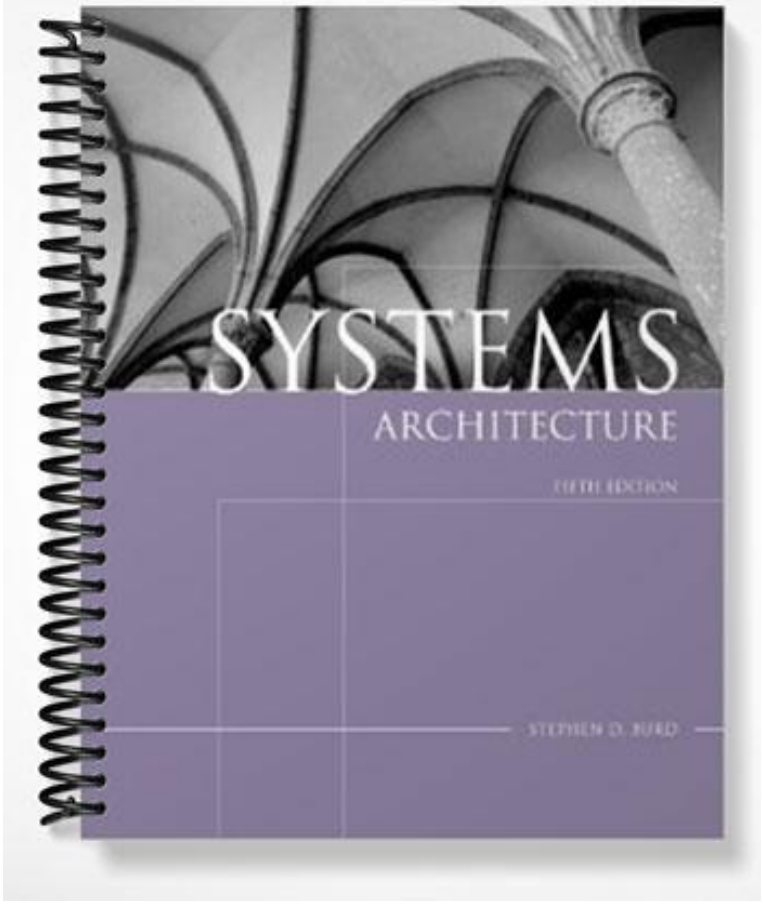
SOLUTIONS MANUAL



Chapter 2 Solutions

Vocabulary Exercises

1. A(n) _____ generally supports more simultaneous users than a(n) _____. Both are designed to support more than one user.
   Answer: mainframe, minicomputer

2. A(n) _____ is a storage location implemented within the CPU.
   Answer: register

3. The term _____ refers to storage devices, not located within the CPU, that hold instructions and data of currently executing programs.
   Answer: memory or main memory

4. A problem-solving procedure that requires executing one or more comparison and branch instruction is called a(n) _____.
   Answer: algorithm

5. A(n) _____ is a command to the CPU to perform one processing function on one or two data inputs.
   Answer: instruction

6. The term _____ describes the collection of storage devices that hold large quantities of data for long time periods.
   Answer:

7. A(n) _____ is a computer that manages shared resources and allows other computers to access them through a network.
   Answer: server

8. A program that solves a(n) _____ requires no branching instructions.
   Answer: formulaic problem

9. The primary components of a CPU are the _____, _____, and a set of _____.
   Answer: control unit, arithmetic logic unit, registers

10. Primary storage also can be called _____ and is generally implemented using _____.
    Answer: memory or main memory, RAM

11. A set of instructions that is executed to solve a specific problem is called a(n) _____.
    Answer: program

12. A(n) _____ is typically implemented with the latest and most expensive technology.
    Answer: supercomputer

13. A(n) _____ is a group of similar or identical computers, connected by a high-speed network, that cooperate to provide services or execute a common application.
    Answer: cluster

14. A(n) _____ is a group of dissimilar computer systems, connected by a high-speed network, that cooperate to provide services or execute a common application.

Answer: grid

15. A(n) _____ is a hardware device that enables a computer system to communicate with humans or other computers.
Answer: I/O device

16. A CPU is a(n) _____ processor capable of performing many different tasks by simply changing the program.
Answer: general-purpose

17. The _____ is the "plumbing" that connects all computer system components.
Answer: system bus

18. The CPU program _____ instructions one at a time.
Answer: executes

19. The term _____ describes a computer system's components and the interaction among them.
Answer: systems architecture

20. Most programs are written in a _____ such as C or Java, which is then translated into an equivalent set of CPU instructions.
Answer: programming language

21. Resource allocation and direct hardware control is the responsibility of a(n) _____.
Answer: operating system

22. _____ software is general purpose. _____ software is specialized to a specific user need.
Answer: system, application

23. A(n) _____ is a set of hardware and software components that enables information, software, and hardware resources to be shared among multiple users and computer systems.
Answer: computer network

Review Questions

1. What similarities exist among mechanical, electrical, and optical methods of computation?
Answer: All harness the energy of something that is moving (e.g., gears, electrons, and photons) to perform work. All are subject to fundamental speed limits based on the speed of their moving "parts". All implement computation using the mathematical properties of physical phenomena.

2. What shortcomings of mechanical computation were addressed by the introduction of electronic computing devices?
Answer: Slow speed, unreliability (due to friction and wear), and fabrication complexity.

3. What shortcomings of electrical computation will be addressed by the introduction of optical computing devices?
Answer: Fabrication complexity (lack of wiring) and unreliability due to heat, friction, and resistance.

4. What is a CPU? What are its primary components?
Answer: The CPU is the brain of a computer system. It fetches and executes instructions in a stored program and controls the movement of data among computer system components. The primary CPU components are the control unit, arithmetic logic unit, and a set of registers.

5. What are registers? What is/are their function(s)?
   Answer: Registers are single storage locations within the CPU used to temporarily hold instructions and/or data.

6. What is main memory? In what way(s) does it differ from registers?
   Answer: Main memory is a set of storage locations, typically implemented using random access memory (RAM), that holds the instructions and some or all of the data of currently executing programs. Primary storage has greater capacity than registers but is slower to access.

7. What are the differences between primary and secondary storage?
   Answer: Primary storage is more volatile, faster, and more expensive than secondary storage. Because of its higher cost it is also usually of lesser capacity. These differences determine differences in use - chiefly that primary storage supports ongoing CPU activity by storing instructions and data of currently executing programs.

8. How does a workstation differ from a microcomputer?
   Answer: There may be no difference. But some interpretations of the term workstation imply greater computational power, storage capabilities, and graphic I/O capabilities than those of an "ordinary" microcomputer.

9. How does a supercomputer differ from a mainframe computer?
   Answer: A supercomputer is optimized for the fastest possible execution of floating point computations. A mainframe is optimized for high I/O capacity and support of a large number of simultaneous users and executing programs. Supercomputers are generally more expensive than mainframes and often use more advanced technology, particularly for the CPU and primary storage.

10. Describe three types of multicomputer configurations. What are their comparative advantages and disadvantages?
    Answer: Multicomputer configurations include clusters, blade servers, and grids. Clusters are scalable and fault tolerant but they are relatively complex to configure and administer. Blade servers are similar to clusters in their scalability, especially for computationally-intensive tasks, and their complexity to configure and administer. They are less fault tolerant than clusters because multiple blades share a single location including cabinet, power supply, and sometimes I/O connections. Grids are not as scalable as clusters and grids because of their architectural differences and greater physical. They are also complex to configure and administer. However, they offer the unique ability to collaborate to tackle large problems when needed and operate independently under local control at all other times.

11. What class(es) of computer system(s) normally are used to implement a server?
    Answer: Any computer class can be used to implement a server. The class required in a specific situation depends on the number and type of resources being served and the number of simultaneous accesses to those resources.

12. What is Grosch's Law? Does it hold today? Why or why not?
    Answer: Grosch's law states that cost is proportional to the square of CPU power measured in MIPS. The law doesn't hold today. Various technological changes since Grosch's time are unaccounted for by his law including distinct classes of computers, the microprocessor, scalable computing platforms, and computer networks.

13. How can a computer system be tuned to a particular application?
    Answer: Subsystems (e.g., CPU, memory, graphics, and secondary storage) may be added or enhanced to alter the overall capabilities of the computer system. For example, database applications are typically aided by increasing the memory and secondary storage capabilities of a computer system. This might be accomplished by doubling installed memory, adding additional secondary storage devices, and upgrading the secondary storage controller.

14. What characteristics differentiate application software from system software?
Answer: Application software is special purpose - written to address a specific need of a specific user or a narrow class of needs for one or many users. Systems software is general purpose - it provides support functions for many types of application processing tasks. Systems software also interacts directly with hardware while application software does not.

15. In what ways does system software make the development of application software easier?
Answer: System software provides a set of general purpose reusable functions that can be incorporated into application software. Many of the functions implement specific hardware control and interface requirements. Thus, application programmers need not write these functions themselves and they need little or no knowledge of the underlying hardware to complete their task.

16. In what ways does system software make application software more portable?
Answer: To the extent system software hides hardware details it makes application software transportable from one hardware platform to another. Of course, the new hardware platform must provide a compatible system software service interface for applications software to use.

17. What are the primary components of an operating system?
Answer: The command layer, service layer, and kernel.

18. Why has the development of system software paralleled the development of computer hardware?
Answer: Software consumes hardware resources and uses them to provide IS services to end users. Software cannot provide services that require non-existent or prohibitively expensive hardware resources. Thus, software advances follow the arrival of sufficiently powerful and inexpensive hardware.

19. List at least five types of resources that can be shared among computers on a local-area or wide-area network.
Answer: Program (software) files, I/O devices, text files, sound and video files, databases, web pages.

20. Describe the dual roles played by most operating systems with respect to external resource access.
Answer: The operating system must locate and access external resources on behalf of local users and must also enable access to local resources by external users.

21. Describe the relationship between the resource allocation and management functions of system software and external resources accessible via a network. What system software functions must be provided to access external resources?
Answer: System software is the "door" through which users and application programs see and access both internal and external resources. System software must provide utilities to locate external resources, negotiate access to those resources, and receive and deliver them to users or their programs. If a computer system makes its resources available on a network then its system software must listen for resource access requests, validate those requests, and deliver resources to requestors.

Research Problems

Project 1

The instructor may wish to make this exercise more challenging by reducing the budget. Software selection may or may not be incorporated into this problem. If so, operating system selection is an issue for the accountant and architect.

Home user: This system will tend to emphasize graphics performance at the expense of other components. However, the budget is more than adequate for the purpose although it can be quickly consumed by the omitted peripherals (e.g., high-quality ink jet printer and scanner) and software.

Accountant: Distinguishing features of this system should be increased, such as faster memory, a high-powered CPU, and a network card. An upgraded operating system (e.g., Windows XP Professional) might also be considered.

Architect: A large monitor or a dual monitor setup is a must in this situation - but it will be tough to fit within the budget. The applications also demand large amounts of fast primary storage, secondary storage, and a high-powered CPU. An upgraded operating system (e.g., Windows XP Professional) might also be considered.

Project 2

The student may not have absorbed sufficient technical information to thoroughly complete this exercise. But, shopping for such computers by taking the sales glossy hype as truth is a useful exercise in discovering the costs and capabilities of current server and minicomputer systems.

Students should shop around on the manufacturer's sites, focusing on their marketing strategies. Going on marketing "hype", students should determine the appropriate product to meet the server requirements.

Project 3

[Note that the address of the textbook support web site is misprinted in the text.] Information is relatively easy to obtain from manufacturer web sites for smaller computer systems. For mainframes and supercomputers, contact with a sales representative may be required. Stress to students that they need to be making "apples-to-apples" comparisons, which is difficult because the raw hardware capabilities of each class are a moving target.