Chapter 2 Solutions

Vocabulary Exercises

1. Types or classes of larger servers include _____, which are generally optimized for data storage and I/O capability, and _____, which are generally optimized for computational capacity and speed.

   mainframes, supercomputers

2. A(n) _____ is a storage location implemented in the CPU.

   register

3. The term _____ refers to storage devices, not located in the CPU, that hold instructions and data of currently running programs.

   memory or main memory

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

   algorithm

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

   instruction

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

   secondary storage

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

   server

8. A program that solves a(n) _____ requires no branching instructions.

   formula

9. The major components of a CPU are the _____, _____, and _____.

   control unit, arithmetic logic unit (ALU), registers

10. Primary storage can also be called _____ and is generally implemented with _____.

    memory or main memory, RAM

11. A(n) _____ typically uses the latest and most expensive technology.

    supercomputer

12. A(n) _____ is a group of similar or identical computers, connected by a high-speed network, that cooperate to provide services or run a shared application.

    cluster

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

    grid

14. A CPU is a(n) _____ processor capable of performing many different tasks simply by changing the program.

    general-purpose

15. The _____ enables the CPU, primary storage, and secondary storage devices to communicate.

    system bus

16. The CPU _____ program instructions one at a time.

    executes

17. Most programs are written in a(n) _____, such as FORTRAN or Java, which is then translated into equivalent CPU instructions.

    programming language

18. A(n) _____ consists of hardware and software components that enable multiple users and computer to share information, software, and hardware resources.

    computer network

19. _____ is a technique that enables a single computer to host multiple virtual machines.

    virtualization

20. _____ says that larger computer classes are more cost-efficient than smaller ones - a statement that doesn't accurately describe modern computing hardware.

    Grosch's Law

21. A(n) _____ is the most common type of system software.

    operating system

22. WWW resources are identified and accessed by a(n) _____.

    Uniform Resource Locator (URL)

23. Key characteristics that distinguish primary and secondary storage include cost, capacity, speed, and _____.

    volatility

Review Questions

1. What similarities exist in mechanical, electrical, and optical methods of computation?

   All harness the energy of something that's moving (such as gears, electrons, and photons) to perform work. All are subject to fundamental speed limits based on the speed of their moving "parts." All perform computation by using the mathematical properties of physical phenomena.

2. What shortcomings of mechanical computation did the introduction of electronic computing devices address?

   Slow speed, unreliability (because of friction and wear), and fabrication complexity

3. What shortcomings of electrical computation will optical computing devices address?

Fabrication complexity (lack of wiring) and unreliability caused by heat, friction, and resistance

4. What is a CPU? What are its primary components?

   The CPU is the brain of a computer system. It fetches and executes instructions in a stored program and controls the movement of data between computer system components. The primary CPU components are the control unit, arithmetic logic unit (ALU), and registers.

5. What are registers? What are their functions?

   Registers are storage locations in the CPU used to hold instructions and data temporarily.

6. What is main memory? How does it differ from registers?

   Main memory is a collection of storage locations, typically implemented with random access memory (RAM), that holds instructions and some or all of the data of currently running programs. Primary storage has more capacity than registers but is slower to access.

7. What are the differences between primary and secondary storage?

   Primary storage is more volatile, faster, and more expensive than secondary storage. Because of its higher cost, its capacity is usually lower than in secondary storage. These differences determine differences in use—chiefly, primary storage supports ongoing CPU activity by storing instructions and data of currently running programs.

8. How does a workstation differ from a desktop computer?

   There might be no difference, but some people consider the term “workstation” to imply a more powerful system than a typical desktop computer—one that’s capable of handling hardware-intensive tasks, such as complex mathematical computation, computer-aided design (CAD), and manipulation of high-resolution video images.

9. How does a supercomputer differ from a mainframe computer?

   A supercomputer is optimized for the fastest possible execution of mathematical computations. A mainframe is optimized for high I/O capacity and supporting the information-processing needs of many simultaneous users and running 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?

    Multicomputer configurations include clusters, blades, and grids. A cluster is a group of similar or identical computers, connected by a high-speed network, that cooperate to provide services or run a single application. Clusters are scalable and fault tolerant, but they’re more complex to configure and administer.

    A blade is a circuit board containing most of a server—typically one or more CPUs, memory areas, and network interfaces. It lacks secondary storage, external I/O connections, and a power supply. Blades are similar to clusters in their scalability (especially for computation-intensive tasks) and their complexity to configure and administer. They’re less fault tolerant than clusters because multiple blades share a single location, including cabinet, power supply, and sometimes I/O connections. However, blades concentrate more computing power in less space and with lower power requirements than a typical cluster needs.

    A grid is a group of dissimilar computers, connected by a high-speed network, that cooperate to provide services or run a shared application. Grids aren’t as scalable as clusters and blades because of their architectural differences and because systems in a grid might be located farther away from each other than systems in a cluster are. They’re

also complex to configure and administer. However, they offer the unique capability to collaborate on tackling large problems when needed and operate independently under local control at all other times.

11. What classes of computer systems are normally used for servers?

    Any computer class can be used for a server. The class depends on the number and type of resources and the number of simultaneous accesses to these resources.

12. What is Grosch's Law? Does it hold today? Why or why not?

    Grosch's Law states that computing power, measured by millions of instructions per second (MIPS), is proportional to the square of hardware cost; therefore, large and powerful computers will always be more cost effective than smaller ones. If all classes of computers are considered as a group, however, the law doesn't hold today. It doesn't account for technological changes since Grosch's time, such as multiple classes of computers, multicomputer configurations, computer networks, and recent trends, such as virtualization and cloud computing.

13. How can a computer system be tuned to a particular application?

    Subsystems (for example, CPU, memory, graphics, and secondary storage) can be added or enhanced to alter a computer's capabilities. For example, database applications are typically aided by increasing the computer's memory and secondary storage capabilities. This increase might be accomplished by doubling installed memory, adding secondary storage devices, and upgrading the secondary storage controller.

14. What characteristics differentiate application software from system software?

    Application software is special purpose—written to address specific needs of specific users. System software is general purpose—it provides support functions for many types of application processing tasks. System software also interacts directly with hardware, and application software does not.

15. In what ways does system software make developing application software easier?

    System software provides general-purpose reusable functions that can be incorporated into application software. Many of the functions implement specific hardware control and interface requirements. Therefore, application programmers don't need to write these functions themselves, and they need little or no knowledge of the underlying hardware.

16. Why has the development of system software paralleled the development of computer hardware?

    Software consumes hardware resources and uses them to provide IS services to users. Software can't provide services that require nonexistent or prohibitively expensive hardware resources. Therefore, software advances follow the arrival of powerful and inexpensive hardware.

17. List at least five types of resources that computers on a local area network or wide area network can share.

    Program (software) files, I/O devices, text files, sound and video files, databases, Web pages

Research Problems

Project 1

The instructor might want to make this exercise more challenging by imposing budgets for each user type – say $500 for the home user and accountant and $750 or $1000 for the architect. Software selection may or may not be incorporated. If it is, OS selection is an issue for the accountant and architect.

1. Home user: This system tends to emphasize graphics performance at the expense of other components. However, the budget is more than adequate for the purpose, although it can be consumed quickly by peripherals (such as a high-quality inkjet printer and scanner) and software.
2. Accountant: The system features to focus on include faster memory, a high-powered CPU, and a network card. An upgraded OS might also be considered.
3. Architect: A large monitor or a dual-monitor setup is a must in this situation, but fitting it in the budget will be tough. The applications also demand large amounts of fast primary storage, secondary storage, and a high-powered CPU. An upgraded OS might also be considered.

Project 2

Students might not have absorbed enough technical information to do this project, but shopping for computers by taking the sales hype as truth is a useful exercise in discovering the costs and capabilities of current server and minicomputer systems.

Project 3

Many supercomputers are clusters of hundreds or thousands of high-end midrange computers. If the student can find the specs for a single node they can search the manufacturer's Web site for nodes with similar specs.