Chapter 02: Computer Organization

Lesson 07
Operating Systems

Objective

- Understand concepts of OS, Multiprogramming, Protection and virtual memory
- Learn OS control of the resources and time slice
- Understand Privilege and user modes

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Operating System

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

The operating system

- Simply another program, one that knows about all the hardware in the computer, with one exception — it runs in privileged (or supervisor) mode

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Privileged Mode

- Allows it access to physical resources that user programs (tasks) cannot control and gives it the ability to start or stop the execution of user programs

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

OS Responsibilities

- Managing the physical resources of the system,
- Loading and executing programs
- Managing devices and network and
- Controlling through *device drivers* the I/O devices

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Multiprogrammed operating system

- It presents the illusion that multiple programs are running simultaneously by switching between programs very rapidly

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Multiprogramming

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Multiprogramming

- Most computer systems support multiprogramming (also called multitasking)─ a technique that allows the system to present the illusion that multiple programs are running on the computer simultaneously, even though the system may only have one processor

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Multi programmed System

- User programs do not need to know which other programs are running on the system at the same time they are, or even how many other programs there are

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Multiuser computers

- Many multiprogrammed computer are also *multiuser* and allow more than one user to be logged in to the computer at once

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Multiuser computers

- Multiuser systems require that the operating system not only protect programs from accessing each other's data but prevent users from accessing data that is private to other users

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Multiprogrammed operating system

- Each program allowed to execute for a fixed amount of time, known as a *timeslice*

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Context Switch

- When a program's timeslice ends, the operating system stops it, removes it from the processor, and loads another program into the processor
- This process known as a *context switch*

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Context switch

- The operating system copies the contents of the currently running program's register file (sometimes called the program's context) into memory, and then copies the contents of the next program's register file out of memory and into the register file

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Context Switch

- Programs cannot tell that a context switch has been performed—to them, it looks like they have been continuously running on the processor

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Context-switch Period

- 60 times per second, making tirneslices l/60th of a second,
- Lately systems have started to context-switch more frequently

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Fast Context Switch Time

- This has caused problems with programs that expect timeslices to be l/60th of a second and use that information to time events or determine performance

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Example 1

- By context-switching 60 or more times per second, a computer can give each program an opportunity to execute sufficiently frequently that the system can prevent the illusion that a moderate number of programs are executing simultaneously on the system

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Example 2

- Obviously, as the number of programs on the system increases, this illusion breaks down—if the system is executing 120 programs, each program may only get a timeslice once every 2 seconds, which is enough of a delay for us to notice.

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Increase of the running time in Multiprogramming

- Running time of applications increase
- The resources of the system are shared among all of the programs running on it

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Protection

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Main requirements of a multiprogrammed operating system

- One is that OS must provide *protection* between programs running on the computer

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Main requirements of a multiprogrammed operating system

- Result of any program running on a multiprogrammed computer must be the same as if the program was the only program running on the computer

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Operating system

- OS and hardware provide *protection* for programs, preventing any program from accessing another program's data unless the two programs have specifically arranged to access each other's data

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Protection

- Programs must not be able to access other programs' data and must be confident that their data will not be modified by other programs.
- Similarly, programs must not be able to interfere with each other's use of the I/O subsystem

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Use of Virtual memory

- One technique that operating systems use to protect each program's data from other programs is *virtual memory*

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Use of Virtual memory

- Allows each program to operate as if it were the only program running on the computer by *translating* memory addresses that the program references into the addresses used by the memory system

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Virtual memory system

- Ensures that two programs' addresses don't translate into the same address
- Programs can be written as if they were the only program running on the machine, since no program's memory references will access data from another program

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Control of physical resources

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Control of physical resources

- Providing protection in a multiprogrammed or multiuser system requires that the operating system control the physical resources of the computer, including the processor, the memory, and the I/O devices

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Without Protection

- User programs could access any of the memory or other storage on the computer, gaining access to data that belongs to other programs or other users

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

With Protection

- Allows the operating system to prevent more than one program from accessing an I/O device, such as a printer, at one time

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Privileged mode

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Privileged mode

- Ensures that the operating system is the only program that can control the system physical resources,
- User programs execute in *user mode* (sometimes called unprivileged mode)

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Context switches and memory allocations

- Certain tasks, such as accessing an I/O device, require that a program be in privileged mode
- If a user-mode program tries to perform one of these tasks, the hardware prevents it from doing so and signals an error

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

User-mode programs

- If want to do something that requires privilege mode, they send a request to the operating system, known as a *system call*, which asks the operating system to do the operation for them

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

User System calls

- If the operation is something that the user program is allowed to do, the operating system performs the operation and returns the result to the user
- Otherwise, signals an error

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

User Interface

- Because OS controls the physical resources of the computer, it is also responsible for the low-level user interface

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Example 1

- When a user presses a key or otherwise sends input to the computer, the operating system is responsible for determining which program should receive the input and sending the input value to that program

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Example 2

- When a program wants to display some information for the use such as printing a character on the monitor, it executes a system call to request that the operating system display the data.

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

Summary

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

We learnt

- OS control of resources,
- Multiprogramming,
- Context Switch
- Protection,
- Time slice
- Privilege Mode and user mode

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009

End of Lesson 7 on

Operating Systems

Copyright © The McGraw-Hill Companies Inc. Indian Special Edition 2009