# Chapter 1

*Solutions*

**True/False Questions**

* A computer system is made of two major components: hardware and software.
* True.
* The hardware components of the computer system consist of the input system, output system, and secondary storage.
* False. It also includes main memory and the CPU.
* The ALU is made of the CPU and primary memory.
* False. The ALU is a component of the CPU.
* Computer software can be divided into two broad categories: system software and application software.
* True.
* System support software includes system utilities and other operating services.
* True.
* Computer languages can be divided into three categories: machine languages, symbolic languages, and high-level languages.
* True.
* In a procedural paradigm, each command changes the state of the memory.
* True.
* In a procedural paradigm, there is a direct relationship between the set of procedures and the set of data packages.
* False. An Object-Oriented Paradigm does, not a procedural paradigm.
* C++ is a language based on the logic paradigm.
* False. C++ is based on the procedural and object-oriented paradigms.
* C++ can be used both as a procedural and an object-oriented paradigm.
* True.

**TF-11.** In a logic paradigm, all queries can be answered using only a set of facts.

**STF-11.** False. It also requires rules.

**Review Questions**

* List and briefly describe the two major components of a computer system.
* A computer is a system made of two major components: hardware and software. The computer hardware is the physical equipment. The software is the collection of programs (instructions) that allow the hardware to do its job.
* Computer hardware is made up of five parts. List and briefly describe them.
* The Central Processing Unit: consists of the arithmetic-logical unit (ALU), the control unit, and a set of registers to hold data temporarily while being processed.
* The input system: usually a keyboard where programs and data are entered into the computer.
* The output system: usually a monitor or a printer where the output is displayed or printed.
* Primary Memory: where programs and data are stored temporarily during processing.
* Secondary Storage: where programs and data are stored permanently in secondary storage
* Explain the difference between primary memory and secondary storage.
* Primary memory is where programs and data are stored temporarily during processing whereas data stored in secondary storage are permanent.
* Explain the reason that we need secondary storage in addition to primary memory.
* Primary memory is where programs and data are stored temporarily during processing whereas data stored in secondary storage are permanent.
* List and explain the duties of three parts of a CPU.
* The central processing unit (CPU) consists of the arithmetic-logical unit (ALU), which executes instructions such as arithmetic calculations and comparisons among data; the control unit, which is the traffic cop of the system; and a set of registers that hold data temporarily while being processed.
* Describe the two major categories of software.
* System software manages the computer resources. Application software, on the other hand, is directly responsible for helping users solve their problems.
* Describe the purpose of an operating system.
* The operating system provides services such as a user interface, file and database access, and interfaces to communication systems. The primary purpose of this software is to operate the system in an efficient manner while allowing the users access to the system.
* Give at least two examples of system software.
* Computer operating system and system development software.
* Give at least two examples of application software.
* A general-ledger system and an Excel spread sheet.
* List three types of computer languages described in the text.
* High-Level Languages, Symbolic Languages, and Machine Languages.
* Describe the primary differences between symbolic and high-level languages.
* Symbolic languages simply mirror machine languages using symbols, or mnemonics, to represent the various machine language instructions. High-level languages allow programmers to concentrate on the application problem at hand rather than the intricacies of the computer.
* Describe the difference between a procedural and an object-oriented language.
* A program written in the procedural paradigm is a set of commands grouped into procedures that may be reusable. The object-oriented paradigm also creates procedures that can be applied to a particular type of data package referred to as an object, which contains all possible operations that can be applied to an object.
* List at least three languages that are designed to use a procedural paradigm.
* FORTRAN, Pascal, and C++.
* List at least three languages that are designed to use an object-oriented language.
* C++, Smalltalk, and Java
* List and explain the steps that a programmer follows to develop a program.
* The following lists the steps.
* The first step is to understand the problem. Then a solution must be designed using tools such as UML.
* Once the solution is understood, the programmer writes the program in an appropriate language. It is then compiled and linked into an executable program.
* The program is then executed using test cases created to verify the accuracy of the program.
* Distinguish between a compiler and a linker.
* A compiler translates the program into machine language. The linker combines the generated code with library functions to create the executable program.

## Problems

* Show the state of the memory for the following example of a procedural paradigm. (See Figure 1.11 in the text).

|  |
| --- |
| input a |
| input b |
| input c |
| sum = a + b + c |
| output sum |

* Assume that the value of a, b, c are 12, 7, and 5 respectively. Figure 1.1 shows the state of memory. We have shown memory in two columns to save space.

|  |
| --- |
| * Solution to PR-1 |
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* Show the state of the memory for the following example of a procedural paradigm (See Figure 1.11 in the text). Assume that value of *length* and *width* are 12 and 8 respectively representing the sides of a rectangle.

|  |
| --- |
| input length |
| input width |
| area = length  width |
| parameter = 2  (length + width) |

* Figure 1.2 shows the state of memory.

|  |
| --- |
| * Solution to PR-2 |
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* Imagine we need to create a bank account object using an object-oriented paradigm. Show the data and list of procedures you think need to be encapsulated with the data (see Figure 1.12 in the book.).
* We assume only three data member for each object (account no, name, and balance). Figure 1.3 shows the situations of shared procedures and objects.

|  |
| --- |
| * Solution to PR-3 |
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* In a functional paradigm, show the result of the following function (See   
  Figure 1.13 in the text.).

|  |
| --- |
| first (rest (rest (a, b, c))) |

* We find the result of the function step by step (starting from the innermost function)

|  |
| --- |
| first (rest (rest (a, b, c))) = first (rest (b, c)) |
| first (rest (b, c)) = first (rest (c)) |
| first (rest (c)) = first (c) |
| first (c) = c |

* In a functional paradigm, show the result of the following function assuming that the list (...) makes a list of given elements. (See Figure 1.13 in the text.).

|  |
| --- |
| list (first (rest (a, b)), first (a, b)) |

* We find the result of the function step by step (starting from the innermost functions.)

|  |
| --- |
| list (first (rest (a, b)), first (a, b)) = list (first (b), a) |
| list (first (b), a) = list (b, a) |

* Based on Figure 1.14 in the text, what is the result of the following queries?

|  |
| --- |
| Parent (Benji, Tara)? |
| GrandParent (Fay, Willi)? |

* The first one is not a fact according to Figure 1.14. The answer is false. For the second query, we need to use the rule defined in Figure 1.14 as shown below:

|  |
| --- |
| GrandParent (Fay, Willi) = Parent (Fay, Tara) AND Parent (Tara, Willie) |

Since both of the two facts are true, the result is true.

* Based on Figure 1.14, what is the result of the following queries?

|  |
| --- |
| Parent (Fay, Tara)? |
| GrandParent (Tara, Willi)? |

* The first one is a fact according to Figure 1.14. The answer is true. For the second query, we need

|  |
| --- |
| GrandParent (Tara, Willi) = Parent (Tara, x) AND Parent (x, Willie) |

Since *x* needs to be the same in both facts, we cannot find either of the facts and the result is false.

* Show the value of *sum* after the following algorithm is executed?

|  |
| --- |
| sum = 0 |
| sum = sum + 10 |
| sum = sum × 10 |
| sum = sum – 10 |

* Figure 1.4 shows the contents of *sum* after each line. Note that the value of *sum* will be changed only if it is at the left-hand side of the assignment. It is copied if it is at the right-hand side of the assignment.

|  |
| --- |
| * Solution to PR-8 |
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* Show the value of *x* after the following algorithm is executed?

|  |
| --- |
| x = 5 |
| x = x + 1 |
| x = x - 10 |

* Figure 1.5 shows the contents of x after each line. Note that the value of x will be changed only if it is at the left-hand side of the assignment. It is copied if it is at the right-hand side of the assignment.

|  |
| --- |
| * Solution to PR-9 |
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* Show the value of *x*, *y*, and *z* after the following algorithm is executed?

|  |
| --- |
| x = 2 |
| y = 5 |
| x = x + 1 |
| y = y - 10 |
| z = 8 |
| z = x + y |
| x = y + z |
| y = x + y + z |

* Figure 1.6 shows the contents of x, y, and z after each line. Note that the value of x, y, or z will be changed only if they at the left-hand side of the assignment. the values are copied if they are at the right-hand side of the assignment.

|  |
| --- |
| * Solution to PR-10 |
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* Design an algorithm that converts a value in centimeters to a value in inches using the following formula:

|  |
| --- |
| 1 inch = 2.54 centimeters |

* The following shows the algorithm:

|  |
| --- |
| Input value in centimeters |
| Divide value in centimeters by 2.54 |
| Output value in inches |

* Design an algorithm that converts a value in inches to a value in centimeters using the following formula:

|  |
| --- |
| 1 centimeter = 0.3937 inch |

* The following shows the algorithm:

|  |
| --- |
| Input value in inches |
| Multiply value in inches by 0.3937 |
| Output value in centimeters |

* Design an algorithm that converts a temperature value in Fahrenheit (F) to a value in Celsius (C) using the following formula:

|  |
| --- |
| C  (F  32)  (100/180) |

* The following shows the algorithm:

|  |
| --- |
| Input temperature in Fahrenheit |
| Subtract 32 from temperature |
| Multiply temperature by 100 |
| Divide temperature by 180 |

* Design an algorithm to find the sales tax and the total sale value of a transaction made of two soft drinks (1 dollars each), three bottles of milk (2 dollars each), and one can of coffee (3 dollars). The tax is 9 percent.
* The following shows the algorithm:

|  |
| --- |
| Input number of soft drinks  Set total to number of soft drinks times 1  Input number of bottles of milk  Set total to total plus bottles of milk times 2  Input number of cans of coffee  Set total to total plus cans of coffee times 3  Set total to total times 1.09 |

* Design an algorithm that finds the smallest among a list of numbers.
* The following shows the algorithm:

|  |
| --- |
| Set smallest to + infinity |
| While there are more numbers repeat |
| Input number |
| If number smaller than smallest |
| Set smallest to number |
| Output smallest |

* Design an algorithm that finds the sum of a list of numbers.
* The following shows the algorithm:

|  |
| --- |
| Set sum to 0 |
| While more numbers  Input next number |
| Add next number to sum |
| Output sum |

* Design an algorithm that finds the product of a list of numbers.
* The following shows the algorithm:

|  |
| --- |
| Set product to 1 |
| While more numbers  Input next number |
| Multiply next number by product |
| Output product |

* Design an algorithm that adds numbers from 1 to 100.
* The following shows the algorithm:

|  |
| --- |
| Set total to 0  Set count to 0  While count less than 100 repeat  Add count to total  Add 1 to count  Output total |

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