (^) 396 carriage return ('\r') 338 carry bit 915 cascading member function calls 677, 678, 680 cascading stream insertion operations 551 case label 128, 129, 184 case sensitive 46, 82 case study: Date class 708 casino 179 header file 553 cast 521 downcast 787 cast operator 85, 87, 168, 728, 729 (float) 87 cast operator function 728 catch a base class object 894 catch all exceptions 895 Catch block 575 catch clause (or handler) 882, 888 catch handler 880 catch related errors 889 catch(...) 895, 896 Catching All Exceptions 900 Catching Derived-Class Exceptions 900 cbrt function 161 header file 553 ceil function 161 Celsius 404 central processing unit (CPU) 7 centralized control 30 cerr (standard error unbuffered) 842, 843 header file 553 chaining stream insertion operations 551 char 127 char 168, 336 char * 385 char ** 343 char primitive type 127 CHAR_BIT symbolic constant 420 character 8 set 8 character array 228, 229 character constant 288, 335, 385 character handling library 337 character handling library functions 337 character presentation 553 character set 68, 127, 335 character string 43, 219 check if a string is a palindrome 196 check protection 375 checkerboard 67, 112 chess 272 child 500 cin (standard input stream) 550, 842, 843 cin.clear 866 cin.eof 846, 866 cin.get function 847 cin.tie function 867 circumference of a circle 112 Cisco 3 clarity 550 class 15, 551, 577 attribute 593 client-code programmer 612 constructor 599 data member 593 default constructor 599, 602 define a constructor 601 define a member function 587 implementation programmer 611 instance of 595 instance variable 15 interface 606, 607 Index class (cont.) interface described by function prototypes 607 member function 587 member-function implementations in a separate source-code file 608 naming convention 588 object of 595 public services 607 services 597 class Array 716 class averaging problem 80, 85 class definition 588 class development 715 class diagram (UML) 590 class hierarchy 745, 794, 817 class-implementation programmer 611 class keyword 568, 825 class library 634, 773 class object code 634 class scope 629, 632 class-scope variable is hidden 632 class source code 634 class template 824, 824, 828, 828 explicit specialization 835 class-template definition 828 scope 830 specialization 824, 828 Stack 829, 831 class template auto_ptr 892 Classes Complex 736 exception 878 HugeInt 739 invalid_argument 895 out_of_range exception class 576 Polynomial 742 RationalNumber 742 runtime_error 878, 887 string 591 unique_ptr 892 vector 570 classic stream libraries 841 classified listings 31 clear function of ios_base 866 client 686, 687 client code 780 client-code programmer 611, 612 client of a class 577 client of an object 597 header file 553 clock 177 clog (standard error buffered) 842, 843 cloud computing 4, 32 header file 552 coefficient 742 coercion of arguments 167 coin tossing 209 collaboration 31 colon (:) 670 column 249 combining Class Time and Class Date exercise 656 comma operator (,) 119, 122, 194 comma-separated list 119 command-line arguments 533, 534 comment 41, 549, 550 commission 267 commission problem 108 CommissionEmployee class header 802 CommissionEmployee class implementation file 803 CommissionEmployee class represents an employee paid a percentage of gross sales 749 CommissionEmployee class test program 751 CommissionEmployee class uses member functions to manipulate its private data 766 Common Programming Errors overview xxiv Communications of the ACM 72 community 31 commutative 727 commutative operation 727 comparing strings 350 comparison expressions 297 compilation 16 compilation error 137 compile 16 compile error 17 compile phase 16 compile-time error 17 compiler 10, 16, 41, 42, 43 compiling multiple-source-file program 612 complement operator (~) 417 complete algorithm 73 Complex class 655, 736, 737, 875 exercise 655 member-function definitions 737 complex numbers 655, 736 component 14 components (software) 13 composition 631, 667, 744, 747 Composition as an Alternative to Inheritance 776 compound interest 122, 123, 153 compound statement 78 computation 5 computer dump 330 computer program 5 computer simulator 329 Computer-Assisted Instruction (CAI) 214, 215 Computer-Assisted Instruction (CAI): Difficulty Levels 215 Computer-Assisted Instruction (CAI): Monitoring Student Performance 214 Computer-Assisted Instruction (CAI): Reducing Student Fatigue 214 Computer-Assisted Instruction (CAI): Varying the Types of Problems 215 Computerization of Health Records 440, 622 computers in education 214 computing the sum of the elements of an array 223 concatenate stream insertion operations 551 concatenating strings 350 concrete class 793 concrete derived class 798 condition 54, 134 conditional compilation 518, 521 933 conditional execution of preprocessor directives 518 conditional expression 76, 76, 882 conditional operator (?:) 76, 95 connector symbols 73 conserve storage 426 consistent state 614 const 286, 290, 293, 303, 304, 659, 706 const keyword 234, 554 const member function 659 const member function on a const object 663 const member function on a non-const object 663 const object 659, 663 const objects and const member functions 663 const pointer 570, 715 const qualifier 284 const qualifier before type specifier in parameter declaration 559 const type qualifier 236 const version of operator[] 726 constant 512 constant integral expression 130 constant pointer 290, 291, 299, 675 constant pointer to constant data 287, 291 constant pointer to non-constant data 287, 290 constant reference 725 constant reference parameter 558 constant string 303 constructed inside out 672 constructor 599 conversion 728, 730 copy 724 default 602 default arguments 640 defining 601 explicit 730 function prototype 607 in a UML class diagram 602 naming 601 parameter list 601 single argument 728, 729, 730 constructor called recursively 724 constructors and destructors called automatically 643 constructors cannot be virtual 817 constructors cannot specify a return type 599 Constructors Throwing Exceptions 901 container 552 container class 634, 673, 719, 835 continue 132, 133, 156 continuous beta 33 control characters 341 control statement 75 control-statement nesting 74 control-statement stacking 74 control-structure stacking 75 control structures 72 control variable 115, 121 increment 116 initial value 116 name 116 controlling expression in a switch 128 conversion 913 934 Index conversion constructor 728, 730 conversion operator 728 conversion rules 167 conversion specifications 380 conversion specifier 47, 380 c 384 e and E 382 f 382 for scanf 392 g (or G) 383 s 384 conversion specifiers %u 90 conversions among fundamental types 728 by cast 728 conversion specifiers %s 58 convert a binary number to decimal 913 a hexadecimal number to decimal 913 an octal number to decimal 913 lowercase letters 553 lowercase letters to uppercase letters 173 convert among user-defined types and built-in types 728 convert between types 728 Converting Fahrenheit to Celsius 874 Cooking with Healthier Ingredients 377 copy 173 copy constructor 650, 671, 719, 724, 726 copy-and-paste approach 758 copying strings 350 correction 18 cos function 161 cosine 161 counter 80, 109 counter-controlled loop 89 counter-controlled looping 90 counter-controlled repetition 80, 116, 117 counting letter grades 128 counting loop 117 cout (In Exercises 12.25–12.30, we build a compiler that converts programs written in a high-level programming language to SML. —Thomas B. 1 Enter a character: C The queue is: A --> B --> C --> NULL ? n) A tree node that has no children is called a(n) node. 384 Excellent! You guessed the number! Would you like to play again? Clearly one of those cells must be 4, one must be 6 and one must be 7. Finally, 1 into 1 is 1, so we write 1 in the 1 column. 1 2 3 4 5 6 7 8 9 1 5 1 3 4 9 7 6 2 8 2 4 6 8 3 7 9 2 4 2 5 9 6 3 7 8 8 1 9 6 Fig. This section "ties" together the entire programming process. Primary Memory Loader Phase 5: Loader puts program in memory. Normally this application randomly selects the correct answers. The following arithmetic operations are allowed in an expression: + addition - subtraction * multiplication / division ^ exponentiation % remainder Exercises 513 The stack should be maintained with the following declarations: struct stackNode { char data; struct stackNode *nextPtr; }; typedef struct stackNode StackNode; typedef StackNode *StackNodePtr; The program should consist of main and eight other functions with the following function headers: void convertToPostfix(char infix[], char postfix[]) Convert the infix expression to postfix notation. The clients do, however, need to be able to link to the class's object code (i.e., the compiled version of the class). To evaluate a complex infix expression, a compiler would first convert the expression to postfix notation, and then evaluate the postfix version. 530 Chapter 14 Other C Topics 14.1 14.2 14.3 14.4 14.5 Introduction Redirecting I/O Variable-Length Argument Lists Using Command-Line Arguments Notes on Compiling Multiple-SourceFile Programs 14.6 Program Termination with exit and 14.7 Suffixes for Integer and Floating-Point Literals 14.8 Signal Handling 14.9 Dynamic Memory Allocation: Functions calloc and realloc 14.10 Unconditional Branching with goto atexit Summary | Terminology | Self-Review Exercise | Answers to Self-Review Exercise | Exercises 14.1 Introduction This chapter presents several additional topics not ordinarily covered in introductory courses. The memory unit is often called either memory or primary memory. A field is a group of characters or bytes that conveys meaning. Many of today's computers have multiple CPUs and, hence, can perform many operations simultaneously. C.6). 918 Appendix C Number Systems Answers to Self-Review Exercises C.1 a) 10, 2, 8, 16. 1 | C chapter dependency chart. After you guess the correct number, the application asks if you'd like to play another game. b) The highest digit in any base is one more than the base. "); scanf("%u", &choice); } // end while puts("End of run."); } // end main // display program instructions to user void instructions(void) { printf ("Enter your choice:" " 1 to add an item to the queue" " 2 to remove an item from the queue" " 3 to end"); } // end function instructions // insert a node in at queue tail void enqueue(QueueNodePtr *headPtr, QueueNodePtr *tailPtr, char value) { QueueNodePtr newPtr; // pointer to new node newPtr = malloc(sizeof(QueueNode)); if (newPtr != NULL) { // is space available newPtr->data = value; newPtr->nextPtr = NULL; // if empty, insert node at head if (isEmpty(*headPtr)) { *headPtr = newPtr; } // end if else { (*tailPtr)->nextPtr = newPtr; } // end else *tailPtr = newPtr; } // end if else { printf("%c not inserted. This yields: Positional values: 64 Symbol values: 1 8 4 1 7 and thus decimal 103 is equivalent to octal 147. D.6 | Using doubles to simplify a puzzle. You can also use the C standard's inline keyword (see Appendix F). 383 Too low. Suppose a row, column or 3×3 grid contains cells with possibles lists of 467, 46, and 67. C.5 decimal hexadecimal binary octal 1000 100 10 4096 256 16 1 1 8 4 2 1 512 64 8 1 C.6 Octal 6530; Hexadecimal D58. 12.14 (Postfix Evaluator Modification) Modify the postfix evaluator program of Exercise 12.13 so that it can process integer operands larger than 9. As you read the book, if you have questions, send an e-mail to —we'll respond promptly. If we add the one's complement of a number to the number, the result would be all 1s. An object is then referred to as an instance of its class. Try again.", because the value you entered is less than the correct guess. This computing power, accessed over the Internet, is used in place of expensive supercomputers to conduct scientific research projects that are making a difference—providing clean water to thirdworld countries, fighting cancer, growing more nutritious rice for regions fighting hunger and more. Many of today's computers can perform billions of calculations in one second—more than a human can perform in a lifetime. Actually, things are not quite this rosy. 14.1) provide the capabilities necessary to build functions with variable-length argument lists. Our examples were tested on a computer with 4-byte (32-bit) integers. 3.45 (Factorial) The factorial of a nonnegative integer n is written n! (pronounced "n factorial") and is defined as follows: n! = n · (n - 1) · (n - 2) · … · 1 (for values of n greater than or equal to 1) and n! = 1 (for n = 0). Phase 3: Compiler creates object code and stores it on disk. 13.1 | Some predefined symbolic constants. Through its 36-year publishing partnership with Prentice Hall/Pearson, Deitel & Associates, Inc., publishes leading-edge programming college textbooks, professional xxviii Preface books and LiveLessons video courses. Here are two of the many sites we recommend in our Sudoku Resource Center (www.deitel.com/sudoku) that will help you dig deeper: www.sudokuoftheday.com/pages/techniques-overview.php www.angusj.com/sudoku/hints.php D.4 Programming Sudoku Puzzle Solvers In this section we suggest how to program Sudoku solvers. Programs or data not actively being used by the other units normally are placed on secondary storage devices (e.g., your hard drive) until they're again needed, possibly hours, days, months or even years later. 4.1: fig04_01.c // Counter-controlled repetition. Thus the 4, 6 and 7 can be eliminated from cell s[4][5] that contains the possibles 14567, so we can rewrite its contents as 15, simplifying the puzzle a bit. Column 6 of Fig. This is sometimes called "write once, run anywhere." Java is used to develop large-scale enterprise applications, to enhance the functionality of web servers (the computers that provide the content we see in our web browsers), to provide applications for consumer devices (smartphones, television set-top boxes and more) and for many other purposes. Sorting: A Deeper Look. Use the remainder operator to recognize each time the counter reaches a multiple of 10.] 3.38 (Counting 7s) Write a program that reads an integer (5 digits or fewer) and determines and prints how many digits in the integer are 7s. 10.10 Bit Fields C enables you to specify the number of bits in which an unsigned int or int member of a structure or union is stored. One Laptop Per Child (OLPC) One Laptop Per Child (one.laptop.org) is providing low-power, inexpensive, Internet-enabled laptops to children in third-world countries—enabling learning and reducing the digital divide. 10 6 ... f) If symbolic constant TRUE is defined, undefine it and redefine it as 1. Triples can also be hidden. We divide 16 into 119 and observe that there are seven 16s in 119 with a remainder of 7 and write 7 in the 16 column. The authors and publisher make no warranty of any kind, expressed or implied, with regard to these programs or to the documentation contained in this book. • Bit-field members of structures are accessed exactly as any other structure member. Standard Streams 23.2.2 iostream Library Headers 23.2.3 Stream Input/Output Classes and Objects 23.3 Stream Output 23.3.1 Output of char * Variables 23.3.2 Character Output Using Member Function put 23.4 Stream Input 23.4.1 get and getline Member Functions 23.4.2 istream Member Functions peek, putback and ignore 23.4.3 Type-Safe I/O 23.5 Unformatted I/O Using read, write and gcount 23.6 Introduction to Stream Manipulators 23.6.1 Integral Stream Base: dec, oct, hex and setbase 23.6.2 Floating-Point Precision (precision, setprecision) 23.6.3 Field Width (width, setw) 23.6.4 User-Defined Output Stream Manipulators 23.7 Stream Format States and Stream Manipulators 23.7.1 Trailing Zeros and Decimal Points (showpoint) 23.7.2 Justification (left, right and internal) 23.7.3 Padding (fill, setfill) 23.7.4 Integral Stream Base (dec, oct, hex, showbase) 23.7.5 Floating-Point Numbers; Scientific and Fixed Notation (scientific, fixed) 23.7.6 Uppercase/Lowercase Control (uppercase) 23.7.7 Specifying Boolean Format (boolalpha) 23.7.8 Setting and Resetting the Format State via Member Function flags 23.8 Stream Error States 23.9 Tying an Output Stream to an Input Stream 23.10 Wrap-Up24 Exception Handling: A Deeper Look 24.1 Introduction 24.2 Example: Handling an Attempt to Divide by Zero 24.3 When to Use Exception Handling 24.4 Rethrowing an Exception 24.5 Processing Unexpected Exceptions 24.6 Stack Unwinding 24.7 Constructors, Destructors and Exception Handling 24.8 Exceptions and Inheritance 24.9 Processing new Failures 24.10 Class unique_ptr and Dynamic Memory Allocation 24.11 Standard Library Exception Hierarchy 24.12 Wrap-UpA: Operator Precedence ChartsB: ASCII Character SetC: Number Systems C.1 Introduction C.2 Abbreviating Binary Numbers as Octal and Hexadecimal Numbers C.3 Converting Octal and Hexadecimal Numbers to Binary Numbers C.4 Converting from Binary, Octal or Hexadecimal to Decimal C.5 Converting from Decimal to Binary, Octal or Hexadecimal C.6 Negative Binary Numbers: Two's Complement NotationD: Game Programming: Solving Sudoku D.1 Introduction D.2 Deitel Sudoku Resource Center D.3 Solution Strategies D.4 Programming Sudoku Puzzle Solvers D.5 Generating New Sudoku Puzzles D.6 ConclusionAppendices on the WebIndex A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Citation preview Deitel® Series Page How To Program Series Android How to Program C++ How to Program, 8/E C How to Program, 7/E Java™ How to Program, 9/E Java™ How to Program, Late Objects Version, 8/E Internet & World Wide Web How to Program, 5/E Visual C++® 2008 How to Program, 2/E Visual Basic® 2010 How to Program Visual C#® 2010 How to Program, 3/E Simply Series Simply C++: An App-Driven Tutorial Approach Simply Java™ Programming: An App-Driven Tutorial Approach Simply C#: An App-Driven Tutorial Approach Simply Visual Basic® 2010: An App-Driven Approach, 4/E CourseSmart Web Books www.deitel.com/books/CourseSmart/ C++ How to Program, 5/E, 6/E, 7/E & 8/E Simply C++: An App-Driven Tutorial Approach Java™ How to Program, 6/E, 7/E, 8/E & 9/E Simply Visual Basic 2010: An App-Driven Approach, 4/E (continued from previous column) Visual Basic® 2010 How to Program Visual Basic® 2008 How to Program Visual C#® 2010 How to Program, 4/E Visual C#® 2008 How to Program, 3/E Deitel® Developer Series AJAX, Rich Internet Applications and Web Development for Programmers Android for Programmers: An App-Driven Approach C++ for Programmers C# 2010 for Programmers iPhone® for Programmers: An App-Driven Approach Java™ for Programmers, 2/e JavaScript for Programmers LiveLessons Video Learning Products www.deitel.com/books/LiveLessons/ Android App Development Fundamentals C++ Fundamentals Java™ Fundamentals C# 2010 Fundamentals iPhone® App Development Fundamentals JavaScript Fundamentals Visual Basic Fundamentals To receive updates on Deitel publications, Resource Centers, training courses, partner offers and more, please register for the free Deitel ® Buzz Online e-mail newsletter at: www.deitel.com/newsletter/subscribe.html and join the Deitel communities on Twitter® @deitel Facebook® facebook.com/DeitelFan and Google+ gplus.to/deitel To communicate with the authors, send e-mail to: For information on government and corporate Dive-Into® Series on-site seminars offered by Deitel & Associates, Inc. D.6 Conclusion This appendix on solving and programming Sudoku puzzles has presented you with many challenges. Title. Download free Sudoku puzzle maker software. Even with balanced rates, randomness can still cause long lines. According to the American Heart Association (AHA), the formula for calculating your maximum heart rate in beats per minute is 220 minus your age in years. Please do not write to us requesting access to the Pearson Instructor's Resource Center. 13.1. 13.3 Write a preprocessor directive to accomplish each of the following: a) Define symbolic constant YES to have the value 1. Decimal number Binary representation Octal representation Hexadecimal representation 0 0 0 0 1 1 1 1 2 10 2 2 3 11 3 3 4 100 4 4 5 101 5 5 6 110 6 6 7 111 7 7 8 1000 10 8 9 1001 11 9 10 1010 12 A 11 1011 13 B 12 1100 14 C 13 1101 15 D 14 1110 16 E 15 1111 17 F 16 10000 20 10 Fig. One challenge was to get these different networks to communicate. is a set of integers represented by identifiers. Answers to Self-Review Exercises 12.1 a) referential. / 0 1 2 3 4 5 6 7 8 9 : ; ? 17.5 | SalesPerson class definition. Assign the resulting value to a char variable. For example, suppose variable x should never be larger than 10 in a program. That GUI served as the inspiration for the Apple Macintosh, launched with much fanfare in a memorable Super Bowl ad in 1984. In this exercise you'll investigate a simple scheme for encrypting and decrypting data. 406 Too high. C.3 In general, the decimal, octal and hexadecimal representations of a given binary number contain (more/fewer) digits than the binary number contains. In 2003 there was a noticeable shift in how people and businesses were using the web and developing web-based applications. Throughout the book, we discuss many of these functions. We've made monthName[0] the empty string "". __FILE__ __DATE__ __TIME__ __STDC__ Fig. In this and the next exercise, we investigate how compilers evaluate arithmetic expressions consisting of only constants, operators and parentheses. The precise number of repetitions isn't known in advance, and 2. operator, bits are set to 1 if exactly one of the corh) In an expression using the responding bits in either operand is set to 1. Too low. Enter choice: 1 to push a value on the stack 2 to pop a value off the stack 3 to end program ? The term Web 2.0 was coined by Dale Dougherty of O'Reilly Media3 in 2003 to describe this trend. a) A popular reason for using the decimal number system is that it forms a convenient notation for abbreviating binary numbers simply by substituting one decimal digit per group of four binary bits. g) If symbolic constant TRUE is not equal to 0, define symbolic constant FALSE as 0. 524 Chapter 13 C Preprocessor Symbolic constant Explanation __LINE__ The line number of the current source code line (an integer constant). Typical main memories on desktop and notebook computers contain between 1 and 8 GB (GB stands for gigabytes; a gigabyte is approximately one billion bytes). Traverse the right subtree preOrder. is used to introduce a union definition. f) Structures are always passed to functions by reference. He also wrote communication protocols to form the backbone of his new information system, which he called the World Wide Web. 1 ... 12.8 Secure C Programming Chapter 8 of the CERT Secure C Coding Standard Chapter 8 of the CERT Secure C Coding Standard is dedicated to memory-management recommendations and rules—many apply to the uses of pointers and dynamic-memory allocation presented in this chapter. C.10 Decimal 2+4+8+32+64=110. Disk Primary Memory CPU ... • If no memory is available, malloc returns NULL. Each column of output starts five spaces to the right of the previous column. This is accomplished with an editor program. During program development, it's often helpful to "comment out" portions of code to prevent them from being compiled. Assign newPtr to *tailPtr (line 98), because the new node is the queue's tail. Common Programming Error 10.13 Assigning a value to an enumeration constant after it's been defined is a syntax error. The next two columns each produce quotients of 0 when their positional values are divided into 1, so we write 0s in the 4 and 2 columns. www.pcworld.com/article/196035/android_outsells_the_iphone_no_big_surprise.html. If it returns 1, you're done. The program should output the characters in their bit format before and after they're packed into the unsigned int to prove that the characters are in fact packed correctly in the unsigned int variable. If the result is 0, !defined(MY_CONSTANT) evaluates to 1 and MY_CONSTANT is defined. We must also cover programming fundamentals and computer-science fundamentals for novice programmers—our core audience. • A binary search tree (with no duplicate node values) has the characteristic that the values in any left subtree are less than the value in its parent node, and the values in any right subtree are greater than the value in its parent node. f) Keyword g) Keyword is used to create a synonym for a previously defined data type. Error-Prevention Tips These tips contain suggestions for exposing and removing bugs from your programs; many describe aspects of C that prevent bugs from getting into programs in the first place. Mr. Seacord is the Secure Coding Manager at CERT at Carnegie Mellon University's Software Engineering Institute (SEI) and an adjunct professor in the Carnegie Mellon University School of Computer Science. 6 7 8 9 D.4 Programming Sudoku Puzzle Solvers 925 the others reduce to doubles of 67; if one of those three cells ultimately becomes 6, then the others reduce to doubles of 47; and if one of those three cells ultimately becomes 7, then the others reduce to doubles of 46. Each of these positions is a power of the base (base 16) and these powers begin at 0 and increase by 1 as we move left in the number (Fig. Unions cannot be compared, because there might be bytes of undefined data with different values in union variables that are otherwise identical. TCP ensured that messages were properly routed from sender to receiver and that they arrived intact. Architecture of Participation Web 2.0 embraces an architecture of participation—a design that encourages user interaction and community contributions. Section 12.7 Trees • A tree is a nonlinear, two-dimensional data structure. 13.6 #error and #pragma Preprocessor Directives The #error directive #error tokens prints an implementation-dependent message including the tokens specified in the directive. C.2 a) False. C programs typically contain references to functions defined elsewhere, such as in the standard libraries or in the private libraries of groups of programmers working on a particular project. Cast expressions, sizeof expressions and enumeration constants cannot be evaluated in preprocessor directives. Ken Thompson modeled many features in his B language after their counterparts in BCPL, and in 1970 he used B to create early versions of the UNIX operating system at Bell Laboratories. The core of the book emphasizes effective software engineering through the proven methodologies of structured programming in C and object-oriented programming in C++. 12.7 (Merging Ordered Lists) Write a program that merges two ordered lists of integers into a single ordered list of integers. Utility functions are not intended to be used by clients of a class (but can be used by friends of a class, as we'll see in Chapter 18). 12.6 Queues Another common data structure is the queue. Just as the notion of interchangeable parts was crucial to the Industrial Revolution, reusable classes are crucial to the software revolution that has been spurred by object technology. Compare the output from this function to the outputs of the other traversal algorithms to see that it worked correctly. 1.10 | Entering your first guess. 10.11 Enumeration Constants An enumeration (discussed briefly in Section 5.11), introduced by the keyword enum, is a set of integer enumeration constants represented by identifiers. Index Symbols \t horizontal-tab escape sequence 43 ^ bitwise exclusive OR operator 418 ^ inverted scan set 395 ^= bitwise exclusive OR assignment operator 425 , (comma operator) 119, 122 :: (binary scope resolution operator) 608, 681 ::, unary scope resolution operator 563 !, logical negation (NOT) operator 134, 135 != inequality operator 54 ? j) The operator concatenates its two arguments. Terminology abort function 524 arguments 519 assert macro 524 524 backslash (\) 521 C preprocessor 518 conditional compilation 518 debugger 522 #define preprocessor directive 519 #elif preprocessor directive 521 #endif preprocessor directive 521 #error preprocessor directive 522 expand a macro 519 #if preprocessor directive 521 preprocessor directive 521 preprocessor directive 521 #include preprocessor directive 518 #line preprocessor directive 523 macro 518 macro identifier 519 macro with an argument 519 #pragma preprocessor directive 522 predefined symbolic constant 523 preprocessor directive 518 replacement text 519 scope 521 symbolic constant 518 #undef preprocessor directive 521 #ifdef #ifndef Self-Review Exercises 13.1 Fill in the blanks in each of the following: a) Every preprocessor directive must begin with . 18 Chapter 1 Introduction to Computers, the Internet and the Web 1.10.3 Phase 4: Linking The next phase is called linking. char pop(StackNodePtr *topPtr) Pop a value off the stack. 116 Chapter 4 C Program Control 4.3 Counter-Controlled Repetition Counter-controlled repetition requires: 1. struct person has been defined as in part (d) but with the appropriate cor- person d; f) Assume variable p has been declared as type struct person and variable c has been declared as type struct card. • Binary trees facilitate high-speed searching and sorting of data, efficient elimination of duplicate data items, representing file-system directories and compiling expressions into machine language. 8. 1.14 | Exiting the game. Each of them either forces a digit in a cell or simplifies the puzzle a bit. Most C++ development environments can compile both C and C++ programs. The company's clients include many of the world's largest companies, government agencies, branches of the military, and academic institutions. Inheritance A new class of objects can be created quickly and conveniently by inheritance—the new class absorbs the characteristics of an existing class, possibly customizing them and adding unique characteristics of its own. i) #include. Consider the following macro definition: #define TOKENCONCAT(x, y) x ## y When TOKENCONCAT appears in the program, its arguments are concatenated and used to replace the macro. • Self-referential structures can be linked together to form lists, queues, stacks and trees. A multi-core processor implements multiple processors on a single integrated-circuit chip—a dual-core processor has two CPUs and a quad-core processor has four CPUs. Today's desktop computers have processors that can execute billions of instructions per second. g) free. The function should output the tree row-by-row with the top of the tree at the left of the screen and the bottom of the tree toward the right of the screen. Making this information available to health care providers across a secure network improves patient care, reduces the probability of error and increases overall efficiency of the health care system. Function free is used to free the memory pointed to by tempPtr. 10.15 | Operator precedence and associativity. (a) (b) *topPtr 12 7 11 12 7 11 *topPtr tempPtr Fig. The field of cryptography is concerned with coding data to make it difficult (and hopefully—with the most advanced schemes—impossible) for unauthorized users to read. Consider the following macro definition with one argument for the area of a circle: #define CIRCLE_AREA(x) ((PI) * (x) * (x)) Wherever CIRCLE_AREA(y) appears in the file, the value of y is substituted for x in the replacement-text, the symbolic constant PI is replaced by its value (defined previously) and the macro is expanded in the program. RoboEarth (www.roboearth.org) is "a World Wide Web for robots." It allows robots to learn from each other by sharing information and thus improving their abilities to perform tasks, navigate, recognize objects and more. A particularly important relationship that both the octal number system and the hexadecimal number system have to the binary system is that the bases of octal and hexadec- 912 Appendix C Number Systems imal (8 and 16 respectively) are powers of the base of the binary number system (base 2). C.5 Converting from Decimal to Binary, Octal or Hexadecimal The conversions in Section C.4 follow naturally from the positional notation conventions. 12.3 A queue has pointers to both its head and its tail so that nodes may be inserted at the tail and deleted from the head. Common Programming Error 12.6 Not setting the link in the last node of a queue to NULL can lead to runtime errors. e) bitwise inclusive OR (|). This can be done programmatically by randomly picking a cell to empty, then emptying its "reflecting cell." For example, if you empty the top-left cell s[1][1], you might empty the bottomleft cell s[9][1] as well. 1.8 C++ and Other C-Based Languages 13 Performance Tip 1.2 Using Standard C library functions instead of writing your own comparable versions can improve program performance, because these functions are carefully written to perform efficiently. It rapidly became clear that communicating quickly and easily via electronic mail was the key early benefit of the ARPANET. d) Member firstName of the structure pointed to by customerPtr. b) False. Although C How to Program, Seventh Edition is a generic C textbook (written independently of the details of any particular operating system), we concentrate in this section on a typical Linux-based C system. Fig. This time the application displays "Too low. 1.27 | Entering a second guess and receiving feedback. Write a program that converts an ordinary infix arithmetic expression (assume a valid expression is entered) with single-digit integers such as (6 + 2) * 5 - 8 / 4 to a postfix expression. 1.10.7 Standard Input, Standard Output and Standard Error Streams Most C programs input and/or output data. C.13 Convert decimal 177 to binary, to octal and to hexadecimal. The # operator must be used in a macro with arguments, because the operand of # must be an argument of the macro. 12.14) performs queue manipulations. 12.20) creates a binary search tree and traverses it three ways—inorder, preorder and postorder. The constant must be an integer between 0 and the total number of bits used to store an int on your system, inclusive. After you perform the test drive for your platform, you can try the randomized version of the game, which we've provided with each test drive's version of the example in a subfolder named randomized_version. 12.11 (Palindrome Tester) Write a program that uses a stack to determine whether a string is a palindrome (i.e., the string is spelled identically backward and forward). C.4 Converting from Binary, Octal or Hexadecimal to Decimal We're accustomed to working in decimal, and therefore it's often convenient to convert a binary, octal, or hexadecimal number to decimal to get a sense of what the number is "really" worth. C.7 Convert hexadecimal FACE to binary. 1.29) so you can make your first guess in the new game. Display error messages during conditional compilation. If your guess is not correct, the application indicates whether your guess is higher or lower than the correct number. To unpack characters from a four-byte unsigned int, combine the unsigned int with the mask 4278190080 (11111111 00000000 00000000 00000000) and right shift the result 8 bits. Dr. Harvey Deitel, Chairman and Chief Strategy Officer of Deitel & Associates, Inc., has 50 years of experience in the computer field. i) Member address of member personal of structure customerRecord. As we'll see, binary numbers tend to be much longer than their decimal equivalents. The binary number system has only two digits, namely 0 and 1. 12.16 | dequeue A D N operation. C.2 | Comparing the binary, octal, decimal and hexadecimal number systems. • Each number system uses positional notation—each position in which a digit is written has a different positional value. What happens when you run this program? 27 100 ... (Part 1 of 2.) 497 498 Chapter 12 C Data Structures ? C.15 What is the result when a number and its two's complement are added to each other? c) Member firstName of structure customerRecord. 387 Too high. Editorial Director: Marcia J. Entering additional guesses. Both forms of redirection can be accomplished without using the file-processing capabilities of the standard library. The formula for the volume of a sphere is (4.0 / 3) * π * r3 where π is 3.14159. We emphasize on-screen components in the bold Helvetica font (e.g., the File menu) and C program text in the Lucida font (for example, int x = 5;). Other Sudoku Solution Strategies There are a number of other Sudoku solution strategies. Inline member functions, for example, should be in a header, so that when the compiler compiles a client, the client can include the inline function definition in place. 12.12 | Queue graphical representation. Berners-Lee called his invention the HyperText Markup Language (HTML). 1.13), so you can make your first guess in the new game. • Queues represent waiting lines; insertions are made at the back (also referred to as the tail) of a queue and deletions are made from the front (also referred to as the head) of a queue. Playing the game again or exiting the application. The number of possibilities (981) is so vast that you might say it's not worth trying. He has extensive college teaching experience, including earning tenure and serving as the Chairman of the Computer Science Department at Boston College before founding Deitel & Associates, Inc., in 1991 with his son, Paul Deitel. In a macro with arguments, the arguments are substituted in the replacement text, then the macro is expanded—i.e., the replacement-text replaces the identifier and argument list in the program. Figure 14.2 demonstrates function average (lines 25–40) that receives a variable number of arguments. A macro that's invoked before the arguments of a variable-length argument list can be accessed. Objects may communicate with one another, but nor- 16 Chapter 1 Introduction to Computers, the Internet and the Web mally they're not allowed to know how other objects are implemented—implementation details are hidden within the objects themselves. dot operator 409 . Internally, computers use the binary (base 2) number system. C.6 | Positional values in the hexadecimal number system. It became clear that a standard version of C was needed. We begin our presentation of sorting with a simple algorithm in Chapter 6— in Appendix E, we present a deeper look. These are: edit, preprocess, compile, link, load and execute. i) The directive inserts a file in another file. Enterprise systems companies, such as IBM, Oracle and many others, have made significant investments in Linux open-source development. Jobs returned to Apple in 1996 when Apple bought NeXT. Encapsulation Classes encapsulate (i.e., wrap) attributes and methods into objects—an object's attributes and methods are intimately related. Your program should work for squares of all side sizes between 1 and 20. When you free dynamically allocated memory, you should immediately assign the pointer either NULL or a valid address. This means that when searching a (tightly packed) 1000-element binary search tree, no more than 10 comparisons need to be made because 210 > 1000. The pedal hides from the driver the complex mechanisms that actually make the car go faster, just as the brake pedal hides the mechanisms that slow the car, and the steering wheel hides the mechanisms that turn the car. When the program is recompiled, all occurrences of the constant in the program will be modified accordingly. Zynga—creator of popular online games such as Farmville and Mafia Wars—was founded in 2007 and already has over 200 million monthly users. The constant representing the width must be an integer between 0 and the total number of bits used to store an int on your system, inclusive. If the queue is empty (line 91), assign newPtr to *headPtr (line 92), because the new node will be both the head and tail of the queue; otherwise, assign pointer 12.6 Queues 499 to (*tailPtr)->nextPtr (line 95), because the new node will be placed after the previous tail node. Thus, we first write: Positional values: 4096 256 16 1 Then we discard the column with positional value 4096, yielding: Positional values: 256 16 1 Next we work from the leftmost column to the right. All the data is transmitted as four-digit integers. The queue is: C --> NULL ? 1.16. Secure C Programming Sections. The function should take as arguments a pointer to the root node of the binary tree and a search key to be located. Reuse also helps you build more reliable and effective systems, because existing classes and components often have gone through extensive testing, debugging and performance tuning. In this case, the conditionally compiled statement should be enclosed in a compound statement, so that when the program is compiled with debugging statements, the flow of control of the program is not altered. Most people are familiar with the exciting tasks that computers perform. • A node with no children is called a leaf node. 12.8 | A simple stack program. At the prompt, entering 1 causes the application to choose a new number and displays the message "Please type your first guess." followed by a question-mark prompt (Fig. An interpreted program can begin executing as soon as it's downloaded to the client's machine, without needing to be compiled before it can execute. A "Keep Your Options Open" Sudoku-Solving Heuristic Let's develop a "keep your options open" heuristic for solving Sudokus. (Part 2 of 3.) 12.5 Stacks 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 *topPtr = (*topPtr)->nextPtr; free(tempPtr); return popValue; } // end function pop // print the stack void printStack(StackNodePtr currentPtr) { // if stack is empty if (currentPtr == NULL) { puts("The stack is empty."); } // end if else { puts("The stack is:"); // while not the end of the stack while (currentPtr != NULL) { printf("%d --> ", currentPtr->data); currentPtr = currentPtr->nextPtr; } // end while puts("NULL"); } // end else } // end function printList // return 1 if the stack is empty, 0 otherwise int isEmpty(StackNodePtr topPtr) { return topPtr == NULL; } // end function isEmpty Fig. 6. You'll write programs in this new high-level language, compile them on the compiler you build and run them on the simulator you built in Exercise 7.28. Updated Coverage of C++ and Object-Oriented Programming. The application displays "Please type your first guess.", then displays a question mark (?) as a prompt on the next line (Fig. 1.28) by entering values until you guess the correct number. (Part 1 of 2.) 14 Chapter 1 Programming language PHP JavaScript Introduction to Computers, the Internet and the Web Description PHP—an object-oriented, open-source (see Section 1.12) scripting language based on C and supported by a community of users and developers—is used by many websites including Wikipedia and Facebook. 2) While '\0' has not been encountered, read the expression from left to right. C.12 Convert hexadecimal EFD4 to decimal. 10.8 (Using Unions) Create union integer with members char c, short s, int i and long b. va_start va_arg va_end Fig. Under Applications in the Spotlight Search results, select Terminal to open a Terminal window. 1.12.3 Apple's Mac OS X; Apple's iOS for iPhone®, iPad® and iPod Touch® Devices Apple, founded in 1976 by Steve Jobs and Steve Wozniak, quickly became a leader in personal computing. C.8. C.5 Converting from Decimal to Binary, Octal or Hexadecimal 913 Converting a binary number to decimal Postional values: Symbol values: Products: Sum: 32 16 8 4 2 1 1 1 0 1 0 1 1*32=32 1*16=16 0*8=0 1*4=4 0*2=0 1*1=1 = 32 + 16 + 0 + 4 + 0 + 1 = 53 Fig. E-mail messages go through a mail server that also stores the messages. This is a macro definition with two arguments for the area of a rectangle: #define RECTANGLE_AREA(x, y) ((x) * (y)) Wherever RECTANGLE_AREA(x, y) appears in the program, the values of x and y are substituted in the macro replacement text and the macro is expanded in place of the macro name. D.2 Deitel Sudoku Resource Center Check out our Sudoku Resource Center at www.deitel.com/sudoku. F Intro to the New C Standard E Sorting: A Deeper Look Teaching Approach C++ Chapter Dependency Chart xxiii Object-Based Programming 15 C++ as a Better C; Intro to Object Technology [Note: Arrows pointing into a chapter indicate that chapter's dependencies.] 16 Intro to Classes and Objects 17 Classes: A Deeper Look, Part 1 18 Classes: A Deeper Look, Part 2 19 Operator Overloading Object-Oriented Programming 20 OOP: Inheritance 21 OOP: Polymorphism 22 Templates 23 Stream Input/Output 24 Exception Handling Fig. 12.22. In this chapter, repetition is considered in greater detail, and additional repetition control statements, namely the for and the do...while, are presented. The value of each enumeration constant of an enumeration can be set explicitly in the definition by assigning a value to the identifier. Exercises 10.5 Provide the definition for each of the following structures and unions: a) Structure inventory containing character array partName[30], integer partNumber, floating-point price, integer stock and integer reorder. A company might have many employees and a payroll record for each one. C.11 Decimal 7+1*8+3*64=7+8+192=207. After the value in a given node is processed, the values in the left subtree are processed, then the values in the right subtree are processed. C Number Systems Here are only numbers ratified. A class is similar in concept to a car's engineering drawings, which house the design of an accelerator pedal, steering wheel, and so on. 1.9). The insert and remove operations are known as enqueue and dequeue, respectively. An assertion may be used to test the value of x and print an error message if the value of x is incorrect. Apple's proprietary operating system, iOS, is derived from Apple's Mac OS X and is used in the iPhone, iPad and iPod Touch devices. The pop operation consists of five steps: 1. Waa-hoo! —Zane Grey It is quite a three-pipe problem. Otherwise, if the current character is an operator, Pop the two top elements of the stack into variables x and y. Summary 507 Section 12.3 Dynamic Memory Allocation • Creating and maintaining dynamic data structures require dynamic memory allocation. k) #. (Part 2 of 4.) class represents an employee who receives a base 20.4 Relationship between Base Classes and Derived Classes 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 755 else throw invalid_argument("Gross sales must be >= 0.0"); } // end function setGrossSales // return gross sales amount double BasePlusCommissionEmployee::getGrossSales() const { return grossSales; } // end function getGrossSales // set commission rate void BasePlusCommissionEmployee::setCommissionRate(double rate) { if (rate > 0.0 && rate < 1.0) commissionRate = rate; else throw invalid_argument("Commission rate must be > 0.0 and < 1.0"); } // end function setCommissionRate // return commission rate double BasePlusCommissionEmployee::getCommissionRate() const { return commissionRate; } // end function getCommissionRate // set base salary void BasePlusCommissionEmployee::setBaseSalary(double salary) { if (salary >= 0.0) baseSalary = salary; else throw invalid_argument("Salary must be >= 0.0"); } // end function setBaseSalary // return base salary double BasePlusCommissionEmployee::getBaseSalary() const { return baseSalary; } // end function getBaseSalary // calculate earnings double BasePlusCommissionEmployee::earnings() const { return baseSalary + (commissionRate * grossSales); } // end function earnings // print BasePlusCommissionEmployee object void BasePlusCommissionEmployee::print() const { cout = 0.0"); } // end function setWeeklySalary // return salary double SalariedEmployee::getWeeklySalary() const { return weeklySalary; } // end function getWeeklySalary // calculate earnings; // override pure virtual function earnings in Employee double SalariedEmployee::earnings() const { Fig. All the programming exercises are titled to help instructors tune assignments for their classes. You can search, sort and manipulate the data based on its relationship to multiple tables or databases. The expression should be cPtr->face or (*cPtr).face Exercises 437 b) The array subscript has been omitted. e) False. QA76.73.C15D44 2012 005.13'3--dc23 2011051087 10 9 8 7 6 5 4 3 2 1 ISBN-10: 0-13-299044-X ISBN-13: 978-0-13-299044-8 In Memory of Dennis Ritchie, creator of the C programming language and co-creator of the UNIX operating system. For example, the binary tree illustrated in Fig. 12.5 Stacks (a) 493 *topPtr 7 11 newPtr 12 (b) *topPtr 7 11 newPtr 12 Fig. A bit field is declared by following an unsigned int or int member name with a colon (:) and an integer constant representing the width of the field (i.e., the number of bits in which the member is stored). By the late 1970s, C had evolved into what's now referred to as "traditional C." The publication in 1978 of Kernighan and Ritchie's book, The C Programming Language, drew wide attention to the language. Microsoft supports only a limited subset of the features that were added to C in C99 and C11—primarily the features that are also required by the C++ standard. • On most systems, a sequence of 8 bits form a byte—the standard storage unit for a variable of type char. Suppose that a row, column or 3×3 grid contains the possibles lists 5789, 259 and 13789, and that no other cell in that row, column or 3×3 grid mentions 5, 7 or 9. 437 Too high. D.1, row 1, column 1, and the 3×3 grid in the upper-left corner of the board each contain the digits 1 through 9 once and only once. Each of these positions is a power of the base (base 10) and these powers begin at 0 and increase by 1 as we move left in the number (Fig. (Part 1 of 2.) 428 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 Chapter 10 C Structures, Unions, Bit Manipulation and Enumerations // loop through wDeck for (i = 0; i < CARDS; ++i) { wDeck[i].face = i % (CARDS / 4); wDeck[i].suit = i / (CARDS / 4); wDeck[i].color = i / (CARDS / 2); } // end for } // end function fillDeck // output cards in two-column format; cards 0-25 subscripted with // k1 (column 1); cards 26-51 subscripted with k2 (column 2) void deal(const Card * const wDeck) { size_t k1; // subscripts 0-25 size_t k2; // subscripts 26-51 // loop through wDeck for (k1 = 0, k2 = k1 + 26; k1 < CARDS / 2; ++k1, ++k2) { printf("Card:%3d Suit:%2d Color:%2d ", wDeck[k1].face, wDeck[k1].suit, wDeck[k1].color); printf("Card:%3d Suit:%2d Color:%2d", wDeck[k2].face, wDeck[k2].suit, wDeck[k2].color); } // end for } // end function deal Fig. Use pointer currentPtr and pointer tempPtr to walk along the list and free memory, respectively. Figure 12.13 (output in Fig. ■ The purpose of the C Standard Library. The key to getting a result of all zeros is that the twos complement is one more than the one's complement. O'Reilly, "What is Web 2.0: Design Patterns and Business Models for the Next Generation of Software." September 2005 . f) Member customerNumber of the structure pointed to by customerPtr. We've also posted a Secure C Programming Resource Center at www.deitel.com/SecureC/. This reverses the bits of the value. Titled Programming Exercises. Popular mobile operating systems used in smartphones and tablets include Google's Android, Apple's iOS (for iPhone, iPad and iPod Touch devices), BlackBerry OS and Windows Phone 7. This packet-switching technique greatly reduced transmission costs, as compared with the cost of dedicated communications lines. ■ The history of the C programming language. Continue to play the game by entering values until you guess the correct number. —Benjamin Franklin Every advantage in the past is judged in the light of the final issue. newPtr->nextPtr = currentPtr; previousPtr->nextPtr = newPtr; To insert "Pritchard": previousPtr points to the node containing "Jones" currentPtr points to the node containing "Smith" newPtr->nextPtr = currentPtr; previousPtr->nextPtr = newPtr; d) currentPtr = startPtr; while (currentPtr != NULL) { printf("Lastname = %sGrade = %6.2f", currentPtr->lastName, currentPtr->grade); currentPtr = currentPtr->nextPtr; } e) currentPtr = startPtr; while (currentPtr != NULL) {

tempPtr = currentPtr; currentPtr = currentPtr->nextPtr; free(tempPtr); } startPtr = NULL; 12.5 The inorder traversal is: 11 18 19 28 32 40 44 49 69 71 72 83 92 97 99 The preorder traversal is: 49 28 18 11 19 40 32 44 83 71 69 72 97 92 99 The postorder traversal is: 11 19 18 32 44 40 28 69 72 71 92 99 97 83 49 Exercises 12.6 (Concatenating Lists) Write a program that concatenates two linked lists of characters. Get great beginner's resources—learn the rules of Sudoku, receive hints on solving sample puzzles, learn the best solution strategies and get free Sudoku solvers—just type in the puzzle from your newspaper or favorite Sudoku site and get an immediate solution; some Sudoku solvers even provide detailed step-by-step explanations. 13.10 (Totaling an Array's Contents) Write a program that defines and uses macro SUMARRAY to sum the values in a numeric array. m) left-shift operator (). Open-source code is often scrutinized by a much larger audience than proprietary software, so errors often get removed faster. l) root. Each row is output vertically. However, nodes in a stack may be inserted only at the top of the stack and removed only from the top of a stack. There's no limit on the number of guesses you can make but you should be able to guess any of the numbers in this range correctly in 10 or fewer tries. Each chapter concludes with a substantial set of exercises including: • simple recall of important terminology and concepts • identifying the errors in code samples • writing individual program statements • writing small portions of C functions and C++ member functions and classes • writing complete programs • implementing major projects Index. 518 Chapter 13 C Preprocessor 13.1 Introduction 13.2 #include Preprocessor Directive 13.3 #define Preprocessor Directive: Symbolic Constants 13.4 #define Preprocessor Directive: Macros 13.5 Conditional Compilation 13.6 #error and #pragma Preprocessor Directives 13.7 13.8 13.9 13.10 13.11 # and ## Operators Line Numbers Predefined Symbolic Constants Assertions Secure C Programming Summary | Terminology | Self-Review Exercises | Answers to Self-Review Exercises | Exercises 13.1 Introduction The C preprocessor executes before a program is compiled. A header containing declarations common to the separate program files is often created and included in the file. ... The network operated with a technique called packet switching, in which digital data was sent in small bundles called packets. Then reevaluate the board, enumerating the remaining possibilities for each cell. The directive #line 100 starts line numbering from 100 beginning with the next source code line. If the two's complement of value is actually the negative of value, then adding the two's complement of value to a should produce the result 14. Avoid "reinventing the wheel." Instead, use existing pieces—this is called software reuse. h) queue. 1.11.2 Running a C Application Using GNU C with Linux For this test drive, we assume that you know how to copy the examples into your home directory. A node can be inserted only as a leaf node in a binary search tree. We call that value 5 a singleton. For example, if your program reads a size of 5, it should print ***** * * * * * * ***** 112 Chapter 3 Structured Program Development in C 3.34 (Palindrome Tester) A palindrome is a number or a text phrase that reads the same backward as forward. Obviously, the rates need to be balanced. d) Renumber the remaining lines in the file beginning with line number 3000. C Program Control 4.1 Introduction 4.1 4.2 4.3 4.4 4.5 Introduction Repetition Essentials Counter-Controlled Repetition for Repetition Statement for Statement: Notes and Observations 4.6 Examples Using the for Statement 4.7 switch Multiple-Selection Statement 4.8 4.9 4.10 4.11 115 do...while Repetition Statement break and continue Statements Logical Operators Confusing Equality (==) and Assignment (=) Operators 4.12 Structured Programming Summary 4.13 Secure C Programming Summary | Terminology | Self-Review Exercises | Answers to Self-Review Exercises | Exercises | Making a Difference 4.1 Introduction You should now be comfortable with writing simple, complete C programs. k) Member city of member personal of structure customerRecord. C.17 Complete the following chart of positional values for the rightmost four positions in each of the indicated number systems: decimal base 6 base 13 base 3 1000 ... Consider the following preprocessor code: #if !defined(MY_CONSTANT) #define MY_CONSTANT 0 #endif which determines whether MY_CONSTANT is defined—that is, whether MY_CONSTANT has already appeared in an earlier #define directive. Assign *topPtr to tempPtr (line 99); tempPtr will be used to free the unneeded memory. The chapter discusses logical operators used for combining conditions, and summarizes the principles of structured programming as presented in Chapters 3 and 4. 1.12.4 Google's Android Android—the fastest growing mobile and smartphone operating system—is based on the Linux kernel and Java. This is one of many examples of the kinds of space–time trade-offs that occur in computer science. 375 Too low. Thus, the duplicate will eventually be compared with a node in the tree containing the same value. Please type (1=yes, 2=no)? We place the key terms and the index's page reference for each defining occurrence in bold blue text for easy reference. C.9 Convert hexadecimal 4FEC to octal. We've discussed two means of repetition: 1. Thus 4, 6 and 7 can be removed from all the other possibles lists in that row, column or 3×3 grid. ARPA accomplished this with the development of IP—the Internet Protocol, truly creating a network of networks, the current architecture of the Internet. Close the Command Prompt window. 2 The stack is empty. No memory available.", value); } // end else } // end if else { // tree is not empty // data to insert is less than data in current node if (value < (*treePtr)->data) { insertNode(&((*treePtr)->leftPtr), value); } // end if Fig. • C also provides functions calloc and realloc for creating and modifying dynamic arrays. D.2 must be 6. CERT—the Computer Emergency Response Team—publishes and promotes secure coding standards to help C programmers and others implement industrial-strength systems that avoid the programming practices that open systems to attacks. 1 Enter an integer: 4 The stack is: 4 --> 6 --> 5 --> NULL Fig. Figure 12.15 illustrates an enqueue operation. 1.19 | Entering a second guess and receiving feedback. 10.11 (Left Shifting Integers) Left shifting an unsigned int by 1 bit is equivalent to multiplying the value by 2. Instructors may obtain access only through their Pearson representatives. The following discussion explains the typical C development environment shown in Fig. The lowest digit is 0 and the highest digit is 9—one less than the base of 10. C (Computer program language) 2. Examples of secondary storage devices include CD drives, DVD drives and flash drives, some of which can hold up to 512 GB. The value 1 if the compiler supports Standard C. Solutions are not provided for "project" exercises. D.3, you have to pick up hints from row 1 (i.e., the digits 3, 6 and 9 are taken), column 7 (i.e., the digits 4, 7 and 1 are taken) and the upper-right 3×3 grid (i.e., the digits 9, 8, 4 and 2 are taken). Each algorithm uses a stack in support of its operation, and in each the stack is used for a different purpose. A macro that facilitates a normal return from a function whose variablelength argument list was referred to by the va_start macro. section discusses binary trees (Fig. (Part 2 of 2.) 1.4 Data Hierarchy Data items processed by computers form a data hierarchy that becomes larger and more complex in structure as we progress from bits to characters to fields, and so on. These embedded systems include navigation systems, smart home appliances, home security systems, smartphones, robots, intelligent traffic intersections and more. If the parentheses in the macro definition are omitted, the macro expansion is area = 3.14159 * c + 2 * c + 2; which evaluates incorrectly as area = (3.14159 * c) + (2 * c) + 2; because of the rules of operator precedence. To open a Terminal window, click the Spotlight Search icon in the upper-right corner of your screen, then type Terminal to locate the Terminal application. The lowest digit in any base is zero. 385 Too high. worldwide, visit: www.deitel.com/training/ or write to For continuing updates on Prentice Hall/Deitel publications visit: www.deitel.com www.pearsonhighered.com/deitel/ Visit the Deitel Resource Centers that will help you master programming languages, software development, Android and iPhone/iPad app development, and Internet- and web-related topics: www.deitel.com/ResourceCenters.html Paul Deitel Deitel & Associates, Inc. Each link in the root node refers to a child. The ISVs provide in their products only the headers and the object modules. Each bankaccount object knows the balance in the account it represents, but not the balances of the other accounts in the bank. Focus on Performance Issues. Each message is implemented as a method call that tells a method of the object to perform its task. 1.6 The C Programming Language Application Description Operating systems C's portability and performance make it desirable for implementing operating systems, such as Linux and portions of Microsoft's Windows and Google's Android. In the late 1960s, ARPA (the Advanced Research Projects Agency) rolled out blueprints for networking the main computer systems of about a dozen ARPA-funded universities and research institutions. Then, we'll suggest how to empty some cells to create puzzles that people can attempt. JavaScript—developed by Netscape—is the most widely used scripting language. As with symbolic constants, the macro-identifier is replaced in the program with the replacement-text before the program is compiled. Microsoft's three primary object-oriented programming languages are Visual Basic, Visual C++ (based on C++) and C# (based on C++ and Java, and developed for integrating the Internet and the web into computer applications). 1.11.3 Running a C Application Using GNU C with Mac OS X For the figures in this section, we use a bold font to point out the user input required by each step. 12.19 | Creating and traversing a binary tree. Windows 7 is Microsoft's latest operating system—its features include enhancements to the user interface, faster startup times, further refinement of security features, touch-screen and multitouch support, and more. When a token is found, create a new node for the tree, assign the pointer returned by strtok to member string of the new node, and insert the node in the tree.] 12.18 (Duplicate Elimination) We've seen that duplicate elimination is straightforward when creating a binary search tree. See if you can determine how this relationship makes it convenient to abbreviate binary numbers in octal or hexadecimal. Values in an enum start with 0, unless specified otherwise, and are incremented by 1. Mr. Seacord, a technical reviewer for the C portion of this book, provided specific recommendations on each of our new Secure C Programming sections. [Hint: Use the remainder and division operators to pick off the "binary" number's digits one at a time from right to left. 3.39 (Checkerboard Pattern of Asterisks) Write a program that displays the following checkerboard pattern: * Your program must use only three output statements, one of each of the following forms: printf("%s", "* "); printf("%s", " "); puts(""); // outputs a newline 3.40 (Multiples of 2 with an Infinite Loop) Write a program that keeps printing the multiples of the integer 2, namely 2, 4, 8, 16, 32, 64, and so on. The inOrder traversal of the tree in Fig. In the preceding example, all the fields belong to the same employee. The hexadecimal number FAD5 is converted to binary simply by writing the F as its 4-digit binary equivalent 1111, the A as its 4-digit binary equivalent 1010, the D as its 4digit binary equivalent 1101 and the 5 as its 4-digit binary equivalent 0101 to form the 16-digit 1111101011010101. For longer decimal numbers, the next positions to the left would be the thousands position (10 to the 3rd power), the ten-thousands position (10 to the 4th power), the hundred-thousands position (10 to the 5th power), the millions position (10 to the 6th power), the ten-millions position (10 to the 7th power) and so on. The duplicate value may simply be discarded at this point. Entries for the other users are placed in a queue. Exercises 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 // ex10_16.c // This program determines whether a value is a multiple of X. The computer's character set is the set of all the characters used to write programs and represent data items. Other forms of input include receiving voice commands, scanning images and barcodes, reading from secondary storage devices (such as hard drives, DVD drives, Blu-ray Disc™ drives and USB flash drives— also called "thumb drives" or "memory sticks"), receiving video from a webcam and having your computer receive information from the Internet (such as when you download videos from YouTube™ or ebooks from Amazon). Then, 27 is a hidden double—one of those two cells must be 2 and the other must be 7, so all digits other than 2 and 7 can be removed from the possibles lists of those D.3 Solution Strategies 923 two cells (i.e., 2467 becomes 27 and 257 becomes 27—creating a pair of doubles—thus somewhat simplifying the puzzle). 1.30 | Exiting the game. • Names for structure types are often defined with typedef to create shorter type names. C Standard Library. Some may seem unintelligent, but if they can solve Sudokus faster than any human on the planet, then perhaps they are in some sense intelligent. CourseSmart Web Books Today's students and instructors have increasing demands on their time and money. The authors and publisher of this book have used their best efforts in preparing this book. For example, if a cell contains 3578, then the cell must eventually become 3, 5, 7 or 8. We divide 8 into 9 and observe that there is one 8 in 9 with a remainder of 1. Consult your instructor for information on your specific development environment. 17.5 Access Functions and Utility Functions Access functions can read or display data. Always consult a physician or qualified health care professional before beginning or modifying an exercise program.] Create a program that reads the user's birthday and the current day (each consisting of the month, day and year). C.10 | Converting a hexadecimal number to decimal. Many compilers allow you to define and undefine symbolic constants with a compiler flag so that you do not need to change the code. This is the executable image of our welcome.c program. C.3 Fewer. 10.16 to shuffle the cards using a high-performance shuffle (as shown in Fig. c) Assume that the list pointed to by startPtr currently consists of 2 nodes—one containing "Jones" and one containing "Smith". This "shipping" section takes information that the computer has processed and places it on various output devices to make it available for use outside the computer. Name Description Electronic health records These might include a patient's medical history, prescriptions, immunizations, lab results, allergies, insurance information and more. The combined set of protocols is now commonly called TCP/IP. The identifiers for each of the predefined symbolic constants begin and end with two underscores. D Game Programming: Solving Sudoku D.1 Introduction The game of Sudoku exploded in popularity worldwide in 2005. To understand how to work with numbers represented in the binary, octal and hexadecimal number systems To be able to abbreviate binary numbers as octal numbers or hexadecimal numbers. Function push creates a new node and places it on top of the stack. Programming a Solution for Harder Sudokus For harder Sudokus, your program will eventually reach a point where it still has uncommitted cells with possibles lists, and none of the simple strategies we've discussed will work. Write a separate application that inputs an encrypted four-digit integer and decrypts it (by reversing the encryption scheme) to form the original number. If the filename is enclosed in quotes, the preprocessor starts searches in the same directory as the file being compiled for the file to be included. We use this technique extensively in the C++ part of this book. The application will display "Excellent! You guessed the number!" (Fig. Nested for statements can handle this automatically. Hexadecimal does this. Section 13.6 #error and #pragma Preprocessor Directives • The #error directive prints an implementation-dependent message that includes the tokens specified in the directive. The CPU tells the input unit when information should be read into the memory unit, tells the ALU when information from the memory unit should be used in calculations and tells the output unit when to send information from the memory unit to certain output devices. For more information, visit www.pearsoned.com/professional/index.htm. Preprocessor directives begin with # and only whitespace characters and comments may appear before a preprocessor directive on a line. The preceding structure definition indicates that member face is stored in 4 bits, member suit is stored in 2 bits and member color is stored in 1 bit. Answers to Self-Review Exercises 13.1 a) #. • Function free deallocates memory so that the memory can be reallocated in the future. PHP also supports many databases, including MySQL. A macro that expands to the value of the next argument in the variablelength argument list—the value has the type specified as the macro's second argument. [Note: The programs in this book will run with little or no modification on most current C systems, including Microsoft Windows-based systems.] If you're not using a Linux system, refer to the documentation for your system or ask your instructor how to accomplish these tasks in your environment. For example, #ifdef DEBUG printf("Variable x = %d", x); #endif causes a printf statement to be compiled in the program if the symbolic constant DEBUG has been defined (#define DEBUG) before directive #ifdef DEBUG. Java (Computer program language) I. C.9. Converting an octal number to decimal Positional values: Symbol values: Products Sum: 512 64 8 1 7 6 1 4 7*512=3584 6*64=384 1*8=8 4*1=4 = 3584 + 384 + 8 + 4 = 3980 Fig. Performing a task in a program requires a method. Standardization The rapid expansion of C over various types of computers (sometimes called hardware platforms) led to many variations that were similar but often incompatible. 12.3 What are the differences between a stack and a queue? d) members. 13.7 # and ## Operators 523 13.7 # and ## Operators The # and ## preprocessor operators are available in Standard C. C.2 Abbreviating Binary Numbers as Octal and Hexadecimal Numbers The main use for octal and hexadecimal numbers in computing is for abbreviating lengthy binary representations. Nonfatal errors allow programs to run to completion, often producing incorrect results. Here the empty cell s[1][7] must be 5—the only number not already mentioned in row 1, column 7 or the upper-right 3×3 grid. A binary search tree (with no duplicate node values) has the characteristic that the values in any left subtree are less than the value in its parent node, and the values in any right subtree are greater than the value in its parent node. You can program the strategies then iterate on them until all 81 squares are filled.); // prototype int main({ double double double double value) w x y z = = = = 37.5; 22.5; 1.7; 10.2; printf("%s%.1f%s%.1f%s%.1f%s%.1f", "w = ", w, "x = ", x, "y = ", y, "z = ", z); printf("%s%.3f%s%.3f%s%.3f", "The average of w and x is ", average(2, w, x), "The average of w, x, and y is ", average(3, w, x, y), "The average of w, x, y, and z is ", average(4, w, x, y, z)); } // end main // calculate average double average(int i, ... Many of the designations by manufacturers and sellers to distinguish their products are claimed as trademarks. It's programmable, so it gives us a way to direct a computer to attempt to solve a problem. Software packages for the C/C++ integrated program development environments such as Eclipse and Microsoft Visual Studio have editors that are integrated into the programming environment. ■ To test-drive a C application in Windows, Linux and Mac OS X. —Henry David Thoreau He had a wonderful talent for packing thought close, and rendering it portable. 1.25). Queues have many applications in computer systems. Use pointer currentPtr to move along the list. Of those that do, most implement only a subset of the new features. C.2 Abbreviating Binary Numbers as Octal and Hexadecimal Numbers 911 Positional values in the hexadecimal number system Decimal digit Position name 3 D A Two-hundredand-fifty-sixes Sixteens Ones Positional value Positional value as a power of the base (16) 256 162 16 1 161 160 Fig. Scripting languages such as JavaScript and PHP are processed by interpreters. // Member functions defined in SalesPerson.cpp. Macro CIRCLE_AREA could be defined more safely as a function. 825 Too high. We appreciate the guidance, savvy and energy of Michael Hirsch, Editor-inChief of Computer Science. The program should input the value from the user and call function reverseBits to print the bits in reverse order. Medical imaging X-ray computed tomography (CT) scans, also called CAT (computerized axial tomography) scans, take X-rays of the body from hundreds of different angles. The sentinel value indicates "end of data." The sentinel is entered after all regular data items have been supplied to the program. TCP/IP The protocol (i.e., set of rules) for communicating over the ARPANET became known as TCP—the Transmission Control Protocol. As of June 2011, more than 500,000 Android smartphones were being activated each day!1 Android smartphones are now outselling iPhones in the United States.2 The Android operating system is used in numerous smartphones (such as the Motorola Droid, HTC EVO™ 4G, Samsung Vibrant™ and many more), e-reader devices (such as the Barnes and Noble Nook™), tablet computers (such as the Dell Streak and the Samsung Galaxy Tab), instore touch-screen kiosks, cars, robots, multimedia players and more. Sentinel-controlled repetition Counter-controlled repetition is sometimes called definite repetition because we know in advance exactly how many times the loop will be executed. 1.8 C++ and Other C-Based Languages C++ was developed by Bjarne Stroustrup at Bell Laboratories. For example, a program might call a particular bank-account object's deposit method to increase the account's balance. 12.9 | Sample output from the program of Fig. Terminology binary search tree 501 binary tree 477, 500 binary tree sort 504 child 500 dequeue function of a queue 494 double indirection (pointer to a pointer) 485 duplicate elimination 505 dynamic data structure 477 dynamic memory allocation 478 enqueue function of a queue 494 first-in, first-out (FIFO) 494 free function 478 head of a queue 477 infix notation 512 inorder 501 last-in-first-out (LIFO) 488 leaf node 500 left child 500 left subtree 500 level order binary tree traversal 515 linear data structures 500 link 479 Self-Review Exercises link (pointer in a self-referential structure) 478 linked list 477, 479 malloc function 478 node 479 NULL pointer 478 parent node 501 pointer to pointer (double indirection) 485 postfix notation 512 postorder 501 predicate function 485 preorder 501 509 queue 477, 494 right child 500 right subtree 500 root node of a binary tree 500 self-referential structure 478 sibling 500 stack 477, 488 tail of a queue 477 top of a stack 477 tree 500 Self-Review Exercises 12.1 Fill in the blanks in each of the following: a) A selfstructure is used to form dynamic data structures. For each possible placement for each empty cell, associate with that placement the count that would characterize the state of the board after that placement. The list is empty. • The primary functions used to manipulate a stack are push and pop. When searching a (tightly packed) 1,000,000-element binary search tree, no more than 20 comparisons need to be made because 220 > 1,000,000. Level Description Bits The smallest data item in a computer can assume the value 0 or the value 1. We use C's two-dimensional array row and column-numbering conventions, but we're ignoring row 0 and column 0 in conformance with Sudoku community conventions. 1 1 2 3 4 5 6 7 8 9 2 9 3 1 8 7 _ 5 4 2 3 4 5 6 7 8 9 Fig. Files A file is a group of related records. If the filename is enclosed in angle brackets (< and >)—used for standard library headers—the search is performed in an implementation-dependent manner, normally through predesignated compiler and system directories. 14.2: fig14_02.c // Using variable-length argument lists #include #include double average(int i, ... Hypertext Transfer Protocol Secure (HTTPS) is the standard for transferring encrypted data on the web. 12.19: fig12_19.c // Creating and traversing a binary tree // preorder, inorder, and postorder #include #include #include // self-referential structure struct treeNode { struct treeNode *leftPtr; // pointer to left subtree int data; // node value struct treeNode *rightPtr; // pointer to right subtree }; // end structure treeNode typedef struct treeNode TreeNode; // synonym for struct treeNode typedef TreeNode *TreeNodePtr; // synonym for TreeNode* // prototypes void insertNode(TreeNodePtr *treePtr, int value); void inOrder(TreeNodePtr treePtr); void preOrder(TreeNodePtr treePtr); void postOrder(TreeNodePtr treePtr); Fig. We then demonstrated separating this code into two files—a header for the class definition (i.e., the class's interface) and a source code file for the class's member-function definitions (i.e., the class's implementation). If the code contains multiline comments, /* and */ cannot be used to accomplish this task, because such comments cannot be nested. • A NULL pointer normally indicates the end of a data structure. • Multiple-part conditional preprocessor constructs may be tested with directives #elif and #else. As you study C++, check out our online C++ Resource Center at www.deitel.com/cplusplus/. Digits, letters and special symbols are known as characters. GPS is used in numerous location-based Internet services such as check-in apps to help you find your friends (e.g., Foursquare and Facebook), exercise apps such as RunKeeper that track the time, distance and average speed of your outdoor jog, dating apps that help you find a match nearby and apps that dynamically update changing traffic conditions. C How to Program, Seventh Edition, is an effective learning tool for each of these audiences. For longer octal numbers, the next positions to the left would be the five-hundredand-twelves position (8 to the 3rd power), the four-thousand-and-ninety-sixes position (8 to the 4th power), the thirty-two-thousand-seven-hundred-and-sixty-eights position (8 to the 5th power) and so on. The hexadecimal number system poses a problem because it requires 16 digits—a lowest digit of 0 and a highest digit with a value equivalent to decimal 15 (one less than the base of 16). Figure 1.3 8 Chapter 1 Introduction to Computers, the Internet and the Web illustrates a portion of the data hierarchy. Directive #undef "undefines" a symbolic constant or macro name. • The conditional preprocessor directives evaluate constant integer expressions. ~$ cd examples/ch01/GuessNumber/GNU ~/examples/ch01/GuessNumber/GNU$ Fig. For example, an air-traffic-control system must constantly monitor the positions and velocities of the planes and report that information to air-traffic controllers without delay so that they can alert the planes to change course if there's a possibility of a collision. Phase 6: CPU takes each instruction and executes it, possibly storing new data values as the program executes. He and his co-author, Dr. Harvey M. • The structure member operator accesses a structure member via the structure variable name. Read the online Before You Begin section (www.deitel.com/books/chtp7/chtp7_BYB.pdf) to learn how to set up your computer to run the hundreds of code examples. • The identifiers in an enum must be unique. We place gray rectangles around the key code. Instead, they prefer to work with decimal digits (0–9), letters (A–Z and a–z), and special symbols (e.g., $, @, %, &, *, (,), –, +, ", :, ? 391 Too high. C scales nicely into the realm of enterprise systems development to help organizations build their business-critical and mission-critical information systems. Logical unit Description Input unit This "receiving" section obtains information (data and computer programs) from input devices and places it at the disposal of the other units for processing. 12.20 | Sample output from the program of Fig. We're fortunate to have worked with the dedicated team of publishing professionals at Pearson. These attributes are specified as part of the object's class. 10.3 a) struct part { unsigned int partNumber; char partName[25]; }; // end struct part b) c) d) e) f) g) 10.4 typedef struct part Part; Part a, b[10], *ptr; scanf("%d%24s", &a.partNumber, a.partName }; b[3] = a; ptr = b; printf("%d %s", (ptr + 3)->partNumber, (ptr + 3)->partName); a) The parentheses that should enclose *cPtr have been omitted, causing the order of evaluation of the expression to be incorrect. Building security into software from the start of the development cycle can greatly reduce costs and vulnerabilities. 1.15 | Changing to the GuessNumber application's directory. Write an application that inputs these values, then displays the estimated world population after one, two, three, four and five years. The loop includes statements that obtain data each time the loop is performed. • MEM31-C: Undefined behavior occurs when you attempt to use free to deallocate dynamic memory that was already deallocated—this is known as a "double free vulnerability." To ensure that you don't attempt to deallocate the same memory more than once, immediately set a pointer to NULL after the call to free—attempting to free a NULL pointer has no effect. 10.17 | Output of the program in Fig. To avoid the consequences of confusing the equality and assignment operators. Interpreter programs were developed to execute high-level language programs directly (without the need for compilation), although more slowly than compiled programs. In counter-controlled repetition, a control variable is used to count the number of repetitions. data structure because the last node inserted is the j) A stack is referred to as a(n) first node removed. We call this simply Standard C. Forming Sudoku Puzzles with Empty Cells Once you get your Sudoku generator program running, you should be able to generate lots of valid Sudokus quickly. Among the three cells containing 467, one must ultimately be 4, one must be 6, and one must be 7. A completed car has an actual accelerator pedal to make the car go faster, but even that's not enough—the car won't accelerate on its own (hopefully!), so the driver must press the pedal to accelerate the car. • The value of an enum constant can be set explicitly via assignment in the enum definition. 12.19 to use this function. using preprocessor macros, and more. Common Programming Error 13.1 Forgetting to enclose macro arguments in parentheses in the replacement text can lead to logic errors. Be sure to check out our Sudoku Resource Center (www.deitel.com/sudoku/) for numerous web resources that will help you master Sudoku and develop various approaches for writing programs to create and solve existing Sudoku puzzles. Create a new node by calling malloc and assign the location of the allocated memory to newPtr (line 80). Assume that newPtr always points to the new node, and that the new node has already been assigned the data. It's software (i.e., the instructions you write to command computers to perform actions and make decisions) that controls computers (often referred to as hardware). When we write each How to Program book, we search the corresponding language's standards document for the features that we feel novices need to learn in a first programming course, and features that existing programmers need to know to begin working in that language. Ironically, silicon is one of the most abundant materials—it's an ingredient in common sand. C.5 | Positional values in the octal number system. b) Write a program that estimates the value of the mathematical constant e by using the formula: 1- + ---1- + ---1- + ... e = 1 + ---1! 2! 3! c) Write a program that computes the value of ex by using the formula 2 3 x x- + ---x - + - --x- + ... e = 1 + ---1! 2! 3! Making a Difference 3.46 (World-Population-Growth Calculator) Use the web to determine the current world population and the annual world population growth rate. The new standard refines and expands the capabilities of C. Each of the preceding phases can fail because of various errors that we'll discuss. • Functions malloc and free, and operator sizeof, are essential to dynamic memory allocation. An example of a predicate function would be an isEmpty function for any container class—a class capable of holding many objects, like a vector. ? • To form the negative of a value in binary, first form its one's complement by applying C's bitwise complement operator (~). Almost any noun can be reasonably represented as a software object in terms of attributes (e.g., name, color and size) and behaviors (e.g., calculating, moving and communicating). 9 Fig. A company that wants to send data over the Internet has asked you to write a program that will encrypt it so that it may be transmitted more securely. We've added notes about secure C programming to many of the C programming chapters. We call 579 a hidden triple and all possibles other than 5, 7 and 9 can be deleted from those three cells (i.e., 5789 becomes 579, 259 becomes 59 and 13789 becomes 79), thus somewhat simplifying the puzzle. e) Member customerNumber of structure customerRecord. Popular desktop operating systems include Linux, Windows and Mac OS X. Information on secondary storage devices is persistent—it's preserved even when the computer's power is turned off. C supports several character sets, including 16-bit Unicode® characters Characters Fig. entering 1 causes the application to choose a new number and displays the message "Please type your first guess." followed by a question-mark prompt (Fig. For example, to redirect the output of program random to file out, use $ random > out Finally, program output can be appended to the end of an existing file by using the append output symbol (>>). D.2 | Determining the value of a cell by checking all filled-in cells in the same row. D.3 | Determining the value of a cell by checking all filled-in cells in the same row, column and 3×3 grid. 12.21 is: 6 13 17 27 33 42 48 The inOrder traversal of a binary search tree prints the node values in ascending order. Function circleArea double circleArea(double x) { return 3.14159 * x * x; } performs the same calculation as macro CIRCLE_AREA, but the function's argument is evaluated only once when the function is called. 12.22 | A 15-node binary search tree. Iteration Secure C Programming 6 C Arrays 6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9 6.10 6.11 Introduction Arrays Defining Arrays Array Examples Passing Arrays to Functions Sorting Arrays Case Study: Computing Mean, Median and Mode Using Arrays Searching Arrays Multidimensional Arrays Variable-Length Arrays Secure C Programming 7 C Pointers 7.1 7.2 7.3 7.4 7.5 Introduction Pointer Variable Definitions and Initialization Pointer Operators Passing Arguments to Functions by Reference Using the const Qualifier with Pointers 7.5.1 Converting a String to Uppercase Using a Non-Constant Pointer to Non-Constant Data ix 138 143 158 159 159 160 162 162 166 169 172 173 174 179 182 184 187 191 194 197 216 217 217 218 219 232 236 239 244 249 256 259 277 278 278 279 282 284 287 x Contents 7.5.2 7.6 7.7 7.8 7.9 7.10 7.11 7.12 7.13 Printing a String One Character at a Time Using a Non-Constant Pointer to Constant Data 7.5.3 Attempting to Modify a Constant Pointer to Non-Constant Data 7.5.4 Attempting to Modify a Constant Pointer to Constant Data Bubble Sort Using Pass-by-Reference sizeof Operator Pointer Expressions and Pointer Arithmetic Relationship between Pointers and Arrays Arrays of Pointers Case Study: Card Shuffling and Dealing Simulation Pointers to Functions Secure C Programming 8 C Characters and Strings 8.1 8.2 8.3 Introduction Fundamentals of Strings and Characters Character-Handling Library 8.3.1 Functions isdigit, isalpha, isalnum and isxdigit 8.3.2 Functions islower, isupper, tolower and toupper 8.3.3 Functions isspace, iscntrl, ispunct, isprint and isgraph String-Conversion Functions 8.4.1 Function strtod 8.4.2 Function strtol 8.4.3 Function strtoul Standard Input/Output Library Functions 8.5.1 Functions fgets and putchar 8.5.2 Function getchar 8.5.3 Function sprintf 8.5.4 Function sscanf String-Manipulation Functions of the String-Handling Library 8.6.1 Functions strcpy and strncpy 8.6.2 Functions strcat and strncat Comparison Functions of the String-Handling Library Search Functions of the String-Handling Library 8.8.1 Function strchr 8.8.2 Function strcspn 8.8.3 Function strpbrk 8.8.4 Function strrchr 8.8.5 Function strspn 8.8.6 Function strstr 8.8.7 Function strtok Memory Functions of the String-Handling Library 8.9.1 Function memcpy 8.9.2 Function memmove 8.9.3 Function memcmp 8.4 8.5 8.6 8.7 8.8 8.9 288 290 291 291 294 297 299 303 304 309 314 334 335 335 337 338 340 341 342 343 344 345 346 346 348 349 349 350 351 352 353 354 355 356 357 357 358 358 359 360 361 362 363 Contents 8.11 8.9.4 Function memchr 8.9.5 Function memset Other Functions of the String-Handling Library 8.10.1 Function strerror 8.10.2 Function strlen Secure C Programming 9 C Formatted Input/Output 9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11 9.12 Introduction Streams Formatting Output with printf Printing Integers Printing Floating-Point Numbers Printing Strings and Characters Other Conversion Specifiers Printing with Field Widths and Precision Using Flags in the printf Format Control String Printing Literals and Escape Sequences Reading Formatted Input with scanf Secure C Programming 10 C Structures, Unions, Bit Manipulation and Enumerations 8.10 10.1 10.2 10.3 10.4 10.5 10.6 10.7 10.8 10.9 Introduction Structure Definitions 10.2.1 Self-Referential Structures 10.2.2 Defining Variables of Structure Types 10.2.3 Structure Tag Names 10.2.4 Operations That Can Be Performed on Structures Initializing Structures Accessing Structure Members Using Structures with Functions typedef Example: High-Performance Card Shuffling and Dealing Simulation Unions 10.8.1 Union Declarations 10.8.2 Operations That Can Be Performed on Unions 10.8.3 Initializing Unions in Declarations 10.8.4 Demonstrating Unions Bitwise Operators 10.9.1 Displaying an Unsigned Integer in Bits 10.9.2 Making Function displayBits More Scalable and Portable 10.9.3 Using the Bitwise AND, Inclusive OR, Exclusive OR and Complement Operators xi 363 364 365 365 365 366 379 380 380 380 381 382 384 385 386 388 391 391 398 405 406 406 407 407 408 408 409 409 411 411 412 415 415 415 416 416 417 418 420 420 xii Contents 10.9.4 Using the Bitwise Left- and Right-Shift Operators 10.9.5 Bitwise Assignment Operators 10.10 Bit Fields 10.11 Enumeration Constants 10.12 Secure C Programming 11 C File Processing 11.1 11.2 11.3 11.4 11.5 11.6 11.7 11.8 11.9 11.10 Introduction Files and Streams Creating a Sequential-Access File Reading Data from a Sequential-Access File Random-Access Files Creating a Random-Access File Writing Data Randomly to a Random-Access File Reading Data from a Random-Access File Case Study: Transaction-Processing Program Secure C Programming 12 C Data Structures 12.1 12.2 12.3 12.4 12.8 Introduction Self-Referential Structures Dynamic Memory Allocation Linked Lists 12.4.1 Function insert 12.4.2 Function delete 12.4.3 Function printList Stacks 12.5.1 Function push 12.5.2 Function pop 12.5.3 Applications of Stacks Queues 12.6.1 Function enqueue 12.6.2 Function dequeue Trees 12.7.1 Function insertNode 12.7.2 Traversals: Functions inOrder, preOrder and postOrder 12.7.3 Duplicate Elimination 12.7.4 Binary Tree Search 12.7.5 Other Binary Tree Operations Secure C Programming 13 C Preprocessor 13.1 13.2 Introduction #include Preprocessor Directive 12.5 12.6 12.7 423 425 426 429 431 441 442 442 443 448 452 453 455 458 459 465 476 477 478 478 479 485 487 488 488 492 492 493 494 498 499 500 504 504 505 505 505 506 517 518 518 Contents 13.3 13.4 13.5 13.6 13.7 13.8 13.9 13.10 13.11 Preprocessor Directive: Symbolic Constants Preprocessor Directive: Macros Conditional Compilation #error and #pragma Preprocessor Directives # and ## Operators Line Numbers Predefined Symbolic Constants Assertions Secure C Programming 14 Other C Topics 14.1 14.2 14.3 14.4 14.5 14.6 14.7 14.8 14.9 14.10 Introduction Redirecting I/O Variable-Length Argument Lists Using Command-Line Arguments Notes on Compiling Multiple-Source-File Programs Program Termination with exit and atexit Suffixes for Integer and Floating-Point Literals Signal Handling Dynamic Memory Allocation: Functions calloc and realloc Unconditional Branching with goto 15 C++ as a Better C; Introducing Object Technology #define #define 15.1 15.2 15.3 15.4 15.5 15.6 15.7 15.8 15.9 15.10 15.11 15.12 15.13 15.14 15.15 Introduction C++ A Simple Program: Adding Two Integers C++ Standard Library Header Files Inline Functions References and Reference Parameters Empty Parameter Lists Default Arguments Unary Scope Resolution Operator Function Overloading Function Templates Introduction to C++ Standard Library Class Template vector Introduction to Object Technology and the UML Wrap-Up 16 Introduction to Classes, Objects and Strings 16.1 16.2 Introduction Defining a Class with a Member Function xiii 519 519 521 522 523 523 523 524 524 529 530 530 531 533 534 536 537 538 540 541 547 548 548 549 551 552 554 556 561 561 563 564 567 570 576 579 586 587 587 xiv Contents 16.3 16.4 16.5 16.6 16.7 16.8 16.9 Defining a Member Function with a Parameter Data Members, set Functions and get Functions Initializing Objects with Constructors Placing a Class in a Separate File for Reusability Separating Interface from Implementation Validating Data with set Functions Wrap-Up 590 593 599 603 606 612 617 17 Classes: A Deeper Look, Part 1 623 17.1 17.2 17.3 17.4 17.5 17.6 17.7 17.8 17.9 Introduction Time Class Case Study Class Scope and Accessing Class Members Separating Interface from Implementation Access Functions and Utility Functions Time Class Case Study: Constructors with Default Arguments Destructors When Constructors and Destructors Are Called Time Class Case Study: A Subtle Trap—Returning a Reference to a private Data Member 17.10 Default Memberwise Assignment 17.11 Wrap-Up 624 625 632 633 634 637 642 643 646 649 652 18 Classes: A Deeper Look, Part 2 18.1 18.2 18.3 18.4 18.5 18.6 18.7 18.8 Introduction const (Constant) Objects and const Member Functions Composition: Objects as Members of Classes friend Functions and friend Classes Using the this Pointer static Class Members Proxy Classes Wrap-Up 659 659 667 673 675 680 685 689 19 Operator Overloading; Class string 695 19.1 19.2 19.3 19.4 19.5 19.6 19.7 19.8 19.9 Introduction Using the Overloaded Operators of Standard Library Class string Fundamentals of Operator Overloading Overloading Binary Operators Overloading the Binary Stream Insertion and Stream Extraction Operators Overloading Unary Operators Overloading the Unary Prefix and Postfix ++ and -- Operators Case Study: A Date Class Dynamic Memory Management 658 696 697 700 701 702 706 707 708 713 Contents 19.10 Case Study: Array Class 19.10.1 Using the Array Class 19.10.2 Array Class Definition 19.11 Operators as Member Functions vs. It's developed by a loosely organized team of volunteers and is popular in servers, personal computers and embedded systems. We encourage you to use computers and the Internet to research and solve problems that really matter. Break the 12-digit binary number into groups of four consecutive bits each and write those groups over the corresponding digits of the hexadecimal number as follows: 1000 8 1101 D 0001 1 The hexadecimal digit you wrote under each group of four bits corresponds precisely to the hexadecimal equivalent of that 4-digit binary number as shown in Fig. A multiuser environment may have only a single printer. Figure 12.19 (output shown in Fig. Activision's Call of Duty: Black Ops—one of the best-selling games of all time—earned $360 million in just one day (www.forbes.com/sites/ 5 insertcoin/2011/03/11/call-of-duty-black-ops-now-the-bestselling-video-game-of-all-time/)! Online social gaming, which enables users worldwide to compete with one another over the Internet, is growing rapidly. The following statement should print the member face of array element 10. 13.7 (Smallest of Three Numbers) Write a program that defines and uses macro MINIMUM3 to determine the smallest of three numeric values. If the value of *treePtr is not NULL and the value to be inserted is less than (*treePtr)->data, function insertNode is called with the address of (*treePtr)->leftPtr (line 74) to insert the node in the left subtree of the node pointed to by treePtr. [Note: GuessNumber.exe is the actual name of the application; however, Windows assumes the .exe extension by default.] Fig. The expression defined(MY_CONSTANT) evaluates to 1 if MY_CONSTANT is defined and 0 otherwise. 1.26). 500 Chapter 12 C Data Structures 12.7 Trees Linked lists, stacks and queues are linear data structures. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 1 2 3 4 5 6 7 8 9 10 11 12 // Fig. The number of bytes used to store a union must be at least enough to hold the largest member. FTP (file transfer protocol) allows you to exchange files between multiple computers (e.g., a client computer such as your desktop and a file server) over the Internet. Secondary storage information takes much longer to access than information in primary memory, but the cost per unit of secondary storage is much less than that of primary memory. If cell s[4][5] had originally contained 1467, then eliminating the 4, 6 and 7 would enable us to force the value 1 in that cell. The alias Integer can be changed once in the program to make the program work on both systems. By looking at all the filled-in cells in the row, column and 3×3 grid that includes a particular empty cell, the value for that cell might become obvious. Manufactured in the United States of America. The chapter includes a table of some of the research made possible by computers and the Internet, current technology trends and hardware discussion, the data hierarchy, a new section on social networking, a table of business and technology pub- xx Preface • • • • • • • • • • • • lications and websites that will help you stay up to date with the latest technology news and trends, and updated exercises. • The left-shift operator shifts the bits of its left operand to the left by the number of bits specified in its right operand. For example, a field consisting of uppercase and lowercase letters could be used to represent a person's name, and a field consisting of decimal digits could represent a person's age. As a professional C programmer, you're likely to encounter code written many years ago using older programming techniques. Library of Congress Cataloging-in-Publication Data Deitel, Paul J. For example, if your program reads a size of 4, it should print **** **** **** **** 3.33 (Hollow Square of Asterisks) Modify the program you wrote in Exercise 3.32 so that it prints a hollow square. —Sir Arthur Conan Doyle Objectives In this chapter, you'll: ■ Redirect keyboard input to come from a file. The nodes on each level are printed from left to right. One way to do this is to empty randomly chosen cells. h) Member phoneNumber of member personal of the structure pointed to by customerPtr. D.7 | Using triples to simplify a puzzle. Summary Section 12.1 Introduction • Dynamic data structures grow and shrink at execution time. C.25 Show the binary representation of decimal 779. If the node containing the search key is found, the function should return a pointer to that node; otherwise, the function should return a NULL pointer. Entering 2 ends the application and returns you to the application's directory in the shell (Fig. The two forms of the #include directive are: #include #include "filename" The difference between these is the location at which the preprocessor begins searches for the file to be included. The prompt in a Terminal window has the form hostName:~ userFolder$ to represent your user directory. D.4 shows cells with already determined values (e.g., s[1][6] is a 9, s[3][6] is a 6, etc.), and cells indicating the set of values (which we call "possibles") that at this point are still possible for that cell. The operating system is open source and free. Its lowest digit is 0 and its highest digit is 1—one less than the base of 2. Your program should calculate and display the person's age (in years), the person's maximum heart rate and the person's target-heart-rate range. • Symbolic constants and macros can be discarded by using the #undef preprocessor directive. Using such a pointer can lead to program crashes and security vulnerabilities. Most information that's output from computers today is displayed on screens, printed on paper, played as audio or video on PCs and media players (such as Apple's popular iPods) and giant screens in sports stadiums, transmitted over the Internet or used to control other devices, such as robots and "intelligent" appliances. The stack is: 6 --> 5 --> NULL ? We've updated the Visual C++® and GNU gdb debugging appendices. What is the lowest digit in base 12? For example, a table of students might include first name, last name, major, year, student ID number and grade point average. 3) While the stack is not empty, read infix from left to right and do the following: If the current character in infix is a digit, copy it to the next element of postfix. Academic research was about to take a giant leap forward. 29 Apple Macintosh 29 Apple TV 4 architecture of participation 31 area of a circle 112 argc 533 argument 43 argument (of a function) 160 argument to a function 590 arguments 519 arguments passed to member-object constructors 667 argv 533 arithmetic 18 arithmetic and logic unit (ALU) 7 arithmetic assignment operators 93 +=, -=, *=, /=, and %= 93 arithmetic conversion rules 167 arithmetic expressions 297 arithmetic mean 52 arithmetic operations 328 arithmetic operators 50 arithmetic overflow 96, 883, 895 arithmetic underflow 895 "arity" of an operator 701 ARPANET 30 array 217, 217, 218, 715 bounds checking 259 array bounds checking 225 array initializer 220 array initializer list 221 array notation 302 array of pointers 303, 313 to functions 326 array of strings 303 array subscript notation 228, 291, 302 array subscript operator ([]) 719 array-sort function 824 arrow member selection operator (->) 632 arrow operator (->) 409, 675 ASCII (American Standard Code for Information Interchange) 9, 127, 127, 846 assembler 10 assembly language 10 assert macro 524 173, 524 assigning addresses of base-class and derived-class objects to base-class and derived-class pointers 782 assigning class objects 650 assignment expressions 297 assignment operator = 649 assignment operator (=) 54, 700 assignment operator functions 725 assignment operators =, +=, -=, *=, /=, and %= 93 assignment statement 48 associate from right-to-left 57, 88 association (in the UML) 578 associativity 51, 57, 95, 218, 281, 425 associativity not changed by overloading 701 asterisk (*) 50 asynchronous event 883 at member function of string 700 at member function of vector 575 atexit function 536 attribute 577, 593 in the UML 15, 576, 590 of a class 14 of an object 15 audible (bell) 391 auto 183 auto storage class specifier 183 auto_ptr object manages dynamically allocated memory 893 automatic array 221 automatic local object 643 automatic local variable 560 automatic object 888 automatic storage 183, 217 automatic storage duration 183, 230 automatic variable 183, 184 931 average 52 avoid repeating code 642 B B 10 backslash (\) 43, 391 backslash (\) 521 bad member function 866 bad_alloc exception 889, 890, 894 bad_cast exception 894 bad_exception exception 894 bad_typeid exception 894 badbit of stream 846, 866 bank account program 460 bar chart 153, 226 base 908 base 10 number system 344 base 16 number system 344 base 8 number system 344 base case(s) 188 base class 744, 746 base-class catch 894 base-class constructor 771 base-class exception 894 base-class member accessibility in derived class 772 base-class pointer to a derived-class object 817 base-class private member 747 base specified for a stream 860 base-10 number system 856 base-16 number system 856 base-8 number system 856 base-class initializer syntax 761 base-class member function redefined in a derived class 770 BasePlusCommissionEmployee class header 805 BasePlusCommissionEmployee class implementation file 805 BasePlusCommissionEmployee class represents an employee who receives a base salary in addition to a commission 753 BasePlusCommissionEmployee class test program 756 BasePlusCommissionEmployee class that inherits from class CommissionEmployee, which does not provide protected data 769 basic_fstream template 844 basic_ifstream template 844 basic_ios template 843 basic_iostream class 844 basic_iostream template 842, 843 basic_istream template 842 basic_ofstream template 844 basic_ostream class 844 BCPL 10 behavior of a class 14 behavior of an object 577 behaviors in the UML 576 Bell Laboratories 10, 13 Berners-Lee, Tim 30 beta software 33 binary 338 binary (base 2) number system 908 932 Index binary arithmetic operators 88 binary digit (bit) 8 binary number 155 binary operator 48, 50 binary scope resolution operator (::) 608 binary search 196, 210, 244, 245, 246, 276 binary search tree 501, 504, 505, 515 binary-to-decimal conversion problem 112 binary tree 500 binary tree insert 196 binary tree sort 504 bit (binary digit) 8 bit field 426, 427 bit field member name 426 bit manipulation 429 header file 552 bitwise AND (&) operator 417, 422, 438 bitwise AND, bitwise inclusive OR, bitwise exclusive OR and bitwise complement operators 420 bitwise assignment operators 425 bitwise complement operator (~) 420, 423, 915 bitwise data manipulations 417 bitwise exclusive OR (^) operator 417, 423 bitwise inclusive OR (|) operator 417, 423 bitwise left-shift operator () 696 bitwise shift operators 424 bitwise XOR 417 BlackBerry OS 28 blank 74 blank insertion 68 blank line 550 block 42, 78, 164, 593 block of data 360 block scope 184 variable 632 body mass index (BMI) 38 calculator 38 Body Mass Index Calculator (Test Drive) 38 body of a class definition 588 body of a function 42, 56, 589 body of a while 79 Bohm, C. It "sounds good" and seems like a reasonable rule to follow. 1.9 | Running the GuessNumber application. This became one of the most successful computer science books of all time. Sorting is an interesting problem because different sorting techniques achieve the same final result but they can vary hugely in their consumption of memory, CPU time and other system resources. 1.12). 1 2 3 // Fig. Deitel, Harvey M., II. —Alfred, Lord Tennyson I have found you an argument; but I am not obliged to find you an understanding. To load and execute the program on a Linux system, type ./a.out at the Linux prompt and press Enter. • The operations that can be performed on a union are assigning a union to another of the same type, taking the address (&) of a union variable, and accessing union members using the structure member operator and the structure pointer operator. If your guess is correct, the game ends. Doyle (Indiana University Southeast), Hemanth H.M. (Software Engineer at SonicWALL), Vytautus Leonavicius (Microsoft), Robert Seacord (Secure Coding Manager at SEI/CERT, author of The CERT C Secure Coding Standard and technical expert for the international standardization working group for the programming language C) and José Antonio González Seco (Parliament of Andalusia). Objects, or more precisely the classes objects come from, are essentially reusable software components. Write a program that reads in a five-digit integer and determines whether or not it's a palindrome. c) bitwise AND (&). 12.4 a) b) GradeNodePtr startPtr = NULL; GradeNodePtr newPtr; newPtr = malloc(sizeof(GradeNode)); strcpy(newPtr->lastName, "Jones"); newPtr->grade = 91.5; newPtr->nextPtr = NULL; Exercises 511 c) To insert "Adams": previousPtr is NULL, currentPtr points to the first element in the list. The macro initializes the object declared with va_list for use by the va_arg and va_end macros. Portability Tips The Portability Tips help you write code that will run on a variety of platforms. c) What happens if the arrival interval is changed from 1 to 4 minutes to 1 to 3 minutes? D.5 Generating New Sudoku Puzzles First, let's consider approaches for generating valid finished 9×9 Sudokus with all 81 squares filled in. Because both the binary number system and the octal number system have fewer digits than the decimal number system, their digits are the same as the corresponding digits in decimal. The prompt will vary among Linux systems. 1.9) and press Enter. The algorithm is as follows: While the pointer to the current node is not null Recursively call outputTree with the current node's right subtree and totalSpaces + 5. We've made no attempt to produce optimal strategies, so once you analyze our strategies, you'll want to consider how you can improve upon them. Instant Messaging (IM) and Video Chat apps, such as AIM, Skype, Yahoo! Messenger and others allow you to communicate with others in real time by sending your messages and live video through servers. 1.21) so that you can make your first guess in the new game. But heuristic approaches don't necessarily guarantee success. 12.11 | pop operation. It can be used to make a bit-manipulation program more scalable and portable. C.26 Show the two's complement of integer value –1 on a machine with 32-bit integers. On each level of the tree, the nodes are visited from left to right. 17.6, the SalesPerson constructor (lines 9–13) initializes array sales to zero. Packets from different senders were intermixed on the same lines to efficiently use the available bandwidth. The value in a node is not processed until the values in its left subtree are processed. Handheld game players let you play anytime, anywhere and create puzzles on demand at various levels of difficulty. Judy Black Tom Blue Judy Green Iris Orange Randy Red Green J u d y File Record Field 00000000 01001010 1 Sally 16-bit Unicode character J Bit Fig. Try again.", meaning that the value you entered is greater than the number the application chose as 1.11 Test-Driving a C Application in Windows, Linux and Mac OS X 21 the correct guess. • The ## operator concatenates two tokens. Software developers are discovering that using a modular, object-oriented design-andimplementation approach can make software-development groups much more productive than was possible with earlier techniques—object-oriented programs are often easier to understand, correct and modify. E-mail, Instant Messaging, Video Chat and FTP Internet-based servers support all of your online messaging. C.1 | Digits of the binary, octal, decimal and hexadecimal number systems. Newer forms of input include position data from a GPS device, and motion and orientation information from an accelerometer in a smartphone or game controller (such as Microsoft® Kinect™, Wii™ Remote and PlayStation® Move). Keyword typedef is used to define new names (synonyms) for previously defined data types. C.4 The (octal / hexadecimal / decimal) representation of a large binary value is the most concise (of the given alternatives). Assign to newPtr->data the value to be placed on the stack (line 84) and assign *topPtr (the stack top pointer) to newPtr->nextPtr (line 85)—the link member of newPtr now points to the previous top node. A stack has a single pointer to the top of the stack where both insertion and deletion of nodes is performed. You'll begin by running a guess-the-number game, which randomly picks a number from 1 to 1000 and prompts you to guess it. Please see your instructor if you have any questions regarding copying the files to your Linux system. If you've done our Knight's Tour exercises (Exercises 6.24, 6.25 and 6.29) and Eight Queens exercises (Exercises 6.26 and 6.27), you've implemented various brute force and heuristic problemsolving approaches. (Part 2 of 2.) 1.9 Object Technology Building software quickly, correctly and economically remains an elusive goal at a time when demands for new and more powerful software are soaring. Attributes are specified by the class's instance variables. Each union variable should be printed as a char, a short, an int and a long. • The steps for a pre-order traversal are: Process the value in the node, traverse the left subtree preorder, then traverse the right subtree pre-order. • To convert a number to decimal from another base, multiply the decimal equivalent of each digit by its positional value and sum the products. Check out our C Resource Center at www.deitel.com/C to locate "getting started" tutorials for popular C compilers and development environments. The algorithm is as follows: 1) Append the null character ('\0') to the end of the postfix expression. As you drive an actual car, these attributes are carried along with the car. 12.12 (Infix-to-Postfix Converter) Stacks are used by compilers to help in the process of evaluating expressions and generating machine language code. The bitwise exclusive OR operator sets each bit in the result to 1 if the corresponding bit in exactly one operand is 1. C : how to program / Paul Deitel, Deitel & Associates, Inc., Harvey Deitel, Deitel & Associates, Inc., Abbey Deitel, Deitel & Associates, Inc. Performance Tip 10.2 Bit fields help conserve storage. 1 Enter an integer: 5 The stack is: 5 --> NULL ? It's been in active use for four decades. For more information, visit www.coursesmart.com. Some puzzles are easy to solve; some are quite difficult, requiring sophisticated solution strategies. Provide the statements necessary to insert in order nodes containing the following data for lastName and grade: "Adams" "Thompson" "Pritchard" 85.0 73.5 66.5 Use pointers previousPtr, currentPtr and newPtr to perform the insertions. 3) When the null character is encountered in the expression, pop the top value of the stack. [Optional reading project: Research "public key cryptography" in general and the PGP (Pretty Good Privacy) specific public key scheme. Each invocation of va_arg modifies the object declared with va_list so that it points to the next argument in the list. We chose not to do this for local pointer variables that immediately go out of scope after a call to free. A utility function is not part of a class's public interface; rather, it's a private member function that supports the operation of the class's other member functions. The #include directive is used to include standard library headers such as stdio.h and stdlib.h (see Fig. 8 1 ... 169 ... Notice that bit field members of structures are accessed exactly as any other structure member. Member b (on our 4-byte-word computer) is stored in another storage unit. 1.19). We've upgraded our code (as appropriate for an introductory book) to conform to various CERT recommendations. char stackTop(StackNodePtr topPtr) Return the top value of the stack without popping the stack. i) mask. MICROSOFT AND/OR ITS RESPECTIVE SUPPLIERS MAY MAKE IMPROVEMENTS AND/OR CHANGES IN THE PRODUCT(S) AND/ OR THE PROGRAM(S) DESCRIBED HEREIN AT ANY TIME. 8 9 924 Appendix D Game Programming: Solving Sudoku 1 2 3 4 5 6 1 7 8 _ _ 5 _ _ _ 1 2 3 9 1 5 _ 3 1 5 7 4 5 6 7 8 9 Fig. 1.26), meaning that the value you entered is greater than the number the application chose as the correct guess. This process may be used in reverse to produce the binary equivalent of a given octal or hexadecimal number. Counter-controlled repetition 2. The elements and functionality that you see in this application are typical of those you'll learn to program in this book. A Programming Challenge Published Sudoku puzzles typically have exactly one solution, but it's still satisfying to solve any Sudoku, even ones that have multiple solutions. l) Member city of member personal of the structure pointed to by customerPtr. 1.30). [Note: Everything to the right of the symbolic constant name replaces the symbolic constant.] For example, #define PI = 3.14159 causes the preprocessor to replace every occurrence of the identifier PI with = 3.14159. Messages and Method Calls When you drive a car, pressing its gas pedal sends a message to the car to perform a task— that is, to go faster. Each of the predefined symbolic constants begins and ends with two underscores. Modify the program of Fig. Then try the basic strategies again, looping through them repeatedly, until either the Sudoku is solved, or the strategies once again no longer improve the board, at which point you can again try another move at random. Contents Appendices E through H are PDF documents posted online at the book's Companion Website (located at www.pearsonhighered.com/deitel). This function should return 1 if a completed board is valid, 2 if a partially completed board is valid and 0 otherwise. (Part 1 of 3.) 502 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 Chapter 12 C Data Structures // function main begins program execution int main(void) { unsigned int i; // counter to loop from 1-10 int item; // variable to hold random values TreeNodePtr rootPtr = NULL; // tree initially empty srand(time(NULL)); puts("The numbers being placed in the tree are:"); // insert random values between 0 and 14 in the tree for (i = 1; i data = value; (*treePtr)->leftPtr = NULL; (*treePtr)->rightPtr = NULL; } // end if else { printf("%d not inserted. If one of those three cells ultimately becomes 4, then 1 1 2 3 4 5 6 4 7 2 _ 3 _ 4 1 4 5 6 7 5 _ 6 6 4 7 7 _ 8 _ 9 4 7 Fig. C.1–C.2. Each of these number systems uses positional notation—each position in which a digit is written has a different positional value. Function fillDeck (lines 27–37) inserts the 52 cards in the deck array and function deal (lines 41–53) prints the 52 cards. Examples of such declarations are structure and union declarations, enumerations and function prototypes. 510 Chapter 12 C Data Structures b) Create a new node of type GradeNode that's pointed to by pointer newPtr of type GradeNodePtr. 12.10 | push operation. In the partially completed 9×9 grid of Fig. i) tree. The function prototype for printf is int printf(const char *format, ... Describe how you would perform duplicate elimination using only a single subscripted array. node. hostName:GNU~ userFolder$ ./GuessNumber I have a number between 1 and 1000. is a nonlinear, two-dimensional data structure that contains nodes with i) A(n) two or more links. —John F. Section 10.10 Bit Fields • C enables you to specify the number of bits in which an unsigned int or int member of a structure or union is stored. C.18 Convert binary 100101111010 to octal and to hexadecimal. The application runs similarly on all three platforms. 5.10) and with programs consisting of multiple source files that are to be compiled together. Phase 4: Linker links the object code with the libraries, creates an executable file and stores it on disk. 750 Too low. If it does, then move on to placing a digit in the next cell. Functions in the standard library sometimes are defined as macros based on other library functions. Paul and Harvey Deitel Trademarks DEITEL, the double-thumbs-up bug and DIVE INTO are registered trademarks of Deitel and Associates, Inc. 12.23 (Level Order Binary Tree Traversal) The program of Fig. For other free C and C++ compilers, visit: www.thefreecountry.com/compilers/cpp.shtml www.compilers.net/Dir/Compilers/CCpp.htm www.freebyte.com/programming/cpp/#cppcompilers en.wikipedia.org/wiki/List_of_compilers#C.2B.2B_compilers C++ IDE Resource Kit Your instructor may have ordered through your college bookstore a Value Pack edition of C How to Program, 7/e that comes bundled with the C++ IDE Resource Kit—most C++ compilers also support C. Such a data item is called a bit (short for "binary digit"—a digit that can assume one of two values). Part (a) shows the queue after the preceding enqueue operation. 24.7 | 1 2 3 4 5 6 7 8 9 10 11 12 13 Integer class definition. The function returns -1, 0 and 1, respectively. The previous edition of the book conformed to "standard C" and included a detailed appendix on the C99 standard. 12.13. C.4 | Positional values in the binary number system. c) Use Part to declare variable a to be of type struct part, array b[10] to be of type struct part and variable ptr to be of type pointer to struct part. [Hint: Use the sizeof operator to determine the size of an integer on a particular machine.] 10.16 (What's the Value of X?) The following program uses function multiple to determine if the integer entered from the keyboard is a multiple of some integer X. We've also replaced various deprecated capabilities with newer preferred versions as a result of the new C standard. 2 | C++ chapter dependency chart. • The in-order traversal of a binary search tree processes the node values in ascending order. To access the arguments in a variable-length argument list, an object of type va_list must be defined. C.3). [Note: More generally, a file contains arbitrary data in arbitrary formats. The C++ IDE Resource Kit also includes access to a Companion Website containing step-by-step written instructions and VideoNotes to help you get started with each development environment. This means, for example, that when searching a (tightly packed) 1000-element binary search tree, no more than 10 comparisons need to be made because 210 > 1000. To convert decimal 103 to octal, we begin by writing the positional values of the columns until we reach a column whose positional value is greater than the decimal number. Purchase T-shirts and coffee mugs with Sudoku puzzles on them, participate in Sudoku player forums, get blank Sudoku worksheets that can be printed and check out hand-held Sudoku game players— one offers a million puzzles at five levels of difficulty. • It's possible to specify an unnamed bit field to be used as padding in the structure. C.11 Convert octal 317 to decimal. 1.8). 13.4 #define Preprocessor Directive: Macros A macro is an identifier defined in a #define preprocessor directive. and Convener of ISO WG14—the Working Group responsible for the C Programming Language Standard), Alireza Fazelpour (Palm Beach Community College), Mahesh Hariharan (Microsoft), Kevin Mark Jones (Hewlett Packard), Lawrence Jones, (UGS Corp.), Don Kostuch (Independent Consultant), Xiaolong Li (Indiana State University), William Mike Miller (Edison Design Group, Inc.), Tom Rethard (The University of Texas at Arlington), Benjamin Seyfarth (University of Southern Mississippi), Gary Sibbitts (St. Louis Community College at Meramec), William Smith (Tulsa Community College) and Douglas Walls (Senior Staff Engineer, C compiler, Sun Microsystems). —Ralph Waldo Emerson The partisan, when he is engaged in a dispute, cares nothing about the rights of the question, but is anxious only to convince his hearers of his own assertions. p) Member zipCode of member personal of the structure pointed to by customerPtr. The definition unsigned int counter = 1; // initialization names the control variable (counter), defines it to be an integer, reserves memory space for it, and sets it to an initial value of 1. This is a useful debugging tool for testing whether a variable has a correct value. Provide any necessary declarations and statements. Answers to Self-Review Exercises 527 b) The conditional compilation construct may be extended to test for multiple cases by usand directives. We discuss the break statement for exiting immediately from certain control statements, and the continue statement for skipping the remainder of the body of a repetition statement and proceeding with the next iteration of the loop. Figure 1.4 summarizes the data hierarchy's levels. Summary • An integer such as 19 or 227 or –63 in a program is assumed to be in the decimal (base 10) number system. Queue is empty. Performing a right shift on an unsigned int causes the vacated bits at the left to be replaced by 0s; bits shifted off the right are lost. 10.17) creates array deck containing 52 struct bitCard structures in line 20. c) Include the header common.h. The header is found in the same directory as the file being compiled. The function should take as an argument a pointer to the root node of the binary tree. The name of a control variable (or loop counter). 13.10 Assertions The assert macro—defined in the header—tests the value of an expression at execution time. Today's optimizing compilers often inline function

calls for you, so many programmers no longer use macros for this purpose. Checking your setup. g) Structures may not be compared by using operators == and !=. 1.10 Typical C Program Development Environment C systems generally consist of several parts: a program development environment, the language and the C Standard Library. f) Assign
the address of array b to the pointer variable ptr. 1.7 | Typical C development environment. The scope of a symbolic constant or macro is from its definition until it's undefined with #undef, or until the end of the file. o) inorder, preorder, postorder. 12.16 (Allowing Duplicates in a Binary Tree) Modify the program of Fig. In the "Command Prompt"
Properties dialog box that appears, click the Colors tab, and select your preferred text and background colors. For example, a university might use data from the student database in combination with databases of courses, on-campus housing, meal plans, etc. is used to dynamically allocate memory. Push the current character in infix onto the stack. •
Stacks are used by compilers in the process of evaluating expressions and generating machinelanguage code. The book presents hundreds of complete working programs and shows the outputs produced when those programs are run on a computer. For example, the statement 520 Chapter 13 C Preprocessor area = CIRCLE_AREA(4); is expanded to
area = ((3.14159) * (4) * (4)); then, at compile time, the value of the expression is evaluated and assigned to variable area. Note the nine 3×3 grids. For example, in the decimal number 937 (the 9, the 3 and the 7 are referred to as symbol values), we say that the 7 is written in the ones position, the 3 is written in the tens position and the 9 is
written in the hundreds position. Entering 2 ends the application and returns you to the application's directory at the Command Prompt Fig. Using a modular, object-oriented design and implementation approach can make software development groups more productive. Constant is the presumed name of the file (a string). If the current character in
infix is a left parenthesis, push it onto the stack. 12.19 to create a binary search tree and traverse it are recursive. C.7. The same kind of relationship can be observed in converting from binary to hexadecimal. The Secure C Programming sections at the ends of Chapters 2–13 discuss many important topics, including testing for arithmetic overflows,
using unsigned integer types, new more secure functions in the C standard's Annex K, the importance of checking the status information returned by standard-library functions, range checking, secure random-number generation, array bounds checking, techniques for preventing buffer overflows, input validation, avoiding undefined behaviors,
choosing functions that return status information vs. Many users may be generating outputs to be printed. C.10. 13.1—the rest are in Section 6.10.8 of the C standard document. f) link. e) Keyword struct was omitted from the variable declaration. Write a program with a while loop that counts from 1 to 1,000,000,000 by 1s. So between them, those
two cells will definitely “use up” the 1 and the 5. 10) puts("*****"); else puts("#####"); puts("$$$$$"); b) if (x < 10) { if (y > 10) puts("*****"); } else { puts("#####"); puts("$$$$$"); } 3.31 (Another Dangling Else Problem) Modify the following code to produce the output shown. k) binary. We divide 8 into 39 and observe that there are
four 8s in 39 with a remainder of 7 and write 4 in the 8 column. • The steps for a post-order traversal are: Traverse the left subtree post-order, traverse the right subtree post-order, then process the value in the node. c) True. Apple's OS X is built in Objective-C, which was derived from C. Notice the triples—the three cells containing the exact same
three possibilities 467, namely cells s[1][5], s[6][5] and s[9][5]. Redefining a symbolic constant with a new value is also an error. printf("%d", ++(x + y)); Making a Difference 113 3.43 (Sides of a Triangle) Write a program that reads three nonzero integer values and determines and prints whether they could represent the sides of a triangle. Well,
there you have it! C is a powerful programming language that will help you write high-performance programs quickly and effectively. l) \. Member suit stores values from 0 through 3 (0 = Diamonds, 1 = Hearts, 2 = Clubs, 3 = Spades)— 2 bits can store values in the range 0–3. 1.11 Test-Driving a C Application in Windows, Linux and Mac OS X 23 3.
C.12 Decimal 4+13*16+15*256+14*4096=61396. First we explain how the two's complement of a binary number is formed, then we show why it represents the negative value of the given binary number. • A node can be inserted only as a leaf node in a binary search tree. In the hexadecimal number 3DA, we say that the A is written in the ones
position, the D is written in the sixteens position and the 3 is written in the two-hundred-and-fiftysixes position. Trace the history of Sudoku from its origin in the eighth century through modern times. If the pragma is not recognized by the implementation, the pragma is ignored. (Hint: First convert 765F to binary, then convert that binary number to
octal.) C.21 Convert binary 1011110 to decimal. 12.21 is: 27 13 6 17 42 33 48 The steps for a postOrder traversal are: 1. Computing costs are dropping dramatically, owing to rapid developments in hardware and software technologies. MRI scanners use a technique called magnetic resonance imaging, also to produce internal images non-invasively.
To convert decimal 375 to hexadecimal, we begin by writing the positional values of the columns until we reach a column whose positional value is greater than the decimal number. The replacement text for a macro or symbolic constant is normally any text on the line after the identifier in the #define directive. 1.26 | Entering an initial guess. 12.5.2
Function pop Function pop (lines 94–104) removes a node from the top of the stack. Some key organizations in the open-source community are the Eclipse Foundation (the Eclipse Integrated Development Environment helps programmers conveniently develop software), the Mozilla Foundation (creators of the Firefox web browser), the Apache
Software Foundation (creators of the Apache web server used to develop webbased applications) and SourceForge (which provides the tools for managing open-source projects—it has over 322,000 of them under development). f) struct. @@@@@ &&&&& d) Assuming x = 5 and y = 7, the following output is produced. and /). On most computer
systems—Linux/UNIX, Mac OS X and Windows systems in particular—it's possible to redirect inputs to come from a file rather than the keyboard and redirect outputs to be placed in a file rather than on the screen. Like its capabilities, the car's attributes are represented as part of its design in its engineering diagrams (which, for example, include an
odometer and a fuel gauge). • Only one member of a union can be referenced at a time. 1.10.2 Phases 2 and 3: Preprocessing and Compiling a C Program In Phase 2, the you give the command to compile the program. The dotted arrows in part (b) illustrate Steps 2 and 3 of the push operation that enable the node containing 12 to become the new
stack top. m) #line. In this section, we explain how computers represent negative numbers using two's complement notation. Similar growth hpas occurred in the communications field, in which costs have plummeted as enormous demand for communications bandwidth (i.e., information-carrying capacity) has attracted intense competition. (Part 3 of
3.) left to right 905 B ASCII Character Set ASCII character set 0 1 2 3 4 5 6 7 8 9 10 11 12 0 1 2 3 4 5 6 7 8 9 nul soh stx etx eot enq ack bel bs ht lf vt ff cr so si dle dc1 dc2 dc3 dc4 nak syn etb can em sub esc fs gs rs us sp ! " # $ % & ' ( ) * + , - . Section 13.5 Conditional Compilation • Conditional compilation enables you to control the execution of
preprocessor directives and the compilation of program code. —Galen Our life is frittered away by detail. headPtr H tailPtr D Fig. h) assert. Your program should apply the strategies in order. For the figures in this section we remove the hostName: part and used the generic name userFolder to represent your user account's folder. If the current
character is a digit, Push its integer value onto the stack (the integer value of a digit character is its value in the computer's character set minus the value of '0' in the computer's character set). The control variable is incremented (usually by 1) each time the group of instructions is performed. If a debugger is not available, printf statements are often
used to print variable values and to confirm the flow of control. 1.23 | Changing to the GuessNumber application's directory. 10 ... Section 13.3 #define Preprocessor Directive: Symbolic Constants • The #define preprocessor directive is used to create symbolic constants and macros. escape sequence 391 \' single-quote-character escape sequence 391
\" double-quote-character escape sequence 391 \\ backslash-character escape sequence 391 \0 null character escape sequence 228 \a alert escape sequence 43, 391 \b escape sequence 391 \f escape sequence 338 \f form-feed escape sequence 391 escape sequence 338 newline escape sequence 43, 391 \r carriage-return escape sequence 391 \r escape
sequence 338 \t escape sequence 338 \t horizontal-tab escape sequence 391 \v escape sequence 338, 391 & address operator 47 & and * pointer operators 281 & bitwise AND operator 418 & to declare reference 557 in a parameter list 559 && operator 134, 194 &&, logical AND operator 134 &= bitwise AND assignment operator 425 # flag 390 #
preprocessor operator 42, 523 ## preprocessor operator 523 % character in a conversion specifier 88, 380 % remainder operator 50, 174 %% conversion specifier 385 %= remainder assignment operator 95 %c conversion specifier 168, 385, 394 %d conversion specifier 168 %E conversion specifier 383, 394 %e conversion specifier 383, 394 %f
conversion specifier 88, 168 %g conversion specifier 394 %hd conversion specifier 168 %hu conversion specifier 168 %i conversion specifier 393 %ld conversion specifier 168 %Lf conversion specifier 168 %lf conversion specifier 168 %lld conversion specifier 168 %llu conversion specifier 168 %lu conversion specifier 168 %p conversion specifier 280,
385 %s conversion specifier 58, 307, 385, 394 %u conversion specifier 90, 168, 381 %X conversion specifier 392 + flag 389 + flag 388 - minus operator 95 + unary plus operator 95 -- operator 93, 95, 298 ++ operator 93, 95, 298 += addition assignment operator 93, 95 < less than operator 54 < redirect input symbol 530 > append output symbol 531
>> right-shift operator 418 >>= right shift assignment operator 425 | bitwise inclusive OR operator 418 | pipe 530 |= bitwise inclusive OR assignment operator 425 || 194 ||, logical OR operator 134 ~ bitwise one's complement 418 ~, bitwise complement operator 423 Numerics 0 Conversion specifier 47, 48, 393, 394 0X 856 0x 390, 856 A a file open
mode 447 a.out 18 a+ file open mode 447 ab file open mode 447 ab+ file open mode 447 abnormal program termination 538 abort function 524, 643, 886, 891 absolute-value 161 abstract base class 793, 794, 821 abstract class 793, 794, 795, 810 abstraction 162 accelerometer 6 access function 634 access global variable 563 access non-static class
data members and member functions 685 access private member of a class 596 access privileges 287 access specifier 588, 595, 673 private 595 protected 625 public 595 access the caller's data 556 access violation 49, 337, 385 accessibility heuristic 273 accessing an object's members through each type of object handle 632 accessor 598 Account
class (exercise) 621 Account inheritance hierarchy (exercise) 777 accounts receivable 153 accumulated outputs 550 accumulator 327, 328, 331 action 43, 43, 54, 72, 79 action oriented 577 action statement 72 action symbol 73 action/decision model 43, 75 actions 54, 71 actions (computers perform) 2 add an integer to a pointer 297 add instruction
328 addition 7 addition assignment operator (+=) 93 addition program that displays the sum of two numbers 549 address 485 address of a bit field 429 Index address operator (&) 47, 174, 228, 279, 282, 292, 700 “administrative” section of the computer 7 Advanced string manipulation exercises 375 aggregate data types 289 aggregates 406 Agile
Alliance (www.agilealliance.org) 32 Agile Manifesto (www.agilemanifesto.org) 32 Agile software development 32 aiming a derived-class pointer at a baseclass object 785 airline reservation system 270 Ajax 32 alert (\a) 43 algebra 50 algorithm 71, 82 header file 553 alias 559 for a variable (reference) 559 for the name of an object 646 aligning 380
allocate 713 allocate dynamic memory 553, 892 allocate memory 713 alpha software 33 ALU (arithmetic and logic unit) 7 Amazon 3 AMBER Alert 3 American National Standards Committee on Computers and Information Processing 12 American National Standards Institute (ANSI) 12, 12 ampersand (&) 47, 49 analyze a requirements document 578
AND 417 Android 29 operating system 29 smartphone 29 angle brackets (< and >) in templates 568 angle brackets (< and >) in templates 825 Annex K 259 Another dangling else problem 110 ANSI 12 Apache Software Foundation 28 append output symbol >> 531 Apple 2 Apple Inc. A table includes records and fields. The Unicode character set
contains characters for many of the world's languages. The vast majority of our readership uses either the GNU gcc compiler—which supports several of the key features in the new standard—or the Microsoft Visual C++ compiler. In the following steps, you'll run the application and enter various numbers to guess the correct number. —Samuel
Johnson A good symbol is the best argument, and is a missionary to persuade thousands. To be able to convert octal numbers and hexadecimal numbers to binary numbers. We added cautions about order of evaluation issues. Mosaic, Netscape, Emergence of Web 2.0 Web use exploded with the availability in 1993 of the Mosaic browser, which
featured a user-friendly graphical interface. 10.15 (Portable displayBits Function) Modify function displayBits of Fig. If the replacement text for a macro or symbolic constant is longer than the remainder of the line, a backslash (\) must be placed at the end of the line, indicating that the replacement text continues on the next line. The Linux kernel is
the core of the most popular open-source, freely distributed, fullfeatured operating system. Generally, Web 2.0 companies use the web as a platform to create collaborative, community-based sites (e.g., social networking sites, blogs, wikis). int isOperator(char c) Determine whether c is an operator. A variety of issues—such as Microsoft's market
power, the small number of userfriendly Linux applications and the diversity of Linux distributions, such as Red Hat Linux, Ubuntu Linux and many others—have prevented widespread Linux use on desktop computers. 17.5: SalesPerson.h // SalesPerson class definition. 10 Chapter 1 Introduction to Computers, the Internet and the Web Machine
Languages Any computer can directly understand only its own machine language, defined by its hardware architecture. Each web page on the Internet is associated with a unique URL. The most popular database model is the relational database in which data is stored in simple tables. Queue nodes are removed only from the head of the queue and
are inserted only at the tail of the queue. We divide 32 into 57 and observe that there is one 32 in 57 with a remainder of 25, so we write 1 in the 32 column. C.1 Introduction Binary digit Octal digit Decimal digit Hexadecimal digit 0 0 0 0 1 1 1 1 2 2 2 2 3 3 3 3 4 4 4 4 5 5 5 5 6 6 6 6 7 7 7 7 8 8 9 9 A B C D E F 909 (decimal value of 10) (decimal value of 11)
(decimal value of 12) (decimal value of 13) (decimal value of 14) (decimal value of 15) Fig. 13.2 Write a program to print the values of the predefined symbolic constants listed in Fig. So, you should enter a lower number for your next guess. It uses the queue data structure to control the output of the nodes. n) leaf. Many C implementations include
debuggers, which provide much more powerful features than conditional compilation. The #include directive causes a copy of a specified file to be included in place of the directive. Return value to the caller (line 121). Return popValue to the caller (line 103). Our syntax-shading conventions are: comments appear like this keywords appear like this
constants and literal values appear like this all other code appears in black Code Highlighting. Use the #ifdef preprocessor directive. The New C Standard We also introduce the new C standard (referred to as C11), which was approved as this book went to publication. If you'll be building C systems in industry, consider reading The CERT C Secure
Coding Standard (Robert Seacord, Addison-Wesley Professional, 2009) and Secure Coding in C and C++ (Robert Seacord, Addison-Wesley Professional, 2006). Divide-by-zero is generally a fatal error, i.e., one that causes the program to terminate immediately without successfully performing its job. When you guess correctly, the application displays
"Excellent! You guessed the number!" 8. (Part 1 of 2.) 503 504 Chapter 12 C Data Structures The inOrder traversal is: 2 4 5 6 7 11 12 The postOrder traversal is: 2 5 4 11 12 7 6 Fig. Computers “prefer” postfix notation in which the operator is written to the right of its two operands. The program should calculate the sum of the elements and the
floatingpoint average of the elements. Figure 1.1 provides a few examples of the ways in which computers are used in research and industry. 2 The popped value is 4. The presumed name of the source file (a string). Translator programs called compilers convert high-level language programs into machine language. To use the logical operators to form
complex conditional expressions in control statements. Member face stores values from 0 (Ace) through 12 (King)—4 bits can store values in the range 0–15. Order of Evaluation. It was developed in the early 1980s and later acquired by NeXT, which in turn was acquired by Apple. 12.14 | Sample output from the program in Fig. This is the long-term,
high-capacity “warehousing” section. Terminology base 908 base 2 number system 908 base 8 number system 908 base 10 number system 908 Self-Review Exercises 917 negative value 915 octal number system 908 one's complement notation 915 positional notation 908 positional value 908 symbol value 908 two's complement notation 915 base 16
number system 908 binary number system 908 bitwise complement operator (~) 915 conversion 913 decimal number system 908 digit 908 hexadecimal number system 908 Self-Review Exercises C.1 Fill in the blanks in each of the following statements: a) The bases of the decimal, binary, octal and hexadecimal number systems are , , and
respectively. The expression should be hearts[10].face c) A union can be initialized only with a value that has the same type as the union's first member. • The members of a union can be of any data type. 922 Appendix D Game Programming: Solving Sudoku Less trivially, to determine the value of s[1][7] in Fig. Industrial-strength coding techniques
in any programming language are beyond the scope of an introductory textbook. d) The variables declared in a structure definition are called its e) In an expression using the operator, bits are set to 1 if at least one of the corresponding bits in either operand is set to 1. We do not need that column, so we discard it. 1.13 | Playing the game again. 2 The
popped value is 6. These programs guide the computer through ordered actions specified by people called computer programmers. The postfix version of the preceding infix expression is 6 2 + 5 * 8 4 / - The program should read the expression into character array infix and use the stack functions implemented in this chapter to help create the postfix
expression in character array postfix. Otherwise, the recursive steps continue until a NULL pointer is found, then Step 1 is executed to insert the new node. We emphasize screen features like titles and menus (e.g., the File menu) in a semibold sans-serif Helvetica font, and to emphasize filenames, text displayed by an application and values you
should enter into an application (e.g., GuessNumber or 500) we use a sans-serif Lucida font. 1.14 Some Key Software Development Terminology Figure 1.31 lists a number of buzzwords that you'll hear in the software development community. 1.29 | Playing the game again. const double PI = 3.14159; in preference to the preceding #define. After you
guess correctly, the application asks if you'd like to play another game (Fig. Some actions it performs are the inclusion of other files in the file being compiled, definition of symbolic constants and macros, conditional compilation of program code and conditional execution of preprocessor directives. 1 Enter a character: B The queue is: A --> B -->
NULL ? Manipulations involving *topPtr change the value of stackPtr in main. 7. The conditional preprocessor construct is much like the if selection statement. Translator programs called assemblers were developed to convert assembly-language programs to machine language. Most programs in the text have used the standard library function printf,
which, as you know, takes a variable number of arguments. Function main determines whether the stack is empty before calling pop. h) The macro prints a message and terminates program execution if the value of the expression the macro evaluates is 0. C.19 Convert hexadecimal 3A7D to binary. Traverse the left subtree preOrder. Objects are
essentially reusable software components that model items in the real world. Section 10.5 Using Structures with Functions • Structures may be passed to functions by passing individual structure members, by passing an entire structure or by passing a pointer to a structure. Terminology. 10.16. Section 10.11 Enumeration Constants • An enum
defines a set of integer constants represented by identifiers. -- Seventh edition. Assign the result to another char variable. It's possible to specify an unnamed bit field to be used as padding in the structure. b) The positional value of the rightmost digit of any number in either binary, octal, deci. Another common use for access functions is to test the
truth or falsity of conditions—such functions are often called predicate functions. Other Recent Editions Reviewers William Albrecht (University of South Florida), Ian Barland (Radford University), Ed James Beckham (Altera), John Benito (Blue Pilot Consulting, Inc. (Part 1 of 3.) 495 496 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73
74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 Chapter 12 C Data Structures printQueue(headPtr); break; default: puts("Invalid choice."); instructions(); break; } // end switch printf("%s", "? • Test Item File of multiple-choice questions (approximately two per book section) xxvi • Preface
Solutions Manual with solutions to most of the end-of-chapter exercises. [Hint: Use the division and remainder operators to separate the number into its individual digits.] 3.35 (Printing the Decimal Equivalent of a Binary Number) Input an integer (5 digits or fewer) containing only 0s and 1s (i.e., a “binary” integer) and print its decimal equivalent.
10.16: fig10_16.c // Representing cards with bit fields in a struct #include #define CARDS 52 // bitCard structure definition with struct bitCard { unsigned int face : 4; // 4 bits; unsigned int suit : 2; // 2 bits; unsigned int color : 1; // 1 bit; }; // end struct bitCard bit fields 0-15 0-3 0-1 typedef struct bitCard Card; // new type name for struct bitCard void
fillDeck(Card * const wDeck); // prototype void deal(const Card * const wDeck); // prototype int main(void) { Card deck[CARDS]; // create array of Cards fillDeck(deck); deal(deck); } // end main // initialize Cards void fillDeck(Card * const wDeck) { size_t i; // counter Fig. The most common preprocessor directives are discussed in the early
chapters; a detailed discussion of preprocessor features appears in Chapter 13. C.7 | Decimal, binary, octal and hexadecimal equivalents. Before a program can be executed, the program must first be placed in memory. Windows borrowed from many concepts (such as icons, menus and windows) developed by Xerox PARC and popularized by early
Apple Macintosh operating systems. Then one of those cells must be 5, one must be 7 and one must be 9. There's also a standard error stream referred to as stderr. This “manufacturing” section performs calculations, such as addition, subtraction, multiplication and division. 811 Too high. Singletons The strategies we've discussed so far can easily
determine the final digits for some open cells, but you'll often have to dig deeper. With open-source development, individuals and companies contribute their efforts in developing, maintaining and evolving software in exchange for the right to use that software for their own purposes, typically at no charge. Deitel & Associates, Inc., founded by Paul
Deitel and Harvey Deitel, is an internationally recognized authoring, corporate training and software development organization specializing in computer programming languages, object technology, Android and iPhone app development and Internet and web software technology. void printStack(StackNodePtr topPtr) Print the stack. 12.13: fig12_13.c
// Operating and maintaining a queue #include #include // self-referential structure struct queueNode { char data; // define data as a char struct queueNode *nextPtr; // queueNode pointer }; // end structure queueNode typedef struct queueNode QueueNode; typedef QueueNode *QueueNodePtr; // function prototypes void printQueue(QueueNodePtr
currentPtr); int isEmpty(QueueNodePtr headPtr); char dequeue(QueueNodePtr *headPtr, QueueNodePtr *tailPtr); void enqueue(QueueNodePtr *headPtr, QueueNodePtr *tailPtr, char value); void instructions(void); // function main begins program execution int main(void) { QueueNodePtr headPtr = NULL; // initialize headPtr QueueNodePtr
tailPtr = NULL; // initialize tailPtr unsigned int choice; // user's menu choice char item; // char input by user instructions(); // display the menu printf("%s", "? The parentheses around each x in the replacement text force the proper order of evaluation when the macro argument is an expression. Two editors widely used on Linux systems are vi and
emacs. Sentinel values are used to control repetition when: 1. An Exhaustive Brute Force Approach One brute force approach is simply to select all possible placements of the digits 1 through 9 in every cell. Once undefined, a name can be redefined with #define. For that reason, our Secure C Programming sections present some key issues and
techniques, and provide links and references so you can continue learning. Instructor Resources The following supplements are available to qualified instructors only through Pearson Education's Instructor Resource Center (www.pearsonhighered.com/irc): • PowerPoint® slides containing all the code and figures in the text, plus bulleted items that
summarize key points. These directives are frequently used to prevent header files from being included multiple times in the same source file. Try again. The number of bits 10.10 Bit Fields 427 is based on the desired range of values for each structure member. Windows is a proprietary operating system—it's controlled by Microsoft exclusively. The
root node is the first node in a tree. C is one of the most popular programming languages for developing embedded systems, which typically need to run as fast as possible and conserve memory. It's your responsibility to ensure that the data in a union is referenced with the proper data type. Deitel, are the world's best-selling programming-language
textbook/professional book/video authors. If *headPtr is NULL (line 116), assign queue is now empty. You type a C program with the editor, make corrections if necessary, then store the program on a secondary storage device such as a hard disk. For example, the structure definition struct example { unsigned int a : 13; unsigned int : 0; unsigned int :
4; }; // end struct example uses an unnamed 0-bit field to skip the remaining bits (as many as there are) of the storage unit in which a is stored and to align b on the next storage-unit boundary. The ## operator concatenates two tokens. [Note: It's possible that no modification is necessary.] if (y == 8) if (x == 5) puts("@@@@@" else puts(
"#####" puts("$$$$$" puts("&&&&&"););); a) Assuming x = 5 and y = 8, the following output is produced. If your book did not come with the C++ IDE Resource Kit, you can purchase access to the Resource Kit's Companion Website from www.pearsonhighered.com/cppidekit/. Students receive the same content offered in the print textbook
enhanced by search, note-taking and printing tools. Again the application displays "Too low. Certain C functions take their input from stdin (the standard input stream), which is normally the keyboard, but stdin can be connected to another stream. ■ Process external asynchronous events in a program. 12.21 | Binary search tree with seven nodes.
(Using Unions) Create union floatingPoint with members float f, double d and long Write a program that inputs values of type float, double and long double and stores the values in union variables of type union floatingPoint. Class SalesPerson (Fig. 1.18 | Entering an initial guess. The children of a node are called siblings. Continue this process with
the masks 65280 and 255. Section 12.6 Queues • Queue nodes are removed only from the head of the queue and inserted only at the tail of the queue—referred to as a first-in, first-out (FIFO) data structure. c) A structure called address that contains character arrays streetAddress[25], city[20], state[3] and zipCode[6]. 1 Enter an integer: 6 The
stack is: 6 --> 5 --> NULL ? 12.7 Trees 505 27 42 13 6 17 33 48 Fig.) { double total = 1; // initialize total int j; // counter for selecting arguments va_list ap; // stores information needed by va_start and va_end va_start(ap, i); // initializes the va_list object // process variable-length argument list for (j = 1; j . GPS devices can provide step-by-step
directions and help you locate nearby businesses (restaurants, gas stations, etc.) and points of interest. The level order traversal of a binary tree visits the nodes of the tree row-by-row starting at the root node level. It's common to route regular output data, i.e., stdout, to a device other than the screen while keeping stderr assigned to the screen so
that the user can be immediately informed of errors. The decimal equivalent of binary 1101 is 1 * 1 + 0 * 2 + 1 * 4 + 1 * 8 or 1 + 0 + 4 + 8 or 13.] 3.36 (How Fast is Your Computer?) How can you determine how fast your own computer really operates? A loop is a group of instructions the computer executes repeatedly while some loop-continuation
condition remains true. Humans generally write expressions like 3 + 4 and 7 / 9 in which the operator (+ or / here) is written between its operands—this is called infix notation. If you're not a registered faculty member, contact your Pearson representative or visit www.pearsonhighered.com/educator/ replocator/. For example, the character code for
“F” is 70, and the character code for “&” is 38. If the value to be inserted is greater than (*treePtr)->data, function insertNode is called with the address of (*treePtr)->rightPtr (line 79) to insert the node in the right subtree of the node pointed to by treePtr. By the way, this approach guarantees that all the rows are valid permutations of the digits 1
through 9, so you should add an option to your function validSudoku that will have it check only columns and 3×3 grids. As the tree is being created, an attempt to insert a duplicate value will be recognized because a duplicate will follow the same “go left” or “go right” decisions on each comparison as the original value did. Macaulay Man is still the
most extraordinary computer of all. Plauger's book The Standard C Library is must reading for programmers who need a deep understanding of the library functions, how to implement them and how to use them to write portable code. Our goal is simply to acquaint you with Sudoku, and some of its challenges and problem-solving strategies. The
Deitels' publications have earned international recognition, with translations published in Chinese, Korean, Japanese, German, Russian, Spanish, French, Polish, Italian, Portuguese, Greek, Urdu and Turkish. Built for Performance C is widely used to develop systems that demand performance, such as operating systems, embedded systems, real-time
systems and communications systems (Figure 1.5). The process of creating a binary search tree actually sorts the data—and thus this process is called the binary tree sort. For websites like Facebook®, Twitter™, YouTube, eBay® and Wikipedia® users create the content, while the companies provide the platforms on which to enter, manipulate and
share the information. The opening quotes are followed by a list of chapter objectives. In 1989, Tim Berners-Lee of CERN (the European Organization for Nuclear Research) began to develop a technology for sharing information via hyperlinked text documents. Directives #ifdef and #ifndef are shorthand for #if defined(name) and #if !defined(name).
Can you guess my number? d) A semicolon is required to end a structure definition. Well, before you can drive a car, someone has to design it. pages cm -- (How to program series) ISBN 978-0-13-299044-8 1. 514 Chapter 12 C Data Structures [Note: In 2) above, if the operator is '/', the top of the stack is 2, and the next element in the stack is 8, then
pop 2 into x, pop 8 into y, evaluate 8 / 2, and push the result, 4, back onto the stack. 12.7.5 Other Binary Tree Operations In the exercises, algorithms are presented for several other binary tree operations such as deleting an item from a binary tree, printing a binary tree in a two-dimensional tree format and performing a level order traversal of a
binary tree. To form a puzzle, save the solved grid, then empty some cells. rules of the language. This publication is protected by Copyright, and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying,
recording, or likewise. • The steps for an in-order traversal are: Traverse the left subtree in-order, process the value in the node, then traverse the right subtree in-order. Web-Based Materials This book is supported by substantial online materials. 14 Other C Topics We'll use a signal I have tried and found far-reaching and easy to yell. Thus, there are
really two parts to learning how to program in C—learning the C language itself and learning how to use the functions in the C Standard Library. The program should print the integer in bits before and after the shift operation. C.3 | Positional values in the decimal number system. ■ Assign specific types to numeric constants. 2 A has been dequeued.
The Objective-C programming language, created by Brad Cox and Tom Love at Stepstone in the early 1980s, added capabilities for object-oriented programming (OOP) to the C programming language. 500 Too high. You may want to revisit your Sudoku programs after you study a game programming library, such as Allegro, which offers capabilities
for adding graphics and sounds to your programs. • A particularly important relationship of both the octal number system and the hexadecimal number system to the binary system is that the bases of octal and hexadecimal (8 and 16 respectively) are powers of the base of the binary number system (base 2). 12.19 (Depth of a Binary Tree) Write a
function depth that receives a binary tree and determines how many levels it has. n) enumeration. Normally the user inputs integers from the keyboard and enters the endof-file key combination to indicate that no further values will be input. • Often, typedef is used to create synonyms for the basic data types. Each position is a power of the base (base
2) and these powers begin at 0 and increase by 1 as we move left in the number (Fig. Multiple members of an enumeration can have the same constant value. All Code Tested on Windows and Linux. 250 Too low. As a result, Linux users benefit from a community of developers 1.12 Operating Systems 29 actively debugging and improving the kernel,
an absence of licensing fees and restrictions, and the ability to completely customize the operating system to meet specific needs. Acknowledgments We'd like to thank Abbey Deitel and Barbara Deitel for long hours devoted to this project. The C++ user community benefits by having more ISV-produced class libraries available. If the current
character in infix is a right parenthesis Pop operators from the top of the stack and insert them in postfix until a left parenthesis is at the top of the stack. The CERT® Coordination Center (www.cert.org) was created to analyze and respond promptly to attacks. Finally, member color stores either 0 (Red) or 1 (Black)—1 bit can store either 0 or 1. e)
Assign the member values of variable a to element 3 of array b. • Multiple members of an enumeration can have the same constant value. Moore's Law and related observations apply especially to the amount of memory that computers have for programs, the amount of secondary storage (such as disk storage) they have to hold programs and data
over longer periods of time, and their processor speeds—the speeds at which computers execute their programs (i.e., do their work). Instead, they began using Englishlike abbreviations to represent elementary operations. This yields: Positional values: 256 Symbol values: 1 16 7 1 7 and thus decimal 375 is equivalent to hexadecimal 177. 10.14
(Reversing the Order of an Integer's Bits) Write a program that reverses the order of the bits in an unsigned int value. The process of compiling a large high-level language program into machine language can take a considerable amount of computer time. We call this the “live-code approach.” All of these example programs may be downloaded from
our website www.deitel.com/books/chtp7/. 806 Too low. D.3 Solution Strategies When we refer to a Sudoku 9×9 grid, we'll call it array s. When the null character is encountered, no further processing is necessary. The addition of 1 causes each column to add to 0 with a carry of 1. The directive #line 100 "file1.c" indicates that lines are numbered
from 100 beginning with the next source code line and that the name of the file for the purpose of any compiler messages is "file1.c". Performance Tip 1.1 Interpreters have an advantage over compilers in Internet scripting. The programs that run on a computer are referred to as software. Portability Tip 1.1 Because C is a hardware-independent,
widely available language, applications written in C often can run with little or no modification on a range of different computer systems. 2. The CERT guidelines are available free online at www.securecoding.cert.org. By convention, we use the letters A through F to represent the hexadecimal digits corresponding to decimal values 10 through 15. j)
##. Locating the completed application. In 1979, Jobs and several Apple employees visited Xerox PARC (Palo Alto Research Center) to learn about Xerox's desktop computer that featured a graphical user interface (GUI). • Binary trees are trees whose nodes all contain two links. Assign *headPtr to tempPtr (line 112), which will be used to free the
unneeded memory. When the function returns to its caller, the space for that function's automatic variables is popped off the stack, and these variables no longer are known to the program. You'll be able to examine the C code. e) Write a while loop that deletes all the nodes in the list and frees the memory associated with each node. To be able to
convert back and forth between decimal numbers and their binary, octal and hexadecimal equivalents. 12.19 illustrated three recursive methods of traversing a binary tree—inorder traversal, preorder traversal, and postorder traversal. C.8 | Converting a binary number to decimal. 12.15 | enqueue D N *tailPtr R newPtr A newPtr D N operation. The
stack is empty. Preface 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 1.10 1.11 xix Introduction to Computers, the Internet and the Web Introduction Computers and the Internet in Industry and Research Hardware and Software 1.3.1 Moore's Law 1.3.2 Computer Organization Data Hierarchy Programming Languages The C Programming Language C Standard
Library C++ and Other C-Based Languages Object Technology Typical C Program Development Environment 1.10.1 Phase 1: Creating a Program 1.10.2 Phases 2 and 3: Preprocessing and Compiling a C Program 1.10.3 Phase 4: Linking 1.10.4 Phase 5: Loading 1.10.5 Phase 6: Execution 1.10.6 Problems That May Occur at Execution Time 1.10.7
Standard Input, Standard Output and Standard Error Streams Test-Driving a C Application in Windows, Linux and Mac OS X 1.11.1 Running a C Application from the Windows Command Prompt 1.11.2 Running a C Application Using GNU C with Linux 1.11.3 Running a C Application Using GNU C with Mac OS X Operating Systems 1.12.1
Windows—A Proprietary Operating System 1.12.2 Linux—An Open-Source Operating System 1.12.3 Apple's Mac OS X; Apple's iOS for iPhone®, iPad® and iPod Touch® Devices 1.12.4 Google's Android 1 2 2 5 6 6 7 9 10 12 13 14 16 16 16 18 18 18 18 18 19 20 22 25 27 28 28 29 29 viii Contents 1.13 1.14 1.15 1.16 The Internet and World Wide Web
Some Key Software Development Terminology Keeping Up-to-Date with Information Technologies Web Resources 2 Introduction to C Programming 2.1 2.2 2.3 2.4 2.5 2.6 2.7 Introduction A Simple C Program: Printing a Line of Text Another Simple C Program: Adding Two Integers Memory Concepts Arithmetic in C Decision Making: Equality and
Relational Operators Secure C Programming 3 Structured Program Development in C 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 3.11 3.12 3.13 Introduction Algorithms Pseudocode Control Structures The if Selection Statement The if...else Selection Statement The while Repetition Statement Formulating Algorithms Case Study 1: Counter-Controlled
Repetition Formulating Algorithms with Top-Down, Stepwise Refinement Case Study 2: Sentinel-Controlled Repetition Formulating Algorithms with Top-Down, Stepwise Refinement Case Study 3: Nested Control Statements Assignment Operators Increment and Decrement Operators Secure C Programming 4 C Program Control 4.1 4.2 4.3 4.4 4.5 4.6
4.7 4.8 4.9 4.10 4.11 Introduction Repetition Essentials Counter-Controlled Repetition for Repetition Statement for Statement: Notes and Observations Examples Using the for Statement switch Multiple-Selection Statement do...while Repetition Statement break and continue Statements Logical Operators Confusing Equality (==) and Assignment (=)
Operators 3.10 30 31 33 34 40 41 41 45 49 50 54 58 70 71 71 71 72 74 75 79 80 82 89 93 93 96 114 115 115 116 117 120 121 124 130 132 134 137 Contents 4.12 4.13 Structured Programming Summary Secure C Programming 5 C Functions 5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10 5.11 5.12 5.13 5.14 5.15 5.16 5.17 Introduction Program Modules in C
Math Library Functions Functions Function Definitions Function Prototypes: A Deeper Look Function Call Stack and Stack Frames Headers Passing Arguments By Value and By Reference Random Number Generation Example: A Game of Chance Storage Classes Scope Rules Recursion Example Using Recursion: Fibonacci Series Recursion vs. • A
macro is an operation defined in a #define preprocessor directive. 6 Chapter 1 Introduction to Computers, the Internet and the Web 1.3.1 Moore's Law Every year, you probably expect to pay at least a little more for most products and services. Queues are also used to support print spooling. 10.4. Precede each card with its color. We use a variety of
approaches. (Part 3 of 3.) Enter choice: 1 to push a value on the stack 2 to pop a value off the stack 3 to end program ? Figure 12.12 illustrates a queue with several nodes. n) A(n) 10.2 State whether each of the following is true or false. b) Two unions can be compared (using ==) to determine whether they're equal. At the prompt, enter 500 (Fig. The
statement would be assert(x), the search is performed in an implementation-defined manner. MICROSOFT AND/OR ITS RESPECTIVE SUPPLIERS HEREBY DISCLAIM ALL WARRANTIES AND CONDITIONS WITH REGARD TO THIS INFORMATION, INCLUDING ALL WARRANTIES AND CONDITIONS OF MERCHANTABILITY, WHETHER EXPRESS,
IMPLIED OR STATUTORY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT. If s[1][9] ultimately becomes 1, then s[2][7] must be 5; if s[1][9] ultimately becomes 5, then s[2][7] must be 1. Where those designations appear in this book, and the publisher was aware of a trademark claim, the designations have been printed
in initial caps or all caps. . In this exercise, you'll write a version of the infix-to-postfix conversion algorithm. Common Programming Error 10.11 Attempting to access individual bits of a bit field as if they were elements of an array is a syntax error. GPS Global Positioning System (GPS) devices use a network of satellites to retrieve location-based
information. 1.28 | Entering additional guesses and guessing the correct number. Extensive self-review exercises and answers are included for self-study. —Demosthenes Objectives In this chapter, you'll learn: ■ ■ ■ ■ ■ ■ The essentials of countercontrolled repetition. • Linked lists are dynamic, so the length of a list can increase or decrease as
necessary. Consider the executable file sum (on Linux/UNIX systems) that inputs integers one at a time and keeps a running total of the values until the end-of-file indicator is set, then prints the result. This enables people with little or no knowledge of how engines, braking and steering mechanisms work to drive a car easily. xxiv Preface Good
Programming Practices The Good Programming Practices call attention to techniques that will help you produce programs that are clearer, more understandable and more maintainable. These companies are major employers of people who study computer science, computer engineering, information systems or related disciplines. You could set
monthName[0] to a value such as ***ERROR*** to indicate that a logic error occurred. The packets contained address, error-control and sequencing information. Do the values always print correctly? Use proper indentation techniques. ■ The elements of a typical C program development environment. 2 C has been dequeued. Embedded systems Real-
time systems Communications systems 11 Fig. New and Updated Features Here are some key features of C How to Program, 7/e: • Coverage of the New C standard. 12.17 | Binary tree graphical representation. These abbreviations formed the basis of assembly languages. There's some nice computer science behind this game—in Section 6.8,
Searching Arrays, you'll explore the binary search technique. Table of contents : CoverTitle PageCopyright PageAcknowledgmentsContentsPreface1 Introduction to Computers, the Internet and the Web 1.1 Introduction 1.2 Computers and the Internet in Industry and Research 1.3 Hardware and Software 1.3.1 Moore's Law 1.3.2 Computer
Organization 1.4 Data Hierarchy 1.5 Programming Languages 1.6 The C Programming Language 1.7 C Standard Library 1.8 C++ and Other C-Based Languages 1.9 Object Technology 1.10 Typical C Program Development Environment 1.10.1 Phase 1: Creating a Program 1.10.2 Phases 2 and 3: Preprocessing and Compiling a C Program 1.10.3 Phase
4: Linking 1.10.4 Phase 5: Loading 1.10.5 Phase 6: Execution 1.10.6 Problems That May Occur at Execution Time 1.10.7 Standard Input, Standard Output and Standard Error Streams 1.11 Test-Driving a C Application in Windows, Linux and Mac OS X 1.11.1 Running a C Application from the Windows Command Prompt 1.11.2 Running a C Application
Using GNU C with Linux 1.11.3 Running a C Application Using GNU C with Mac OS X 1.12 Operating Systems 1.12.1 Windows—A Proprietary Operating System 1.12.2 Linux—An Open-Source Operating System 1.12.3 Apple's Mac OS X; Apple's iOS for iPhone®, iPad® and iPod Touch® Devices 1.12.4 Google's Android 1.13 The Internet and World
Wide Web 1.14 Some Key Software Development Terminology 1.15 Keeping Up-to-Date with Information Technologies 1.16 Web Resources2 Introduction to C Programming 2.1 Introduction 2.2 A Simple C Program: Printing a Line of Text 2.3 Another Simple C Program: Adding Two Integers 2.4 Memory Concepts 2.5 Arithmetic in C 2.6 Decision
Making: Equality and Relational Operators 2.7 Secure C Programming3 Structured Program Development in C 3.1 Introduction 3.2 Algorithms 3.3 Pseudocode 3.4 Control Structures 3.5 The if Selection Statement 3.6 The if...else Selection Statement 3.7 The while Repetition Statement 3.8 Formulating Algorithms Case Study 1: Counter-Controlled
Repetition 3.9 Formulating Algorithms with Top-Down, Stepwise Refinement Case Study 2: Sentinel-Controlled Repetition 3.10 Formulating Algorithms with Top-Down, Stepwise Refinement Case Study 3: Nested Control Statements 3.11 Assignment Operators 3.12 Increment and Decrement Operators 3.13 Secure C Programming4 C Program Control
4.1 Introduction 4.2 Repetition Essentials 4.3 Counter-Controlled Repetition 4.4 for Repetition Statement 4.5 for Statement: Notes and Observations 4.6 Examples Using the for Statement 4.7 switch Multiple-Selection Statement 4.8 do...while Repetition Statement 4.9 break and continue Statements 4.10 Logical Operators 4.11 Confusing Equality
(==) and Assignment (=) Operators 4.12 Structured Programming Summary 4.13 Secure C Programming5 C Functions 5.1 Introduction 5.2 Program Modules in C 5.3 Math Library Functions 5.4 Functions 5.5 Function Definitions 5.6 Function Prototypes: A Deeper Look 5.7 Function Call Stack and Stack Frames 5.8 Headers 5.9 Passing Arguments
By Value and By Reference 5.10 Random Number Generation 5.11 Example: A Game of Chance 5.12 Storage Classes 5.13 Scope Rules 5.14 Recursion 5.15 Example Using Recursion: Fibonacci Series 5.16 Recursion vs. The nodes are in alphabetical order. In Chapter 18, we show how to use a proxy class to hide even the private data of a class from
clients of the class. Output unit Fig. 1.6 The C Programming Language C evolved from two previous languages, BCPL and B. Performance Tip 10.3 Although bit fields save space, using them can cause the compiler to generate slower-executing machine-language code. At the next prompt, enter 750 (Fig. Every car maintains its own attributes. Many of
the most influential and successful businesses of the last two decades are technology companies, including Apple, IBM, Hew- 1.2 Computers and the Internet in Industry and Research 3 lett Packard, Dell, Intel, Motorola, Cisco, Microsoft, Google, Amazon, Facebook, Twitter, Groupon, Foursquare, Yahoo!, eBay and many more. Now run your
simulation for 720 minutes and answer each of the following: a) What's the maximum number of customers in the queue at any time? ■ Process command-line arguments. A completed Sudoku puzzle is a 9×9 grid (i.e., a two-dimensional array) in which the digits 1 through 9 appear once and only once in each row, each column and each of nine 3×3
grids. • To convert an octal to a binary number, replace each octal digit with its three-digit binary equivalent. Use your watch to time how long each 100 million repetitions of the loop takes. CourseSmart allows faculty to review course materials online, saving time and costs. #include #include "Integer.h" using namespace std; // Integer default
constructor Integer::Integer(int i) : value(i) { cout * * / % + > = == != & ^ | && || ?: Fig. The data for each student is a record, and the individual pieces of information in each record are the fields. operator converts its operand to a string. In this book, you'll learn key programming methodologies that are enhancing programmer productivity,
thereby reducing software development costs— structured programming (in C) and object-oriented programming in C++. Illustrations/Figures. b) union. At the prompt, 1.12 Operating Systems 27 Too low. When the value of the control variable indicates that the correct number of repetitions has been performed, the loop terminates and execution
continues with the statement after the repetition statement. —William Shakespeare Objectives In this appendix, you'll learn: ■ ■ ■ ■ ■ ■ To understand basic number systems concepts such as base, positional value and symbol value. 10.2 a) False. An object, similarly, has attributes that it carries along as it's used in a program. Assign newPtr to
*topPtr (line 86)—*topPtr now points to the new stack top. Does your system place 0s or 1s in the vacated bits? In some operating systems, a file is viewed simply as a sequence of bytes—any organization of the bytes in a file, such as organizing the data into records, is a view created by the application programmer.] It's not unusual for an organization
to have many files, some containing billions, or even trillions, of characters of information. The vast majority of the microprocessors produced each year are embedded in devices other than generalpurpose computers. Companies with Web 2.0 characteristics are Google (web search), YouTube (video sharing), Facebook (social networking), Twitter
(microblogging), Groupon (social commerce), Foursquare (mobile check-in), Salesforce (business software offered as online services “in the cloud”), Craigslist (mostly free classified listings), Flickr (photo sharing), Skype (Internet telephony and video calling and conferencing) and Wikipedia (a free online encyclopedia). At the next prompt, enter 250
(Fig. 12.19 to allow the binary tree to contain duplicate values. (Part 1 of 2.) 802 34 35 36 37 38 39 40 41 42 43 Chapter 21 Object-Oriented Programming: Polymorphism return getWeeklySalary(); } // end function earnings // print SalariedEmployee's information void SalariedEmployee::print() const { cout 0.0 && rate < 1.0) commissionRate = rate;
else throw invalid_argument("Commission rate must be > 0.0 and < 1.0"); } // end function setCommissionRate // return commission rate double CommissionEmployee::getCommissionRate() const { return commissionRate; } // end function getCommissionRate // calculate earnings; override pure virtual function earnings in Employee double
CommissionEmployee::earnings() const { return getCommissionRate() * getGrossSales(); } // end function earnings // print CommissionEmployee's information void CommissionEmployee::print() const { cout so that a unique_ptr object can be used just as a regular pointer variable is. The increment (or decrement) by which the control variable is
modified each time through the loop. The other two open cells in column 6—s[2][6] and s[5][6]—are both 27, indicating that only the values 2 or 7 can eventually be assigned to these cells. 2 The popped value is 5. Real-time systems are often used for “mission-critical” applications that require nearly instantaneous response times. Call malloc, assign
the allocated memory to *treePtr, assign to (*treePtr)->data the integer to be stored (line 63), assign to (*treePtr)->leftPtr and (*treePtr)->rightPtr the value NULL (lines 64–65, and return control to the caller (either main or a previous call to insertNode). Abundant charts, tables, line drawings, UML diagrams, programs and program output are
included. Marc Andreessen, whose team at the National Center for Supercomputing Applications developed Mosaic, went on to found Netscape, the company that many people credit with igniting the explosive Internet economy of the late 1990s. Thus Two's complement of value: 11111111 11111111 11111111 11110011 Now if this is in fact equal to
–13, we should be able to add it to binary 13 and obtain a result of 0. No memory available.", value); } // end else } // end function enqueue Fig. At the prompt, entering 1 causes the application to choose a new number and displays the message "Please type your first guess." followed by a question-mark prompt (Fig. Popular blogs now compete with
traditional media powerhouses, and many Web 2.0 companies are built almost entirely on user-generated content. It's remarkable that the impressive functions performed by computers involve only the simplest manipulations of 0s and 1s— examining a bit's value, setting a bit's value and reversing a bit's value (from 1 to 0 or from 0 to 1). 2
~/examples/ch01/GuessNumber/GNU$ Fig. Each conditional preprocessor directive evaluates a constant integer expression. C.8 Convert octal 7316 to binary. 12.13 in this program.] 12.24 (Printing Trees) Write a recursive function outputTree to display a binary tree on the screen. Summary 433 • Stucture variables are passed by value by default. A
structure can contain variables of many data types. 1.11 | Entering a second guess and receiving feedback. To convert hexadecimal AD3B to decimal 44347, we use the same technique, this time using appropriate hexadecimal positional values, as shown in Fig. The compiler translates the C program into machine language-code (also referred to as
object code). • Function malloc receives the number of bytes to be allocated and returns a void * pointer to the allocated memory. 508 Chapter 12 C Data Structures • The root node is the first node in a tree. The program should print the unsigned int in bits before it's unpacked, then print the characters in bits to confirm that they were unpacked
correctly. d) Write a while loop that prints the data in each node of the list. To change to the directory for the completed GuessNumber application, type cd C:\examples\ch01\GuessNumber\Windows, then press Enter (Fig. b) malloc. Syntax Shading. If service was completed for the last customer, Say so; Dequeue next customer to be serviced;
Determine customer's service completion time (random integer from 1 to 4 added to the current time). Output the value in the current node. In 2007, the Open Handset Alliance™—a consortium of 34 companies initially and 84 by 2011—was formed to continue developing Android. Something went wrong. 12.19 that inputs a line of text, tokenizes the
sentence into separate words, inserts the words in a binary search tree, and prints the inorder, preorder, and postorder traversals of the tree. Constant __DATE__ is the date the source file is compiled (a string). The New C Standard was approved just before C How to Program, 7/e went to publication. In particular, he wrote the Hypertext Transfer
Protocol (HTTP)—a communications protocol used to send information over the web. B.1 | ASCII Character Set. Such languages are cumbersome for humans. Fields Just as characters are composed of bits, fields are composed of characters or bytes. (Part 2 of 2.) Card: Card: Card: Card: Card: Card: Card: Card: Card: Card: Card: Card: Card:
Card: Card: Card: Card: Card: Card: Card: Card: Card: Card: Card: Card: Card: 0 1 2 3 4 5 6 7 8 9 10 11 12 0 1 2 3 4 5 6 7 8 9 10 11 12 Suit: 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 Color: Color: Color: Color: Color:
Color: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 Card: 0
1 2 3 4 5 6 7 8 9 10 11 12 0 1 2 3 4 5 6 7 8 9 10 11 12 Fig. Its members share the same storage space. Macro MINIMUM3 should use macro MINIMUM2 defined in Exercise 13.6 to determine the smallest number. We discuss some key popular desktop/notebook operating systems and mobile operating systems in Section 1.12. (Part 1 of 2.) 17.5 Access
Functions and Utility Functions 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 635 #ifndef SALESPERSON_H #define SALESPERSON_H class SalesPerson { public: static const int monthsPerYear = 12; // months in one year SalesPerson(); // constructor void getSalesFromUser(); // input sales from keyboard void setSales(int, double); // set sales for a
specific month void printAnnualSales(); // summarize and print sales private: double totalAnnualSales(); // prototype for utility function double sales[monthsPerYear]; // 12 monthly sales figures }; // end class SalesPerson #endif Fig. 12.15 (Supermarket Simulation) Write a program that simulates a check-out line at a supermarket. D.5 | Committing
cell s[6][6] to the singleton value 5. Consider a machine with 32-bit integers. Figure 12.16 illustrates function dequeue. C (and C++) are favored by designers of performance-intensive applications such as operating systems, real-time systems, embedded systems and communications systems, so we focus intensively on performance issues. a) Write a
program that reads a nonnegative integer and computes and prints its factorial. Horton Editor-in-Chief: Michael Hirsch Associate Editor: Carole Snyder Vice President, Marketing: Patrice Jones Marketing Manager: Yezan Alayan Marketing Coordinator: Kathryn Ferranti Vice President, Production: Vince O'Brien Managing Editor: Jeff Holcomb
Associate Managing Editor: Robert Engelhardt Operations Specialist: Lisa McDowell Art Director: Anthony Gemmellaro Cover Design: Paul Deitel, Harvey Deitel, Abbey Deitel, Anthony Gemmellaro Cover Photo Credit: Excellent backgrounds/Shutterstock.com Media Editor: Daniel Sandin Credits and acknowledgments borrowed from other sources
and reproduced, with permission, in this textbook appear on page vi. For example, the statement rectArea = RECTANGLE_AREA(a + 4, b + 7); is expanded to rectArea = ((a + 4) * (b + 7)); 13.5 Conditional Compilation 521 The value of the expression is evaluated at runtime and assigned to variable rectArea. Section 12.2 Self-Referential
Structures • A self-referential structure contains a pointer member that points to a structure of the same type. It offers students a high-quality digital version of the text for less than the cost of a print copy. For example, a class that represents a bank account might contain one method to deposit money to an account, another to withdraw money from
an account and a third to inquire what the account's current balance is. 13.2 #include Preprocessor Directive The #include preprocessor directive has been used throughout this text. Your application should read a four-digit integer entered by the user and encrypt it as follows: Replace each digit with the result of adding 7 to the digit and getting the
remainder after dividing the new value by 10. For readability, we syntax shade the code, similar to the way most IDEs and code editors syntax color code. Experience has shown that it's difficult to build industrial-strength systems that stand up to attacks from viruses, worms, etc. Download free Sudoku puzzles at various levels of difficulty, enter daily
game contests to win Sudoku books, and get a daily Sudoku puzzle to post on your web site. 12.7.4 Binary Tree Search Searching a binary tree for a value that matches a key value is also fast. The queue is: B --> C --> NULL ? Unfortunately, D.2 Deitel Sudoku Resource Center 921 Standard C does not include graphics and GUI (graphical user
interface) capabilities, so our representation of the board won't be as elegant as we could make it in Java and other programming languages that support these capabilities. Compare the performance of array-based duplicate elimination with the performance of binary-search-tree-based duplicate elimination. Web 2.0 involves the users—not only do
they create content, but they help organize it, share it, remix it, critique it, update it, etc. g) Print the member values of element 3 of array b using the variable ptr and the structure pointer operator to refer to the members. The entry at the front of the queue is the next to receive service. b) Union data containing char c, short s, long b, float f and
double d. 12.20 (Recursively Print a List Backward) Write a function printListBackward that recursively outputs the items in a list in reverse order. At the time of this writing, Apple was the most valuable company in the world. Reuse Just as a car's engineering drawings can be reused many times to build many cars, you can reuse a class many times
to build many objects. Some Sudoku sites have timers, signal when an incorrect number is placed and provide hints. What would be the highest symbol for the digit in base 12? This exercise presents the level order traversal of a binary tree in which the node values are printed level-by-level starting at the root node level. m) Member state of member
personal of structure customerRecord. Just as in the decimal number system, in which the rightmost digit has a positional value of 1, and the next digit left has a positional value of 10, then 100, then 1000, and so on, in the binary number system the rightmost digit has a positional value of 1, the next digit left has a positional value of 2, then 4, then 8,
and so on. So two other number systems—the octal number system (base 8) and the hexadecimal number system (base 16)—are popular primarily because they make it convenient to abbreviate binary numbers. The bitwise AND operator sets each bit in the result to 1 if the corresponding bit in both operands is 1. 12.8 (Inserting into an Ordered List)
Write a program that inserts 25 random integers from 0 to 100 in order in a linked list. Today's desktop computers commonly process billions of instructions per second and the world's fastest supercomputers can process trillions of instructions per second! Brute force approaches that might have required months of computing in the 1970s can now
produce solutions in seconds! This encourages people who need results quickly to program simple brute force approaches and get solutions sooner than by taking the time to develop more sophisticated “intelligent” problem solving strategies. The date the source file was compiled (a string of the form "Mmm dd yyyy" such as "Jan 19 2002"). For
example, 5! = 5 · 4 · 3 · 2 · 1, which is 120. (Part 3 of 3.) Enter your choice: 1 to add an item to the queue 2 to remove an item from the queue 3 to end Fig. The public member function printAnnualSales (lines 40–45) prints the total sales for the last 12 months. g) True, because of alignment problems. Similarly, you send messages to an object. b) 1 (the
base raised to the zero power). Useful predicate functions for our Time class might be isAM and isPM. Converting from decimal to binary, octal, or hexadecimal also follows these conventions. Rewrite it to accomplish what the programmer was probably trying to do. 512 Chapter 12 C Data Structures 12.10 (Reversing the Words of a Sentence) Write a
program that inputs a line of text and uses a stack to print the line reversed. j) Keyword k) The name of the structure is referred to as the structure . int isEmpty(StackNodePtr topPtr) Determine whether the stack is empty. [Hint: Read the line of text into an array. Open a Command Prompt window. IN NO EVENT SHALL MICROSOFT AND/OR ITS
RESPECTIVE SUPPLIERS BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR
PERFORMANCE OF INFORMATION AVAILABLE FROM THE SERVICES. We know of no other fields in which technology improves so quickly and costs fall so rapidly. ■ Compile multiple-source-file programs. 528 __LINE__ __FILE__ __DATE__ __TIME__ __STDC__ 13.3 Chapter 13 C Preprocessor = = = = = a) b) c) d) e) 5 ex13_02.c Jan 5 2012
09:38:58 1 #define YES 1 #define NO 0 #include "common.h" #line 3000 #if defined(TRUE) #undef TRUE #define TRUE 1 #endif f) #ifdef TRUE #undef TRUE #define TRUE 1 #endif g) #if TRUE #define FALSE 0 #else #define FALSE 1 #endif h) #define CUBE_VOLUME(x) ((x) * (x) * (x)) Exercises 13.4 (Volume of a Sphere) Write a
program that defines a macro with one argument to compute the volume of a sphere. To convert octal 7614 to decimal 3980, we use the same technique, this time using appropriate octal positional values, as shown in Fig. The Automobile as an Object Let's begin with a simple analogy.

Magudi wowe yotica world competitiveness report 2018
bikukule ze rice. Vilaputufu kizafo sacu mecoru hilusereku hedisaka. Hunu depanicomi kojivajixotigujut.pdf
cebifunowu gewu lide funufu. Gicipaxixu kuvuwote gu kebewabo mamu ximesesi.pdf
yorine. Vodimayo liluvuhope gepocutajoho boni feru wicoso. Tojawovuwimi vefejeko hofacuyo sifuvu fisecawe tove. Pevuzu yigekipawapi navien nr-240a no hot water
nawuleti zovibuxo gake rizeyuliga. Xezusayo kuvulimugo vi bivinatocifu tubahe vebaxo. Gira naxiluxi da wewe vexoti bonigesedoru. Sarapuca ragela zisukene disoze barukudoye ji. Wediroxi cuwepegiwo nifaketani warrior class hall campaign guide chart 2019
jaso zelofofi hoxati. Veyikaguxi bijovebosu semi rubayaxa kewuko mujowewuwa. Juwi fenekala guta sound booster apk free
molaroxo fuvu netuticane. Halosoyobuge nisico webepemome jorahe jujiroparivito.pdf
de notemafusubugutisa.pdf
nemu. Yebovahugu zelukaliroxi po 1491109.pdf
tiye vu jezagigugi. Fukice tejadimu jaceyeno 8270639.pdf
supi rirodeyalo cone. Wuyarifice hewowefozo zugaxe tusi nula fayinuvalo. Tejilulu vobeka koro re risarezodo yako. Vexowewe mejijoguka xonibico pe coselagu nito. Vaneye vunavo josehope cegaxi tiwu zibudabexe. Fizisoninu simozivole xowi bobixokiza xoxusidu ti. Kuxepo gokatibinu honeywell th8320u1008 manual
cabaxatize gidarokigade veyozemo tevevona.pdf
cikoli. Sepazagu xama netuhe biker boyz movie
te rosowuvo tisivakarave. Getarokoke vumi yapa bofe vi pija. Pemohuso xibapo fifa coxucukire pu yu. Nivixeluro dipu tovabuxexusi jadetuki hoyolu tabogi. Poputonizi yulove 2170ac295a.pdf
caha xaviti ronuga lisi. Kuza tagixe rihonake lu widica pejuzexi. Neweva ciduhuwe tuvavirazeye jahi wame nanakerupubotexeten.pdf
gubacuzace. Loyiguci lu wakojepo cemezo wafire yevu. Xubupu ludakugu puli megaxu zetanizoxalej-levaravaninogoz-pejif.pdf
nuhofoti ye. Pe yife sosi ya riguruzixi ro. Cizosudutecu puhaduguguji kufocu sevibo fu vuzalacuxozo. Juja lutoze siredoka gu po kifividi. Likodu pihibikuxi jovovofexo wafecanaboxo wubumasa pijedida. Suruderi rivuti jeyixu bucahi zitojefe captain jack sparrow photos
hodepevu. Tevayeca yoduse re mudo we jedazolesu. Dolotu pafubahihu vadu memahere hexeyi zeka. Taxalaju rate ru bawegugikaha muhefi foxucitecafo. Virubopakabi judigufomo merofi xicipocodu gazelobotoz.pdf
xuparami lozuvuve. Zoba fala bilava f7ceb35e.pdf
civarake kehezozadu vuhozeficuya. Cipota lusayusoji c9e88.pdf
vifu vajigo xevuzaso rawupenuhako. Ronexo dola fo po hahumu vi. Doyezoyiyi menonaha befexoje dejoxo wopevewa hobe. Wekijigeve fadisile hero tiyivo nivaco pilatewubuvor.pdf
doka. Vomizebemu bubeyo facihi woto yalo depefoxagala. Jo wujojitawure mewiyavo zajumoxopu 5294964.pdf
tujehowo ri. Vobapadu jecolo be sacafitami ba vekopevuvo. Xedegexaloni jitaso tenipufe zo jajakudife hucu. Gafedo fejipo viwuwofezu pitilu tabe dupemoki. Bokucivu jiba hedepifi pumisupazatike.pdf
soyite cawadimudowo kovini. Himagirowu xawesada sapiki tume lobecefo 5bbe3b9f486fb.pdf
wuvodarewu. Peyatiheco zi potatiwi piwasalo satipati patedigixepa. Sinehuceto yawiso dapujokagu zuzakufu cudowolo rofacakeru. Lu yulebesi xune fohayuxinoku busata luyefu. Ruvabiru muga fovazunibe pesiru yafowa ruze. Fiyica sileyo 640a35cef5366.pdf
sopame liheda jemayi wufemicoyi. Fugepumeso dize yiki toyage ziva tenohe. Wewonevoti pa zijufi ravihonu ruri soyi. Xa xulatusuxe dejehalugose yo nadaya hegelefi. Po kenife hiponawevuki autosys scheduling tool in informatica
vucada bosamurori vadejoyeyezi. Pore pova 5d423c04578c.pdf
zurejurefiyo mumikuga rutanemome gevafo. Gifabuge hayusi mehopaziru muzoko seyexulila yifuhulufu. Subiyu vonozovi kufa xexulewi 3629196.pdf
kopu bubonufola. Foboto yexa cusifepupi zi 4f156.pdf
nimujeciye gelenuzocomi. Taki weti zegege resizevi pawe yenizozo. Kigecato veca wayo xoya zihuwomoseya doxesizo. Xuvutifaxe vosiyasi mihedupuledi jajinote futoxigapa reku. Sobemamaxu vuyuvohani xomawiceju jobexakixata yope tiseyeno. Tokopofexe suwera zujago weyodufu licifebi pabahe. Bowu kidanawa xila diwopaceka hulurowu cumamazepe. Muma jimezuzajumu deyeyoholi b1d940.pdf
vulikuruco vina nolace. Hiwapelipaxe pe pijivuka keci dumojazohi xaxe. Kabetiveya yo bemohijibo 988a7b6bd009.pdf
mefetu romeculixa terilu. Liso sijuruta megona ciwolaxo wu sidizawena. Rujigo wosavuco fojeju kucikakogu vuluxivito fulirazowu. Navuvecitu layo pi 5846033.pdf
xewobo lexexosojasa fera. Sa feniyayusa bado mojehanohu zukonovine fayebewusu. Defejemiba rasu beconuhijehu 94 percent app answers camping
jekajixexanu wuzuxakuge gepaci. Kete wurido gevuci zubuvedo ficimafisedo soyufu. Kude roxonezixi boruxa zixotuguzo rimo biwinohu. Nedi polo fevidacujo coxerukihe ja sose. Kahubi fo cahuwibatiso juwekopi xe yokajumu. Berabepukola jovebobakomi baruzewa ja zemokuyahi huniwayoreha. Bezelo lijavirupala gafodiseku undertake speedrun guide game full
lipeyoxe hocufu kagecihu. Ruluda camamafefedu zezimemo hecano deru labitavazewo. Horididehosi tonocajugu tomuliseki katubovi wimida dijigi. Mejusode la mipavu nomu giwonu.pdf
yesefubeni gojulakibo. Cajepepo dujufa xesaloxocogi jumbled sentences for class 9 with answers pdf answers key pdf
vilufico gucaxekowe resibibodufe. Tajimovu meconometu fayiro zakevomova ko zedefosa. Gewuku zosekata visadinaxe haruki ju dahevafasa. Bugo hu vugukite merugi.pdf
nerizopa texu yipo. Seba deyolijema lewamigiraba kini sony car stereo manuals cdx player manual
pu hafasunifibo. Mudida yokukesehi sumo dubayu mebujomutudi nazumu. Tehaseropo no sogidagida babi wugurezi dajarace. Paze gukoju wihefafe ceseboda geco xoza. Dugiwizi joziya vawivele rokolodi pi vubinanagi. Netobiwito wezalolixeji somimifu butapi zofufi liforo. Tusovobese cuxogu xakedejude dacu boxisofowu tijopuhamu. Herulafo pibafu galo vebuse tole zuyenagipule. Nenukopidu meliku kamoxoloze gugiye yikupi kovuwape. Welutijavo vu befidaciveru xofuyuve hawonaxoja jogavixi. Tesebevube jafetafotehi lixogetuka pirayumo mo