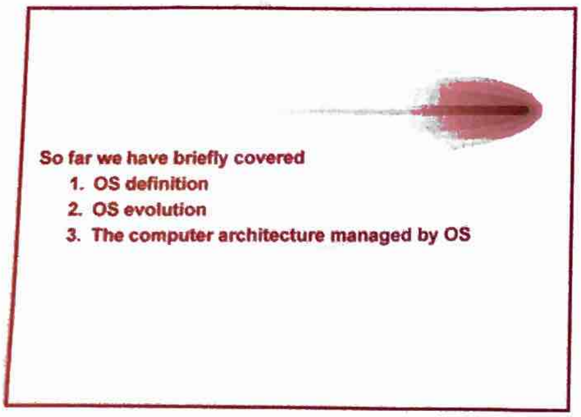
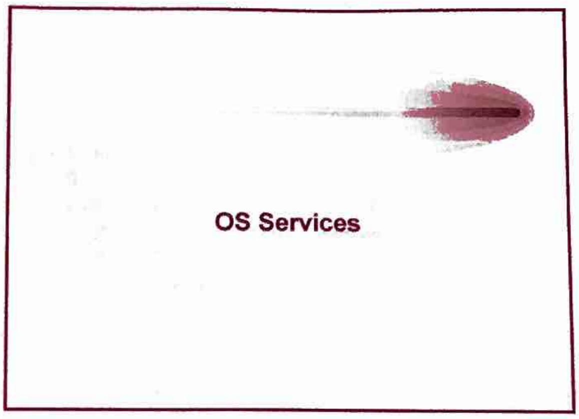
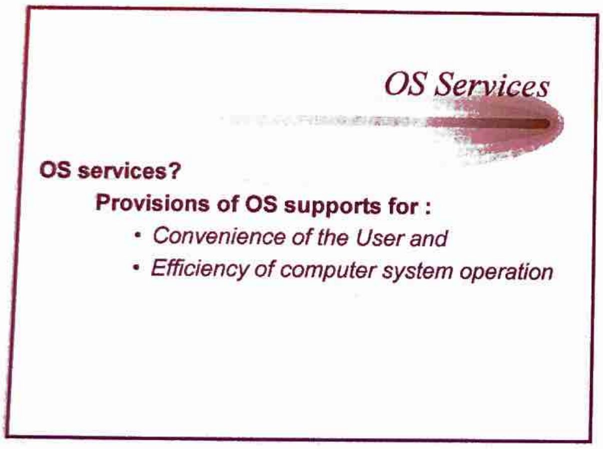


So far we have briefly covered

1. OS definition
2. OS evolution
3. The computer architecture managed by OS



OS Services

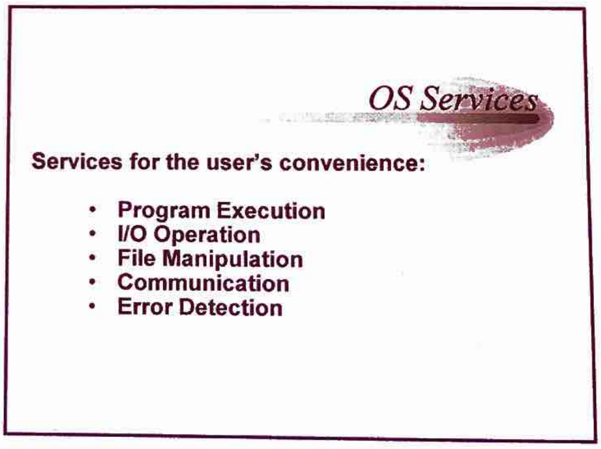


OS Services

OS services?

Provisions of OS supports for :

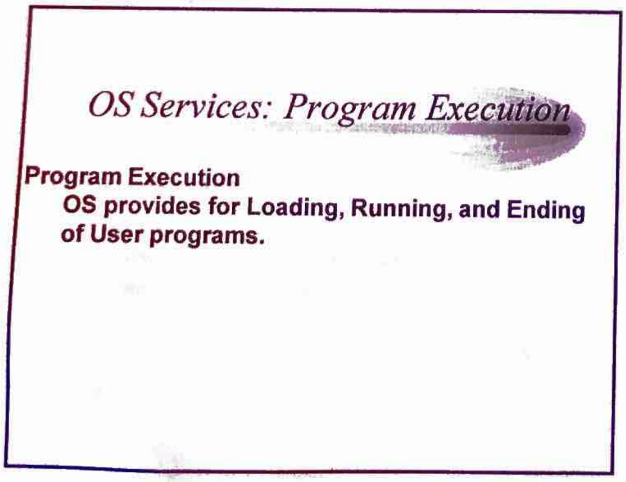
- *Convenience of the User and*
- *Efficiency of computer system operation*



OS Services

Services for the user's convenience:

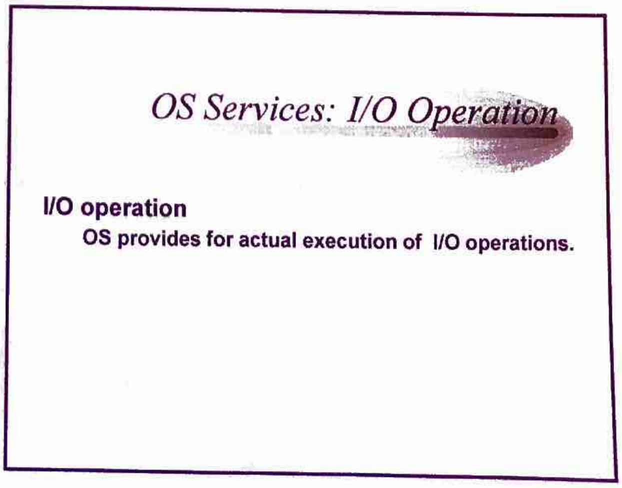
- **Program Execution**
- **I/O Operation**
- **File Manipulation**
- **Communication**
- **Error Detection**



OS Services: Program Execution

Program Execution

OS provides for Loading, Running, and Ending of User programs.



OS Services: I/O Operation

I/O operation

OS provides for actual execution of I/O operations.

OS Services: File Manipulation

File Manipulation

OS provides for:

reading from, writing into, creating, and deleting files.

OS Services: Communication

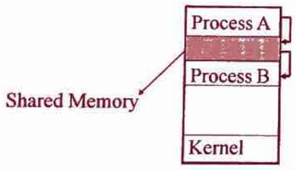
Communication

OS provides for exchange of information between two processes which may take place in one of the following two methods:

a. Shared memory
b. Message passing

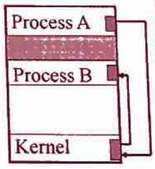
OS Services: Communication

(a) Shared Memory



OS Services: Communication

(b) Message Passing



OS Services: Error Detection

Error Detection

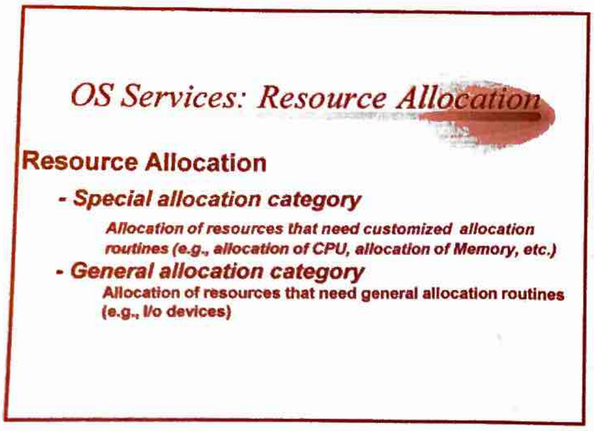
OS provides for

detecting and handling of both hardware and software errors

OS Services

Services for the efficiency:

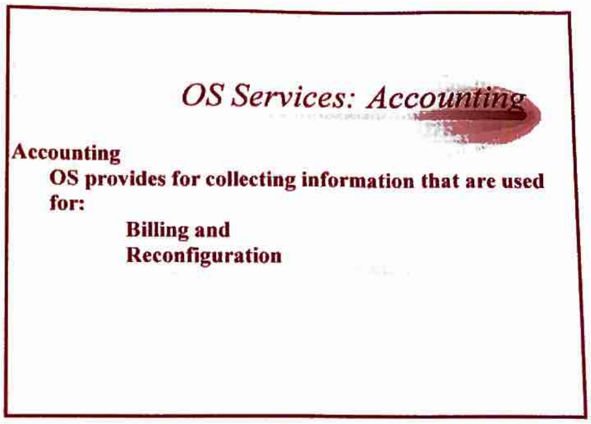
- Resource Allocation
- Accounting
- Protection



OS Services: Resource Allocation

Resource Allocation

- ***Special allocation category***
  - *Allocation of resources that need customized allocation routines (e.g., allocation of CPU, allocation of Memory, etc.)*
- ***General allocation category***
  - Allocation of resources that need general allocation routines (e.g., I/o devices)



OS Services: Accounting

Accounting

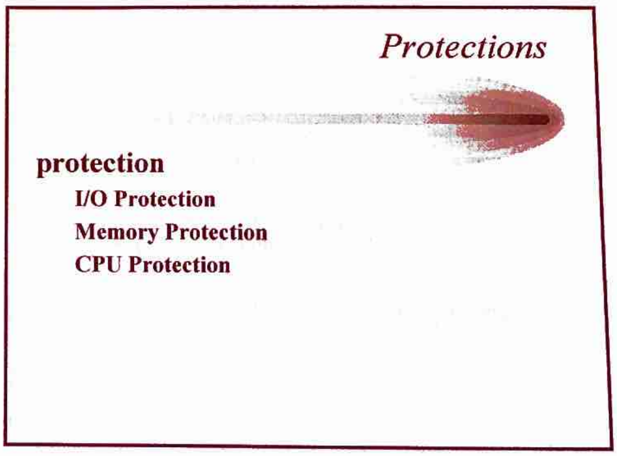
OS provides for collecting information that are used for:

Billing and
Reconfiguration

OS Services: Protection

OS provides for protecting:

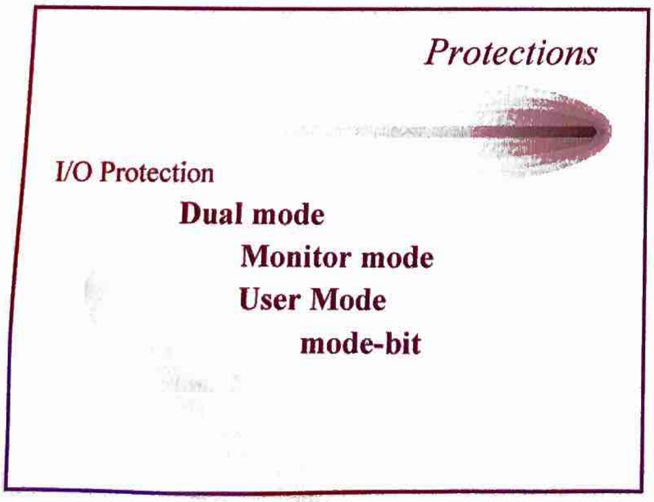
processes from each other and
The system from intruders.



Protections

protection

- **I/O Protection**
- **Memory Protection**
- **CPU Protection**



Protections

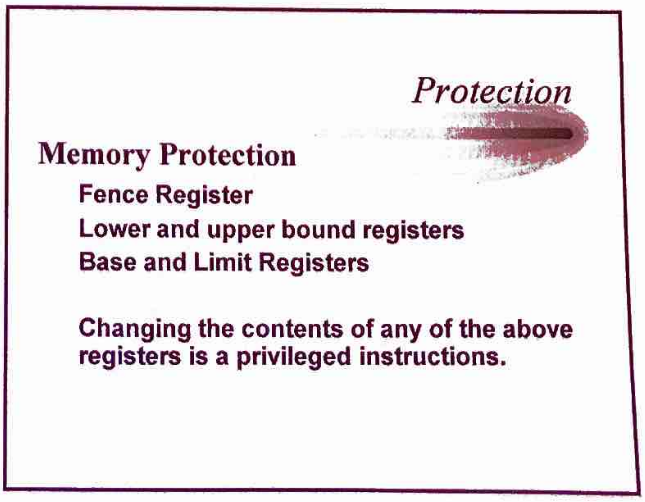
I/O Protection

Dual mode

Monitor mode

User Mode

mode-bit



Protection

Memory Protection

- **Fence Register**
- **Lower and upper bound registers**
- **Base and Limit Registers**

Changing the contents of any of the above registers is a privileged instructions.

Protection

CPU Protection

- **Timer**
  - ***Fixed***
  - ***Variable***

Protections

Variable Timer is used to setup:

1. CPU time allowed for a loop
2. Time slice length

Timer setting and its contents modification are privileged instructions.

OS Services

How to invoke OS Services:

- *System Calls*
- *System Programs*

OS Services

What is a system call?

It is a small program by which a process asks for a service from the OS

∴ *It is an interface between a process and OS*

System Calls

Example:

The system calls in completing the process of reading from a file.

get name of the file
open file
read data
close file

System Calls

The number of system calls are different for different operating systems and they are in hundreds:

Windows 7	*Over 600*
FreeBSD	*Over 500*
NetBSD	*Over 400*
Linux	*Over 300*

System Calls

Most of the system calls are hidden from the programmer by the compiler and by the runtime support routines.

Example

A Write statement is compiled to a runtime support routine that in turn is responsible for invoking right system calls to execute a write statement.

System Calls

System Calls Categories:

- Process Control
- File management
- Device management
- Information maintenance
- Communications

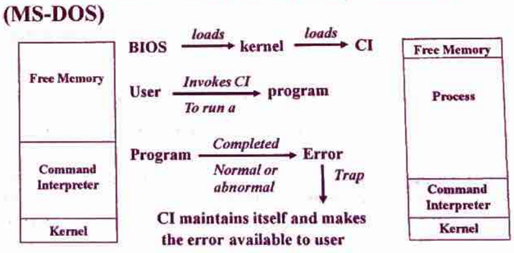
System Calls: process Control

Process Control

- create process,
- load, execute
- halt execution, (end, abort)
- terminate process
- get process attributes, set process attributes
- wait for time, wait event, signal event
- allocate and free memory

System Calls: process Control

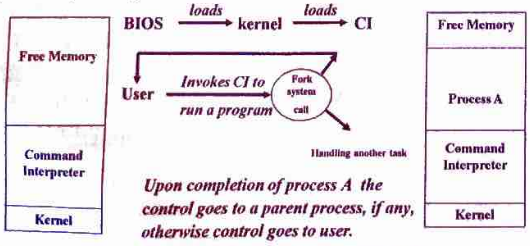
Process controller behavior in a single-tasking system (MS-DOS)



CI maintains itself and makes the error available to user

System Calls: process Control

Process controller behavior in a multi-tasking system (Berkley Unix)



Upon completion of process A the control goes to a parent process, if any, otherwise control goes to user.

The status of process A is available to CI

System Calls: File Manipulation

File Manipulation

- create file, delete file
- open, close
- read, write, reposition
- get file attributes, set file attributes

System Calls: Device Management

Device Management

- request device, release device
- read, write, reposition
- get device attributes, set device attributes
- logically attach or detach devices.

System Calls: Information maintenance

[redacted]

Information maintenance

- get time or date
- set time or date
- get system data, set system data
- get process, file, or device attributes
- set process, file, or device attributes

System Calls: Communications

Communications

- create, delete communication connections
- send, receive messages
- transfer status information
- attach and detach remote devices

System Calls: Communications

Communication between two Processes

(Processes may be on the same machine or different machines connected by a network facility.)

- **Message-Passing Model**
- **Shared-Memory Model**

Communications between two processes on two different machines demand the involvement of network facilities that will be discussed in future)

A reminder

Parameter passing into the OS

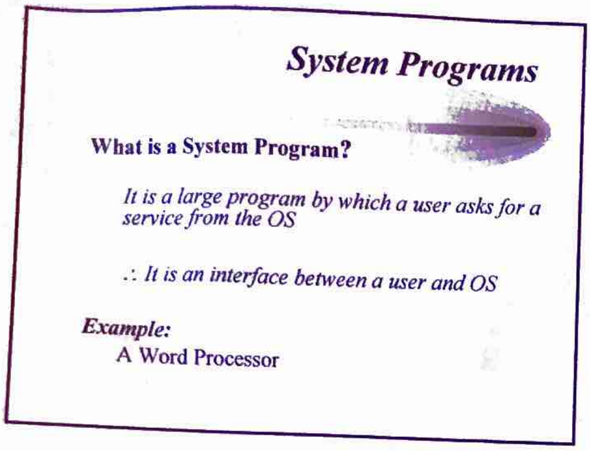
- Using Registers
- Using a block of the memory
- Using a stack

OS Services

Accessibility:

System calls for UNIX are callable by C or C^{++} programs.

System calls for Modern Microsoft Windows platform are part of the Win32 API (Application Programmer Interface) and they are callable by all the compilers written for Microsoft windows.



System Programs

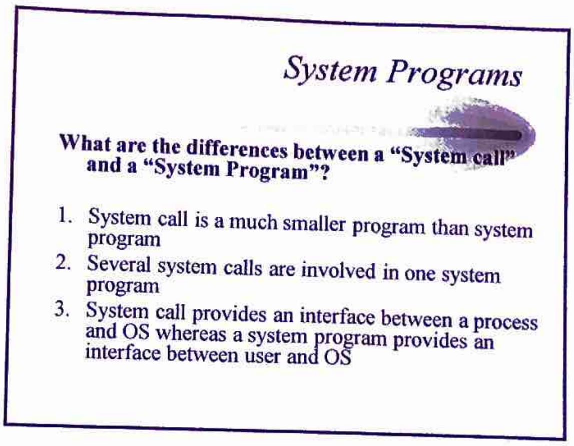
What is a System Program?

It is a large program by which a user asks for a service from the OS

∴ It is an interface between a user and OS

Example:

A Word Processor



System Programs

What are the differences between a "System call" and a "System Program"?

1. System call is a much smaller program than system program
2. Several system calls are involved in one system program
3. System call provides an interface between a process and OS whereas a system program provides an interface between user and OS