Chapter 1

- An ***operating system*** acts as an intermediary between the user of a computer and the computer ***hardware***.
- The purpose of an ***operating system*** is to provide an ***environment*** in which a user can execute programs in a convenient and efficient manner.
- An operating system is ***software*** that ***manages*** the computer hardware.
- An ***operating system*** is a program that ***manages*** the computer hardware. It also provides a basis for application programs and acts as an ***intermediary*** between the computer ***user*** and the computer ***hardware***.
- A computer system can be divided roughly into four components: the ***hardware***, the ***operating system***, the ***application programs***, and the ***users***.
- The operating system ***controls*** and ***coordinates*** the use of the ***hardware*** among the various application programs for the various users.
- Typically, bootstrap program is stored in read-only memory (***ROM***) or electrically erasable programmable read-only memory (EEPROM), known by the general term ***firmware***, within the computer hardware.
- Hardware may trigger an ***interrupt*** at any time by sending a signal to the CPU, usually by way of the system bus.
- Interrupt transfers control to the interrupt service routine generally, through the ***interrupt vector***, which contains the ***starting addresses*** of all the service routines.
- A ***trap*** is a software-generated interrupt caused either by an error or a user request.
- An operating system is ***interrupt*** driven.
- ***Main memory*** is the only large storage area (millions to billions of bytes) that the processor can access directly.
- Main memory is a ***volatile*** storage device that ***loses*** its contents when power is turned off or otherwise lost.
- The main differences among the various storage systems lie in ***speed***, ***cost***, ***size***, and ***volatility***.
- A general-purpose computer system consists of CPUs and multiple device ***controllers*** that are connected through a ***common bus***.
- Each device ***controller*** is in charge of a specific type of device.
- A device controller maintains some local buffer storage and a set of special-purpose ***registers***.
- The device ***controller*** is responsible for moving the data between the peripheral ***devices*** that it controls and its ***local buffer storage***.
- Typically, operating systems have a device ***driver*** for each device ***controller***.
- Device ***driver*** understands the device ***controller*** and presents a uniform ***interface*** to the device to the rest of the ***operating system.***
- In a parallel system, by increasing the number of processors, we expect to get more work done in less time. The speed-up ratio with N processors is ***less*** than N.
- The difference between ***blade-servers*** and traditional multiprocessor systems is that each blade-processor board boots independently and runs its own operating system.
- Some blade-server boards are multiprocessor as well.

- In essence, those ***blade-servers*** consist of multiple independent multiprocessor systems.
- Clustering can be structured asymmetrically or symmetrically.
- In ***asymmetric*** clustering, one machine is in ***hot-standby*** mode while the other is running the applications. The hot-standby host machine does nothing but ***monitor*** the active server. If that server fails, the hot-standby host becomes the active server.
- In ***symmetric*** mode, two or more hosts are running applications, and are ***monitoring*** each other.
- A ***time-shared*** operating system allows many users to share the computer simultaneously. As the system switches rapidly from one user to the next, each user is given the impression that the entire computer system is dedicated to his use, even though it is being shared among many users.
- A time-shared operating system uses CPU ***scheduling*** and ***multiprogramming*** to provide each user with a small portion of a time-shared computer.
- If several jobs are ready to be brought into memory, and if there is not enough room for all of them, then the system must choose among them. Making this decision is ***job scheduling***.
- if several jobs are ready to run at the same time, the system must choose among them. Making this decision is ***CPU scheduling.***
- ***Virtual memory*** is a technique that allows the execution of a process that is not completely in memory.
- The main advantage of the virtual-memory scheme is that it enables users to run programs that are ***larger*** than actual physical ***memory***.
- A ***trap*** (or an ***exception***) is a software-generated interrupt caused either by an error or by a specific request from a user program that an operating-system service be performed.
- In an operating system, at least, we need two separate modes of operation: ***user*** mode and ***kernel*** mode (also called ***supervisor*** mode, ***system*** mode, or ***privileged*** mode).
- At system boot time, the hardware starts in ***kernel*** mode. The operating system is then loaded and starts user applications in ***user*** mode. Whenever a trap or interrupt occurs, the hardware switches from user mode to kernel mode (that is, changes the state of the mode bit to 0). Thus, whenever the operating system gains control of the computer, it is in ***kernel*** mode. The system always switches to ***user*** mode (by setting the mode bit to 1) before passing control to a user program.
- The hardware allows ***privileged*** instructions to be executed only in kernel mode.
- If an attempt is made to execute a ***privileged*** instruction in user mode, the hardware does not execute the instruction but rather treats it as illegal and traps it to the ***operating system***.
- ***System calls*** provide the means for a user program to ask the operating system to perform tasks reserved for the operating system on the user program's behalf.
- A ***process*** needs certain resources-including CPU time, ***memory***, files, and ***I/O devices*** - to accomplish its task. These resources are either given to the process when it is created or allocated to it while it is running.

- A ***process*** is the unit of work in a system.
- The ***main memory*** is generally the only large storage device that the CPU is able to address and access directly.
- Files are normally organized into ***directories*** to make them easier to use.
- Most modern computer systems use ***disks*** as the principal on-line storage medium for both programs and data.
- Only the ***device driver*** knows the peculiarities of the specific device to which it is assigned.
- A ***distributed*** system is a collection of physically ***separate***, possibly heterogeneous computer systems that are networked to provide the users with access to the various ***resources*** that the system maintains.
- Embedded systems almost always run ***real-time operating*** systems.
- A ***real-time*** system has well-defined, fixed ***time constraints.*** Processing *must* be done ***within*** the defined constraints, or the system will fail.

Chapter 2

- ***OSes*** provide an environment for execution of programs and services to programs and users.
- Communications may be implemented via ***shared memory*** or through ***message passing***, in which packets of information are moved between processes by the operating system.
- The main function of the command ***interpreter*** is to get and ***execute*** the next user-specified command.
- There are two general ways in which these commands can be implemented. In one approach, the command interpreter itself ***contains*** the code to execute the command. An alternative implements most commands through system ***programs***.
- Three general methods are used to pass parameters to the operating system.
    1. The simplest approach is to pass the parameters in ***registers***.
    2. In some cases, there may be more parameters than registers. In these cases, the parameters are generally stored in a ***block***, or ***table***, in memory, and the ***address*** of the block is passed as a parameter in a register. This is the approach taken by Linux and Solaris.
    3. Parameters also can be placed, or *pushed,* onto the ***stack*** by the program and ***popped*** off the stack by the operating system.
- System calls can be grouped roughly into the following major categories: ***process*** control, file manipulation, device manipulation, information maintenance, communications and protections.
- ***Debugger*** is a system program designed to aid the programmer in finding and correcting bugs.
- There are two common models of interprocess communication: the ***message passing*** model and the ***shared-memory*** model.
- ***System*** programs provide a convenient environment for program development and

execution.

- One important principle is the separation of policy from mechanism. ***Mechanisms*** determine *how* to do something; ***policies*** determine *what* will be done.
- ***System calls*** allow a running program to make requests from the operating system directly.
    1. The four typically structures for OS are simple structure, ***layered***, ***microkernels*** and ***modules***.
    2. Microkernel contains only essential OSes functions, including ***memory management***, ***CPU scheduling,*** and ***IPC***.
- **A *virtual machine*** treats hardware and the operating system kernel as though they were all hardware.
- ***Virtualization*** is a technology that allows operating systems to run as applications within other operating systems.
- JVM consists of ***class loader,*** class verifier, and Java ***interpreter*.**
- The procedure of starting a computer by loading the kernel is known as ***booting*** the system.
- On most computer systems, a small piece of code known as the ***bootstrap program*** or ***bootstrap loader*** locates the kernel, loads it into main memory, and starts its execution.