NEW HORIZON COLLEGE

SUBJECT: OPERATING SYSTEMS

SEMESTER: III SEMESTER

COURSE: BCA

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Chapter – 1 -Introduction to Operating system

- An Operating system is a program that controls the execution of application programs and acts as an interface between the user of a computer and the computer hardware.

Functions of operating system

- **Convenience:** An OS makes a computer more convenient to use.

- **Efficiency**: An OS allows the computer system resources to be used in an efficient manner.

- **Ability to Evolve:** An OS should be constructed in such a way as to permit the effective development, testing and introduction of new system functions without at the same time interfering with service.

EVOLUTION OF OPERATING SYSTEM

Serial Processing

- No operating systems.
- Time slots are allocated to users.
- During allocated time, the users could occupy the computers.

Disadvantages

- Scheduling
- Setup time

- Programs used cards. Each card contains holes or no holes, indicating 0 or 1 respectively.
- Programs were loaded into memory via card reader.
- To compile the programs, users had to load manually compiler program first and then input.
- If an error occurred ,the user had to repeat the whole process from the beginning. Thus much time was wasted.

Simple Batch Systems

- Jobs of a similar nature can be bundled together in batch systems.
- The steps followed in batch processing

1. Programmers submit a deck of punched cards containing their programs
2. Card reader reads them on to a magnetic tape.

3.After collecting batch of jobs,the tape is mounted on tape drive

4 .Operator loads the special program called monitor and runs the first job.

5. The OS reads the next job and runs it.

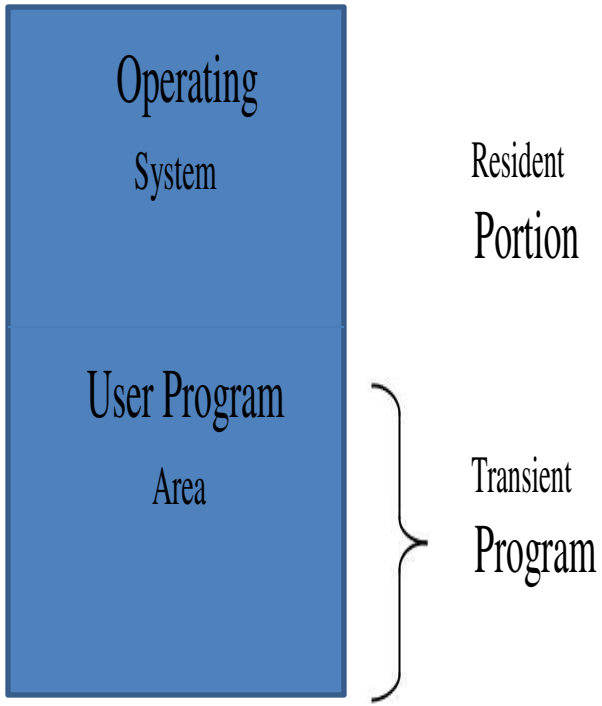
6.The output of every job is written onto the output tape.

7.On the completion of entire batch ,the output tape is taken away for printing off line.

8.The task of monitor (OS) was to transfer the control from one job to next.

9.The operating system is available in memory.

Memory Layout for a Simple Batch System



Advantages

- Jobs of a similar nature can be bundled together in batch systems to speed up the process.
- Simple Scheduling
- Does not use critical device management

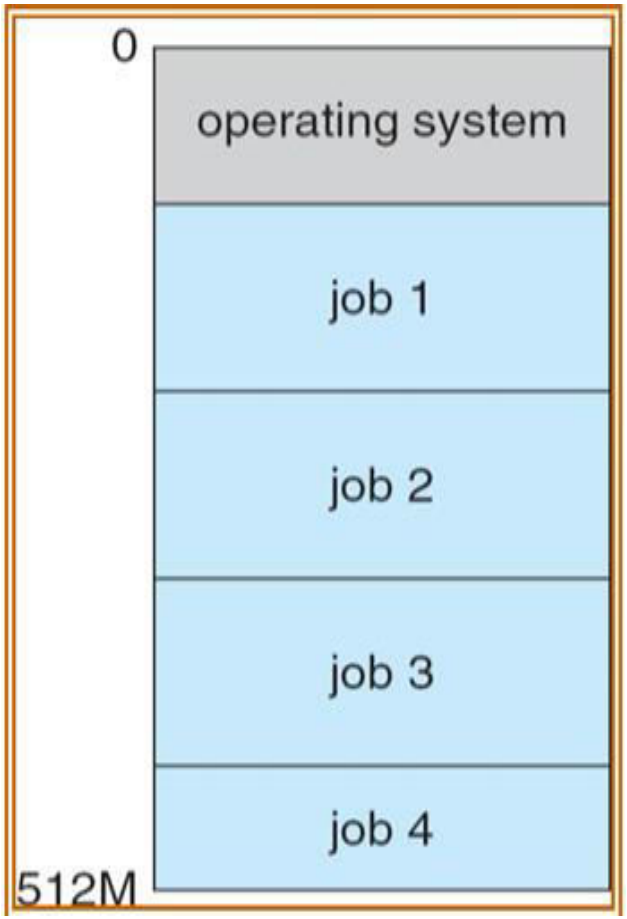
Disadvantages

- CPU is often idle due to slow I/O devices.
- Turn around time is more
- More difficult to debug the errors
- A job could corrupt the monitor, thus affecting the pending jobs.
- Protection scheme is not available.

Multiprogramming systems

- When two or more programs are in memory at the same time, sharing the processor is referred to the multiprogramming operating system.
- The OS rapidly switches the processor from job to job.
- Primary goal of multi-programmed systems

  are resource sharing.
- CPU is always busy executing on of the jobs.CPU utilization is high


0
operating system
job 1
job 2
job 3
job 4
512M

The steps in multi-programming

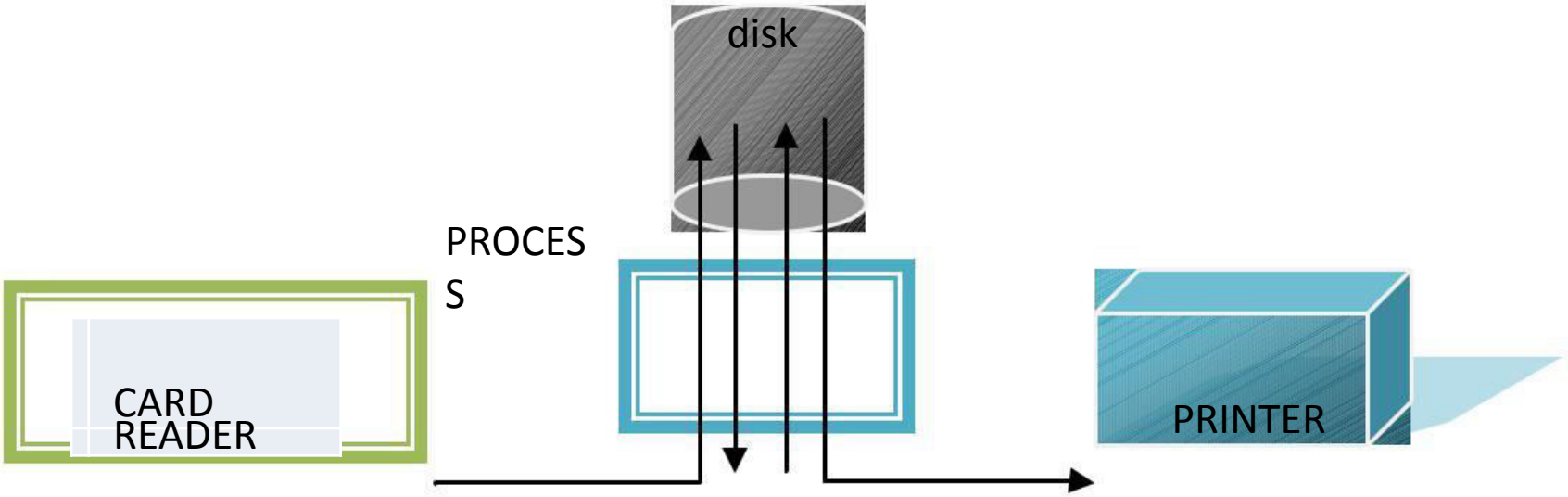
- The OS keeps several jobs in its main memory simultaneously.
- The operating system select one of the programs and starts executing.
- If that program1 needs I/O operation, then OS switches over to next job i.e program2
- Program1 finishes its I/O operation, then OS switches the control from program2 to program1

- **Advantages**
- High CPU utilization.
- Increased throughput
- Management of several jobs at a time
- **Disadvantages**
  - CPU scheduling is requires.
  - To accommodate many jobs in memory, memory management is required.

SPOOLING

- simultaneous peripheral operations on line.
- Spooling refers to keeping jobs in a buffer or on a disk where a device can access them when it is ready.
- In print spooling, documents are loaded into a buffer and then the printer pulls them off the buffer at its own rate.

SPOOLING



- **Advantage of Spooling**
  - The spooling operation uses a disk as a very large buffer.
  - Spooling is however capable of overlapping I/O operation for one job with processor operations for another job.

Time-sharing systems

- Time-slice is allocated to the users.
- Programs are executed for the allotted time-slice.
- A time-shared operating system allows the many users to share the computer simultaneously.

Advantages of time sharing systems

- Tasks of many users are processed simultaneously
- Idle time of CPU is minimized
- Users get quick response
- Resources can be shared

Disadvantages

- Complex than multi-programmed systems
- Requires memory management, disk management.
- It needs concurrency control.
- Protection is necessary

Real time operating system

- It is used in environments where a large number of external events processed within time limits. E-x
- Medical imaging systems
- Flight control
- Military applications
- Industrial control systems
- simulations

Advantages of Real-time systems

- Provides interrupt and i/o management
- File management
- Resource management

Disadvantages

- Costly
- Time limit allotted for every event.

Personal computer system

- A computer dedicated to a single user.
- OS are MS-DOS , LINUX,UNIX,WINDOWS
- Software – database packages ,Ms-word, ms-excel,ms-powerpoint.
- Hardware – Monitor,Keyboard,CD-ROM
- Multi tasking
- Low cost
- File protection is available

Distributed systems

- Transferring the information from one computer network to another computer network.
- Each and every computer has its own mwmory.
- It uses client/server technology.

Objectives or Advantages

- Resource sharing
- Load sharing
- Reliability
- communication

Disadvantages

- Implementation is difficult
- Requires resource management, memory management and protection.

Network operating system

- It is a collection of programs and associated protocols which allows a set of computers interconnected by a computer network.

Advantages

- Allows the users to access various resources on the network.
- Provides protection
- Makes usage of remote resources

Parallel systems(Multi-processor systems)

- Multi-processor systems contains two or more CPU's sharing the common bus.
- More than one program can be processed at the same time.
- There are two types of multi-processor

  Asymmetric multi-processor

  Symmetric multi-processor

Asymmetric Multi-processor

- Each processor is assigned a particular job.
- Each processor has its own memory and resources. But it is not shared by other processor
- It uses master/slave technology.
- Master processor controls the system.
- Master processor allocates the work to the slave systems.

Symmetric multiprocessor

- They have multiple cpu's, all with access to the same memory.
- There is no master/slave relationship.
- Each processor has its own registers and cache memory ,but its sharing the physical memory.

Advantages of Parallel systems

- Increased throughput
- Increased reliability
- Economy
- Performance

Disadvantages

- In asymmetric multi-processor, communication between processor is slow,
- In symmetric multi-processor, Memory is shared by multiple-processor.

Multi-processing,Multi-tasking,Multi-user systems

- **Multi-processing:** Multiple CPUs perform more than one job at a time.
- **Multi-programming**: A single CPU perform multiple jobs at a time.
- **Multi-tasking :** Multiple programs run simultaneously in a single computer system.
- **Multi-user :** Multiple users run their programs concurrently using multiple terminals.

CHAPTER - 2

OPERATING SYSTEM STRUCTURES

Operating system components

- Process management
- Main memory management
- File Management
- I/O Device management
- Secondary storage management
- Networking
- Protection system
- Command interpreter system

Process Management

- Process – Program in execution.
- Process can be executed sequentially.
- The functions of operating system in process management are

    (i) creation and deletion of process

    (ii) Suspending and resuming the process

    (iii) Providing mechanisms for process communication.

    (iv) Providing mechanisms for deadlock handling

Main memory management

- Main memory is the only storage space that CPU can access directly.
- To execute the program , first it is loaded into the main memory.
- When the program terminates, the memory space is available for other processes.

The functions of operating system in memory management are

(i) Keeping track of memory usage.

(iii) selecting process to be loaded into memory.

(iii)Allocating and reclaiming the memory space on completion of the process.

File Management

- File – Collection of related information.
- Collection of files are called directories.

The activities of Operating system in File management are

(i) Creation, deletion and manipulation of files and directories.

(ii) Mapping of files onto secondary storage.

(iii) Backup and recovery of file.

I/O device management

- Operating system is used to manage the computer’s input/output devices.
- Input devices-
- keyboard, mouse,microphone,scanner
- Output devices- monitor , printers ,speakers.

The responsibilities of operating system in I/O management are

(i) To manage the device drivers for I/O devices.

(ii) To manage I/O operations with devices such as keyboard,mouse,printer,monitor

(iii) To manage the memory component that control buffering, caching and spooling

Secondary storage management

- Secondary storage is used to store the programs permanently.
- The functions of Disk management

  (i) Storage allocation

  (ii) scheduling of disk

  (iii) Management and allocation of free space

Networking

- The Networked system is a collection of processors and associated protocols.
- These processors are communicated through high speed buses.
- The set of computers are interconnected by a communication network.

Protection systems

- Controlling access of programs,processes and resources.
- Improve reliability by early detection of errors
- Provide control to authorized users

Command interpreter system

- Command interpreter is one of the system programs for an Operating system.
- It acts as an interface between user and operating system.
- Command-line interpreter reads the control statements and executes it.
- E-x in UNIX Operating system – shell (command interpreter)

Command interpreter deals with

- Process management
- File management
- I/O management
- Secondary management
- Main memory management
- Protection and networking system

Operating system goals

- Efficiency
  Throughput, turnaround time
- Robustness
  fault tolerance, reliable
- Scalability
  multiprogramming, adding more resources
- Extensiblity
  Adapt new technology
- Portability
  Operate on any hardware configuration

- Security

  providing authorization
- Interactivity

  quick response
- Usability

  easy to user interface

Types of operating system services

- User view

  OS services provide functions helpful to users.

- System view

  OS services provide functions helpful to systems

User view

- User interface

  Command Line Interface - Used to enter commands and text

Batch Interface

  Group of commands are entered.

Graphical User Interface

  icons and menus are used .

- Program execution
- i/o operations
- File-system manipulation
- Error detections – hardware errors – power failure , connection failure,memory error

System view

- Resources allocation

  Resources like Cpu,Main memory,file storage and i/o devices are managed by OS.
- Accounting

  which users ,How many users
- Protection and security

System calls

- In computing, a system call is the programmatic way in which a computer program requests a service from the operating system.
- It act as an interface between process and operating system

System calls in process management

- End - terminate a process
- Load – Load the process
- Execute – execute the process
- Create – create the new process
- Allocate – allocate the memory for process
- Free – Removing the memory from process
- Wait – wait for signal
- Get – get process atrributes

System calls in file management

- Create a file, delete a file.
- Open , close a file.
- Read, write, reposition on file.
- Get file attributes, set file attributes

System calls in device management

- Request device, Release device.
- Read ,write, reposition
- Get device attributes, set device attributes.
- Attach or detach devices.

Information maintenance

- Get time/date, set time/date.
- Get process, file or device attributes
- Set process, file or device attributes.

Communication management

- Create ,delete connection
- Send, receive message
- Attach, detach remote devices.
- Transfer status information.

System programs

File management

Create, copy,delete,rename,print,list of files and directories.

Status information

These programs give information about date, time, available memory, no of users.

Programming language support

compilers,assemblers,interpreters

- Program loading and execution

  loaders,linkers – system programs

Communication

System programs create virtual connections between process, users and various computers.

- Send messages to one another.
- Send e-mail
- Transfer file from one computer to another computer.

Command interpreter

it is a system program used to interpret the commands entered by users.

Operating system Architecture

- Monolithic Architecture
- Layered Architecture
- Micro kernel Architecture

Monolithic Architecture

- The core software components of an operating system are known as kernel.
- The kernel has unrestricted access to all the resources.
- All the components of OS contained within kernel.
- Each component directly communicate with one another .
- Example – os/360.Linux,VMS

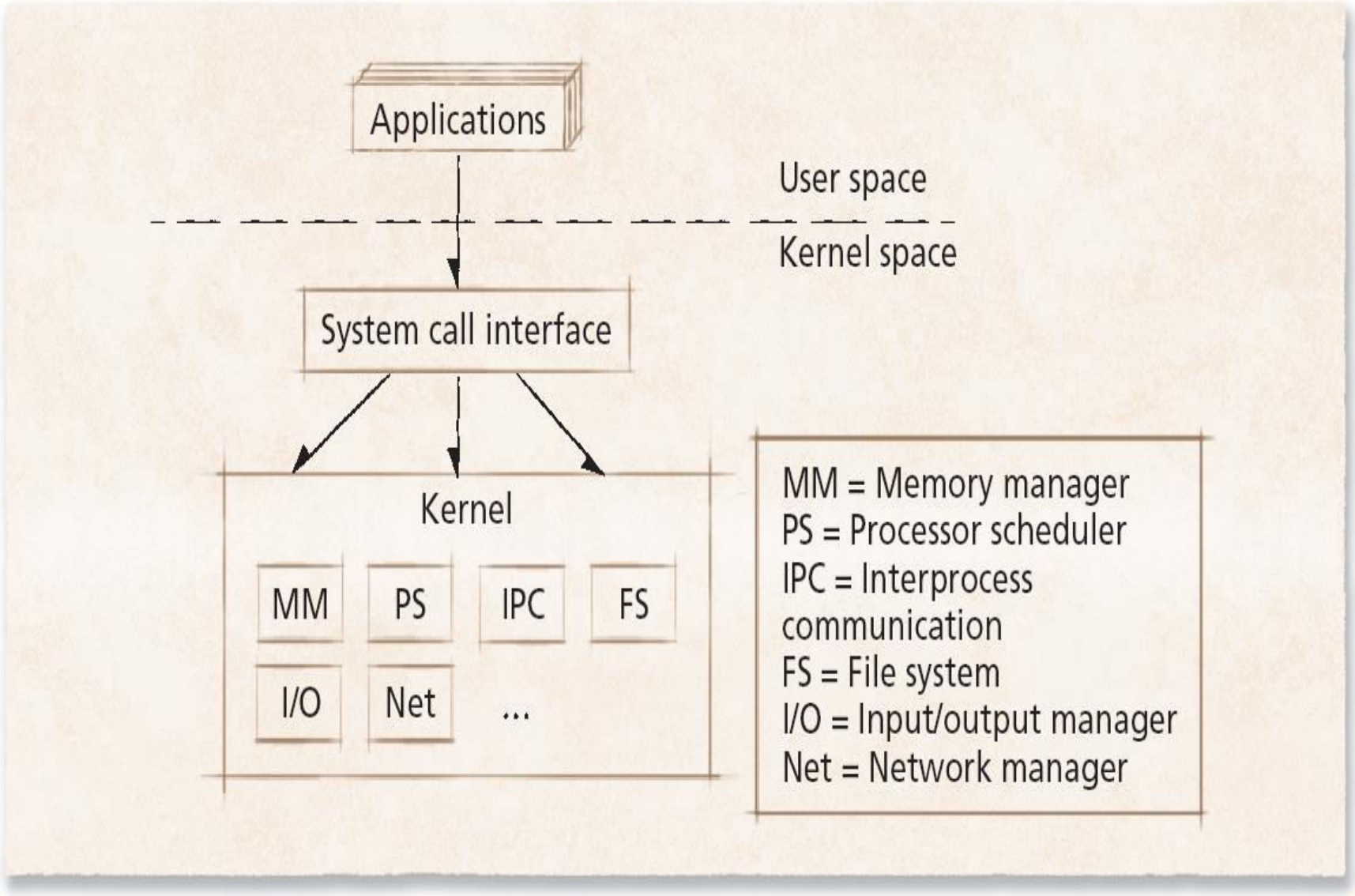
Advantages

- Direct communication between components.

DISADVANTAGES

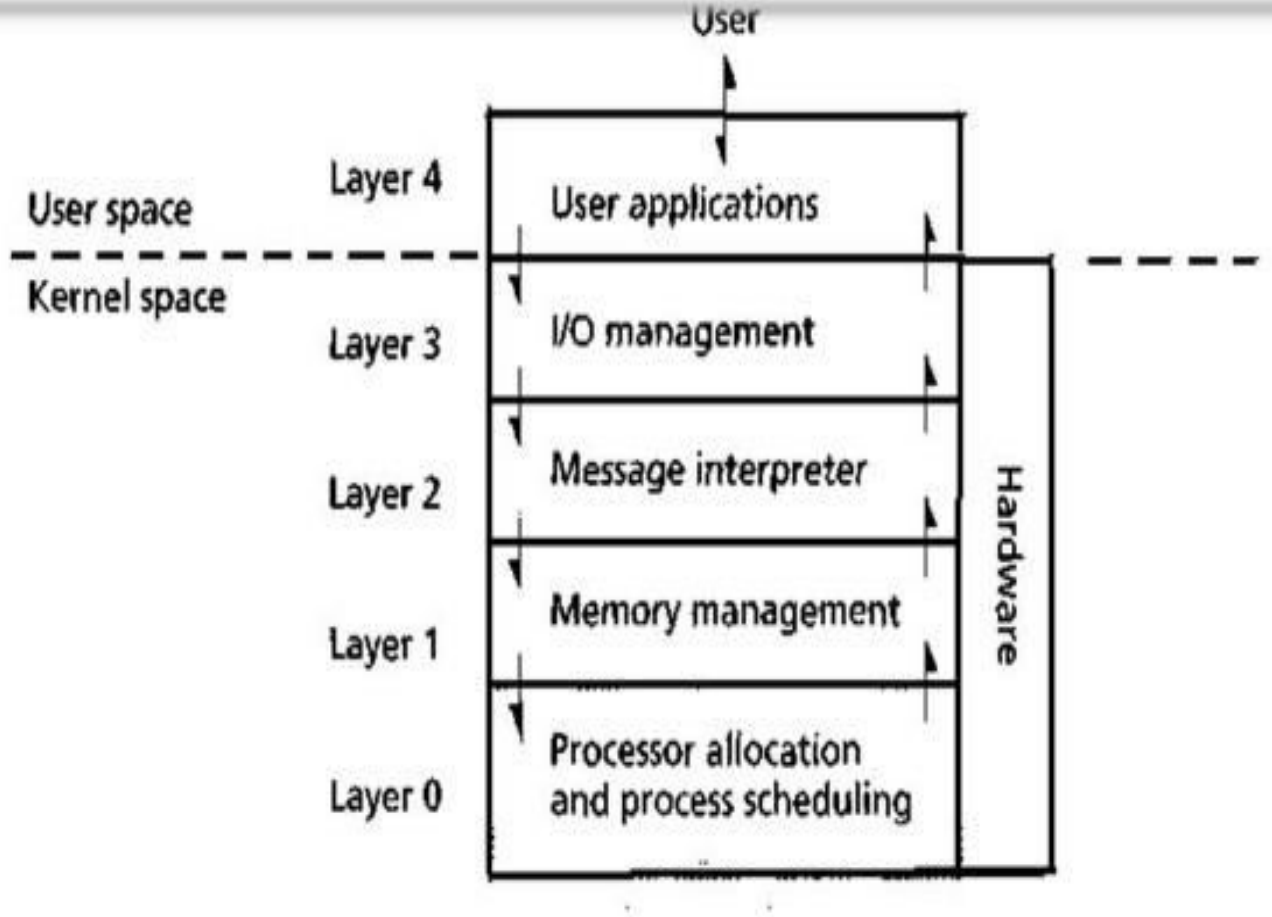
1. It is difficult to correct the errors.
2. There was a high risk of damage due to erroneous code.

MONOLITHIC OS ARCHITECTURE



Layered Architecture

- Group the components with similar functionalities into layers.
- Each layer communicates only with the layer immediately above and below it.
- Implementation of each layer to be modified without requiring any modification in adjacent layers.
- E-x Linux , windows


User
User space
Kernel space
Layer 4
User applications
Layer 3
I/O management
Layer 2
Message interpreter
Layer 1
Memory management
Layer 0
Processor allocation
and process scheduling
Hardware

Advantages

- This approach simplifies debugging and system verification.
- Each layer hides the existence of certain data structures ,operations and hardware from higher –level layers.

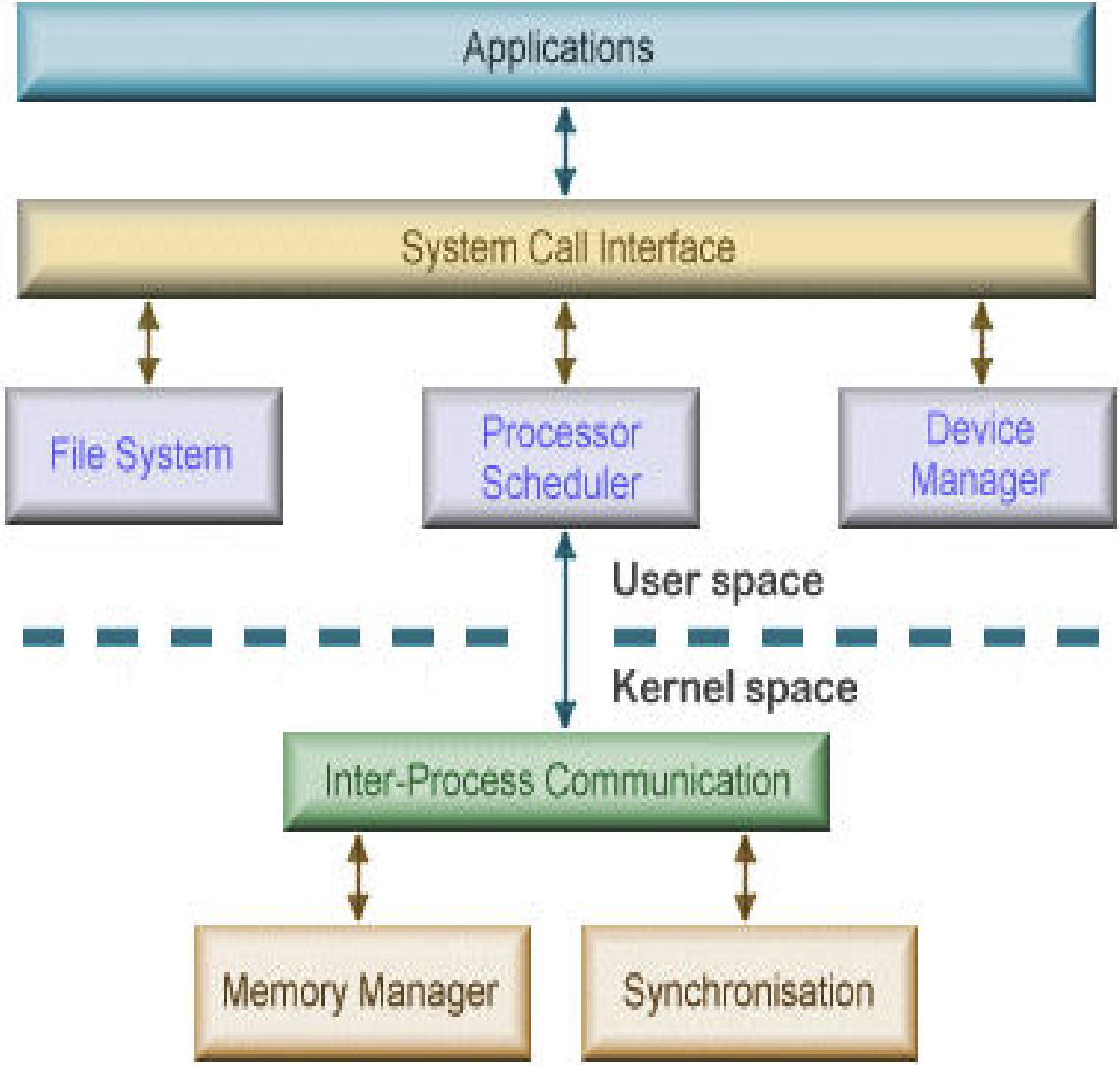
Disadvantages

- The major difficulty is in appropriately defining the various layers

Microkernel Architecture

- In microkernel architecture, only the most important services are put inside the kernel and rest of the OS service are present in the user space.
- Microkernel is responsible for the three important services of operating system namely:
- Inter-Process communication
- Memory management
- CPU scheduling

E-x windows xp,linux


Applications
System Call Interface
File System
Processor Scheduler
Device Manager
User space
Kernel space
Inter-Process Communication
Memory Manager
Synchronisation

Advantages

- Kernel is small and isolated and can hence function better
- Expansion of the system is easier, it is simply added in the system application without disturbing the kernel.

Disadvantages

- Increased level of inter-module communication which can degrade system performance.

VIRTUAL MACHINES

- A virtual machine is a software computer that, like a physical computer, runs an operating system and applications.
- The virtual machine is comprised of a set of specification and configuration files and is backed by the physical resources of a host.
- E-x Vmware, Java Virtual Machine

Advantages

- **Virtual machine** can offer an instruction set architecture that differs from real computer's;
- Easy maintenance, application provisioning, availability and convenient

CHAPTER -3 - PROCESS MANAGEMENT

- Process – Program in execution.
- When an executable file of a program is loaded into memory, it becomes process.

Components of process are :

- Object Program
- Data
- Resources
- Status of the process execution.

Program	Process
Program is static object	Process is dynamic object
Program is sequence of instructions	Process is a sequence of instructions in execution
Program resides in secondary memory	Process resides in main memory
The time span of the program is umlimited	The time span of process is limited

Process states

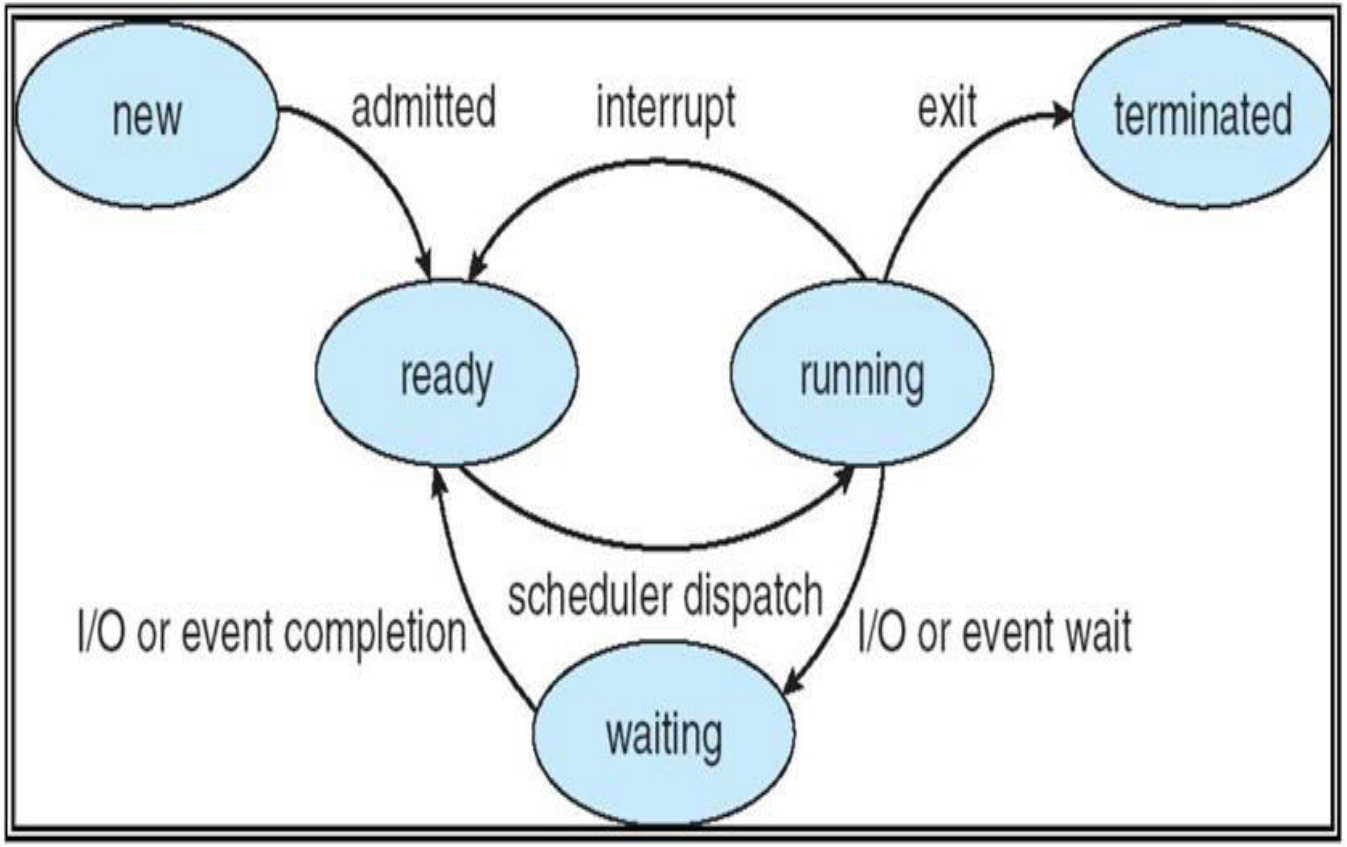
Each process is in one of the states. The states are listed below.

- New
- Ready
- Running
- Waiting
- Terminated

Process states

- New : A process that just been created.
- Ready : The process is waiting to be allocated to the Processor.
- Running : The process that is currently being executed.
- Waiting : A process is waiting for some event to occur such as the completion of an I/O operation.
- Terminated : A process that has been released from the pool of executable processes by the operating system.

Process state diagram



Process Control Block (PCB)

- Each process contains the process control block (PCB). PCB is the data structure used by the operating system.
- Operating system groups all information that needs about particular process.

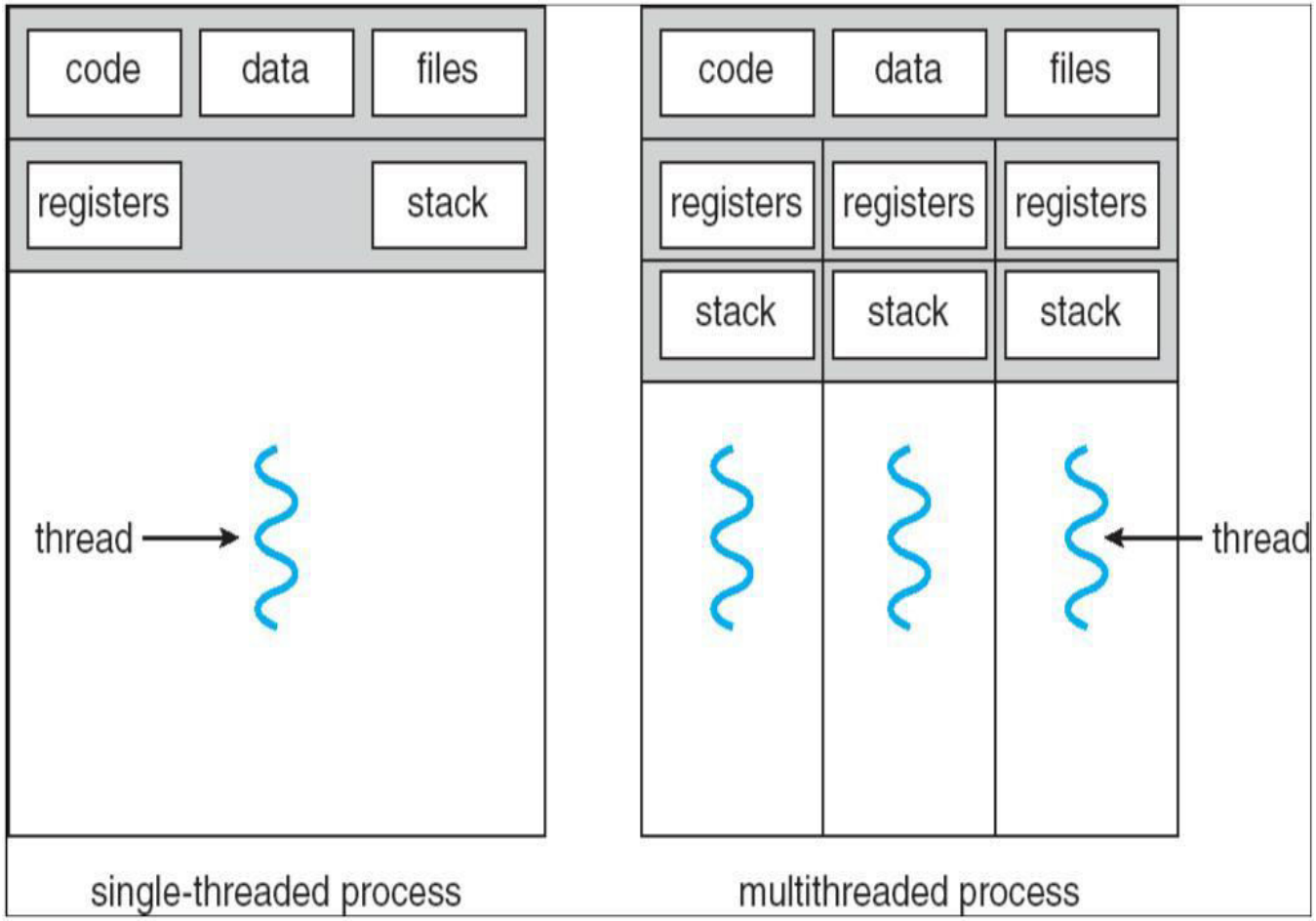
- **Pointer** : Pointer points to another process control block.
- **Process State** : Process state may be new, ready, running, waiting ,terminated.
- **Process number** :The identification of each process number,called process ID
- **Program Counter** : It indicates the address of the next instruction to be executed for this process.
- **CPU register** : It indicates general purpose register, stack pointers, index registers and accumulators etc.

- **Memory Management Information** : This information may include the value of base and limit register. This information is useful for deallocating the memory when the process terminates.

- **Accounting Information** : This information includes the amount of CPU and real time used, time limits, job or process numbers, account numbers etc.

Thread

- A thread is the smallest unit of processing that can be performed in an OS. A single process may contain multiple threads.
- Every thread consists of thread ID, program counter, register set and a stack.


code
data
files
registers
stack
thread
code
data
files
registers
registers
registers
stack
stack
stack
thread
single-threaded process
multithreaded process

Advantages

- Responsiveness
- Resource sharing
- Scalability

Interprocess communication

- When processes execute concurrently,they can be of two types.
- Independent process
- Co-operative process

Independent Process

- It does not affect or does not get affected by other process.
- An independent process does not share its data with any other process.

Co-operative process

- It does affect or gets affected by other processes.
- Shares the data and information with other process
- Two types of data model

  Message passing model

  Shared memory model

Message passing Model

- This model communicates by exchanging messages between co-operating process.
- Two processes

  send message

  Receive message
- Communication link can be implemented.
- Some of the methods are implementing the link are

  Direct or indirect communication

  Synchronization

  Buffering

Shared memory model

- A shared memory resides in the address space of the process.
- The processes can exchange information by reading and writing the data in the shared area.
- The process wants to communicate using this shared-memory must attach to their address space

Benefits of co-operating process

- Information sharing
- Computational speedup
- Modularity
- Convenience

PROCESS SCHEDULING

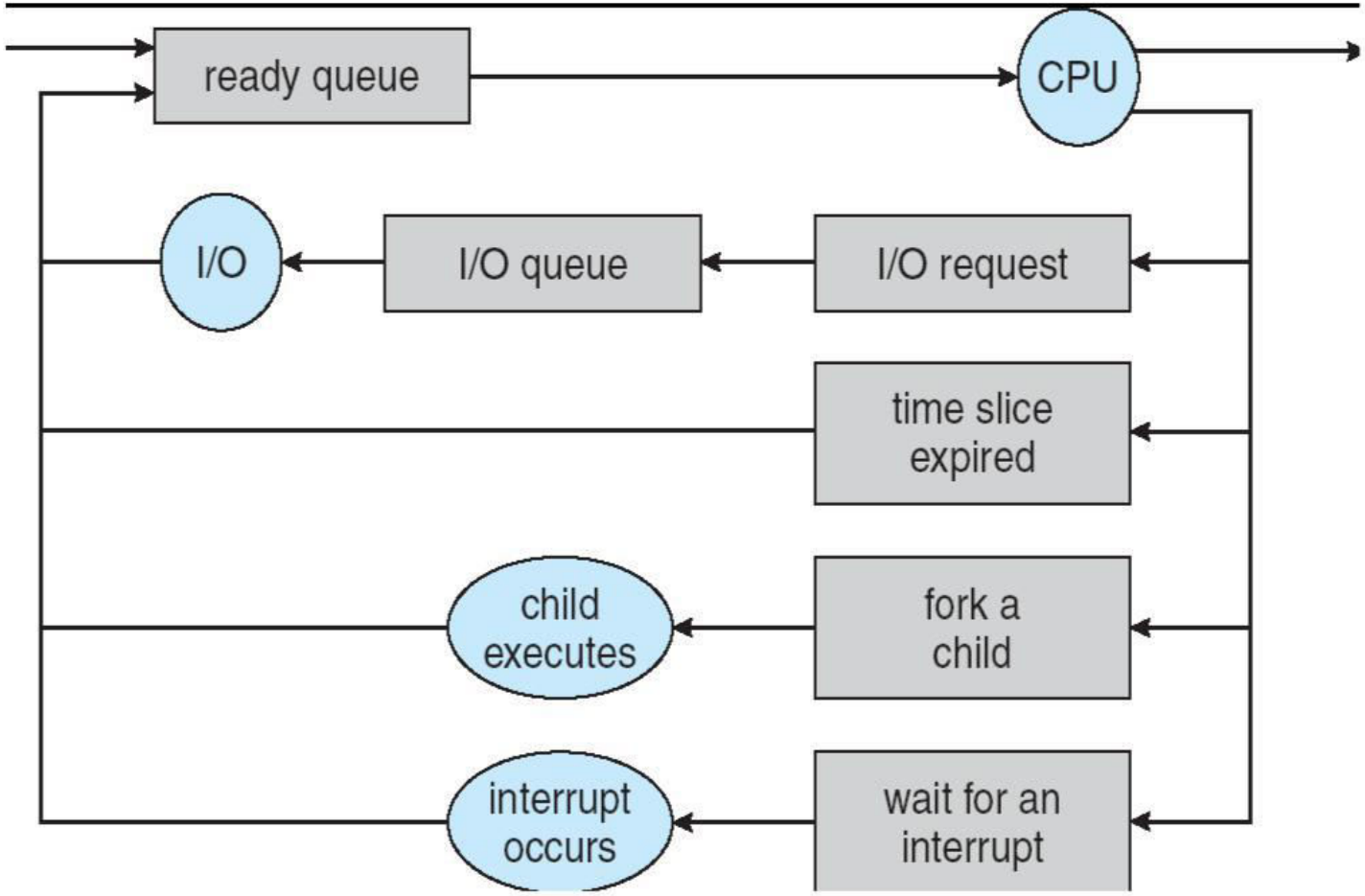
- The scheduling mechanism is the part of the process manager that handles the removal of the running process from the CPU and the selection of another process on the basis of particular strategy.

- Multiprogramming operating system allows more than one process to be loaded into the executable memory at a time and for the loaded process to share the CPU using time multiplexing.

Scheduling queues

- All the processes are stored in **job queue**.
- The processes residing in the main memory, which are ready and waiting to execute are kept on **ready queue.**
- Processes waiting for a device are placed in **device queue**.

Queuing diagram



- Queue is represented in rectangular box
- The circle represents the resources that serves the queue.
- The arrows indicate the process flow in the system.

Schedulers

- A scheduler is an operating system which selects the next job to be executed from queues. There are 3 types of schedulers. They are
- 1) Long term schedulers
- 2) Medium term schedulers
- 3) Short term schedulers.

Long Term schedulers

- It is also called job scheduler.
- Job scheduler determines which programs are admitted to the system for processing.
- Job scheduler selects processes from the queue and loads them into memory for execution.
- These processes are kept on Disk

- I/O bound process – Processes are doing more i/o than doing computation.
- CPU bound process – Process spends more time in cpu computation than in generating i/o request.

Short term scheduler

- It allocates processes in the ready queue to the CPU for immediate processing.
- The short term scheduler must be very fast since the CPU executes the process for only a few milliseconds

Medium term scheduler

- Medium term scheduling is part of the swapping function. It removes the processes from the memory.
- The medium term scheduler is in charge of handling the swapped out-processes.

Context switching

- The task of switching the CPU from one to another process , saving the state of the current process and loading the saved state of another process is known as context switching.