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2 MARKS QUESTIONS

1.Define real time operating system. List its any four applications of it.

Real time Operating System:

A real time system has well defined fixed time constraints. Processing should be done within the defined constraints -Hard and Soft real time system.

OR

The real-time operating system used for a real-time application means for those applications where data processing should be done in the fixed and small quantum of time.

Types of real time operating system

1. Hard real-time
2. Soft real-time

Applications:

1. Flight Control System
2. Simulations
3. Industrial control
4. Military applications

2.Explain any 4 services provided by OS.

1.User Interface: All operating systems have a user interface that allows users to communicate with the system. Three types of user interfaces are available:

a. Command line interface (CLI)

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b. Batch interface

c. Graphical user interface (GUI)

2. Program execution: The operating system provides an environment where the user can conveniently run programs. It also performs other important tasks like allocation and deallocation of memory, CPU scheduling etc. It also provides service to end process execution either normally or abnormally by indicating error.

3. I/O operations: When a program is running, it may require input/output resources such as a file or devices such as printer. So the operating system provides a service to do I/O.

4.File system manipulation: Programs may need to read and write data from and to the files and directories. Operating system manages the secondary storage. Operating system makes it easier for user programs to accomplish their task such as opening a file, saving a file and deleting a file from the storage disk.

5.Communication: In the system, one process may need to exchange information with another process. Communication can be implemented via shared memory or through message passing, in which packets of information are moved between processes by the operating system.

6.Error detection: Operating systems detects CPU and memory hardware such as a memory error or power failure, a connection failure on a network or lack of paper in the printer etc.

7.Resource allocation: Operating system manages resource allocation

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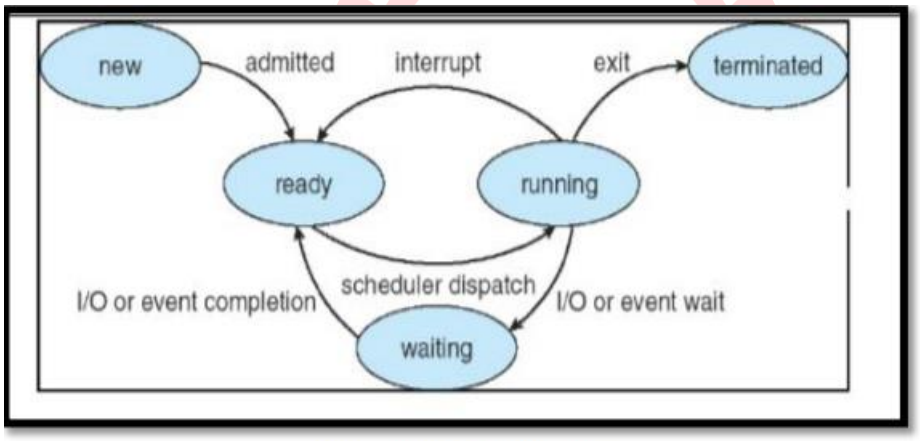
to the processes. These resources are CPU, main memory, file storage and I/O devices.

8.Accounting: Operating system keeps track of usages of various computer resources allocated to users.

9.Protection & security: When several separate processes execute concurrently, one process should not interfere with the other processes or operating system itself. Protection provides controlled access to system resources. Security is provided by user authentication such as password for accessing information.

3. Draw process state diagram.



process state diagram

4. Explain any four scheduling criteria

1. CPU utilization: In multiprogramming the main objective is to keep CPU as busy as possible. CPU utilization can range from 0 to 100 percent.

2.Throughput: It is the number of processes that are completed per unit time. It is a measure of work done in the system. When CPU is busy in

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executing processes, then work is being done in the system. Throughput depends on the execution time required for any process. For long processes, throughput can be one process per unit time whereas for short processes it may be 10 processes per unit time.

3. Turnaround time: The time interval from the time of submission of a process to the time of completion of that process is called as turnaround time. It is the sum of time period spent waiting to get into the memory, waiting in the ready queue, executing with the CPU, and doing I/O operations.

4.Waiting time: It is the sum of time periods spent in the ready queue by a process. When a process is selected from job pool, it is loaded into the main memory (ready queue). A process waits in ready queue till CPU is allocated to it. Once the CPU is allocated to the process, it starts its execution and if required request for resources. When the resources are not available that process goes into waiting state and when I/O request completes, it goes back to ready queue. In ready queue again it waits for CPU allocation.

5.Response time: The time period from the submission of a request until the first response is produced is called as response time. It is the time when system responds to the process request not the completion of a process. In the system, a process can Produce some output fairly early and can continue computing new results while previous results are being output to the user.

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5.Define virtual memory

Virtual memory is a memory management capability of an operating system (OS) that uses hardware and software to allow a computer to compensate for physical memory shortages by temporarily transferring data from random access memory (RAM) to disk storage.

OR

Virtual memory is the separation of user logical memory from physical memory. This separation allows an extremely large virtual memory to be provided for programmers when only a smaller physical memory is available. Virtual memory makes the task of programming much easier, because the programmer no longer needs to worry about the amount of physical memory available, or about what code can be placed in overlays, but can concentrate instead on the problem to be programmed.

6. Write syntax for following commands: i)Sleep ii)Kill

i)sleep

Syntax: sleep NUMBER[SUFFIX]…

sleep OPTION

ii) kill

Syntax: kill pid

7.Describe any four file attributes

File attributes:

 Name: The symbolic file name is the only information kept in

human readable form.

 Identifier: File system gives a unique tag or number that

identifies file within file system and which is used to refer files

internally.

 Type: This information is needed for those systems that support

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different types.

- Location: This information is a pointer to a device and to the location of the file on that device.
- Size: The current size of the file (in bytes, words or blocks) and possibly the maximum allowed size are included in this attribute.
- Protection: Access control information determines that who can do reading, writing, executing and so on.
- Time, Date and User Identification: This information may be kept for creation, Last modification and last use. These data can be useful for protection, security and usage monitoring.

8. Differentiate between Multi programmed and Multitasking operating system (Any two points)

Features	Multiprogramming	Multitasking
Basic	It allows multiple programs to utilize the CPU simultaneously.	A supplementary of the multiprogramming system also allows for user interaction.
Mechanism	Based on the context switching mechanism.	Based on the time-sharing mechanism.
Objective	It is useful for reducing/decreasing	It is useful for running multiple processes at the

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	CPU idle time and increasing throughput as much as possible.	same time, effectively increasing CPU and system throughput.
Execution	When one job or process completes its execution or switches to an I/O task in a multi-programmed system, the system momentarily suspends that process. It selects another process from the process scheduling pool (waiting queue) to run.	In a multiprocessing system, multiple processes can operate simultaneously by allocating the CPU for a fixed amount of time.
CPU Switching	In a multiuser environment, the CPU switches between programs/processes quickly.	In a single-user environment, the CPU switches between the processes of various programs.
Timing	It takes maximum time to execute the process.	It takes minimum time to execute the process.

9. List any four services provided by O.S.

User Interface

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

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 Resource Allocation

 Accounting

 Protection and security

10.Define : Process, PCB

Process:-A process is a program in execution. Process is also called as job, task or unit of work.

PCB:-Process Control Block is a data structure that contains information of the process related to it. The process control block is also known as a task control block, entry of the process table, etc

11. Define CPU and I/O burst cycle

CPU burst cycle: It is a time period when process is busy with CPU.

I/O burst cycle: It is a time period when process is busy in working with I/O resources.

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12. Differentiate between paging and segmentation.

	leading to internal fragmentation.	blocks at all. Thus, it may lead to external fragmentation.
Logical Address	A logical address divides into page offset and page number in the case of Paging.	A logical address divides into section offset and section number in the case of Segmentation.
Data Storage	In the case of Paging, the page table leads to the storage of the page data.	In the case of Segmentation, the segmentation table leads to the storage of the segmentation data.
		their actual address as well as virtual address.
Speed	This technique is comparatively much faster in accessing memory.	This technique is comparatively much slower in accessing memory than Paging.
Size	The available memory determines the individual page sizes.	The user determines the individual segment sizes.
Fragmentation	The Paging technique may underutilize some of the pages- thus	The Segmentation technique may not use some of the memory

13. Write syntax of following commands-(i) Kill(ii) Sleep

i) kill

Syntax: kill Pid

ii) sleep

Syntax: sleep NUMBER[SUFFIX]…

sleep OPTION

14. List any four file operations.

- Creating a file

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- Writing a file:
- Reading a file:
- Repositioning within a file
- Deleting a file
- Appending new information to the end of the file
- Renaming an existing file.
- Creating copy of a file, copy file to another I/O device such as printer or display

4 Marks Questions

1.Enlist types of operating system. Explain multiprogramming OS in detail.

Types of operating system

1.Batch Systems

2.Multiprogramming

3.Multitasking

4.Time-Sharing Systems

5.Desktop Systems

6.Distributed system

7.Clustered system

8.Real Time system:

Multiprogramming:

 In multiprogramming, more than one program lies in the memory.

 The scheduler selects the jobs to be placed in ready queue from a number of programs.

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 The ready queue is placed in memory and the existence of more than one program in main memory is known as multiprogramming.

 Since there is only one processor, there multiple programs cannot be executed at a time.

 Instead the operating system executes part of one program, then the part of another and so on.

 Example of multiprogramming: user can open word, excel, access and other applications in a system.

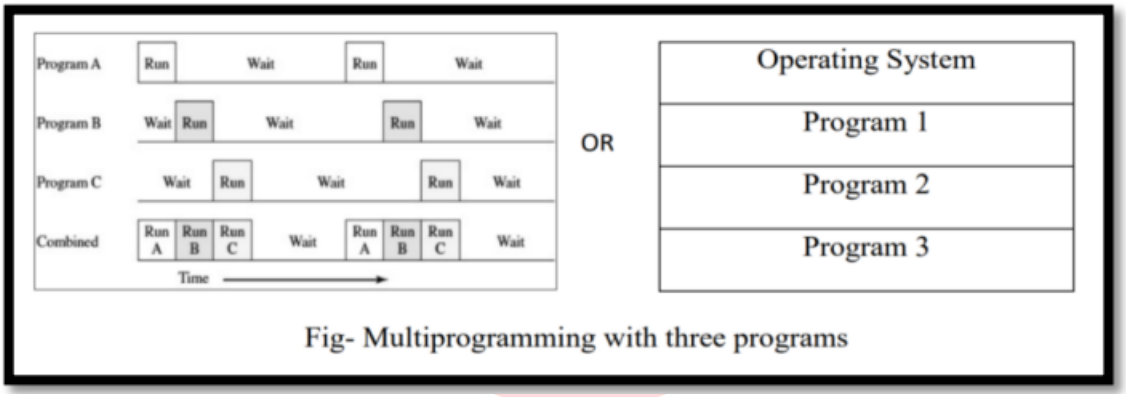

Fig- Multiprogramming with three programs

2. List components of OS. Explain process management in detail.

List of System Components:

1. Process management
2. Main memory management
3. File management
4. I/O system management
5. Secondary storage management

Process Management: The operating system manages many kinds of

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activities ranging from user programs to system programs like printer spooler, name servers, file server etc.

Each of these activities is encapsulated in a process.

 A process includes the complete execution context (code, data, PC, registers, OS resources in use etc.).

 The basic unit of software that the operating system deals with in scheduling the work done by the processor is either a process or a thread, depending on the operating system.

 It's tempting to think of a process as an application, but that gives an incomplete picture of how processes relate to the operating system and hardware.

 The application you see (word processor or spreadsheet or game) is, indeed, a process, but that application may cause several other processes to begin, for tasks like communications with other devices or other computers.

 There are also numerous processes that run without giving you direct evidence that they ever exist. A process, then, is software that performs some action and can be controlled by a user, by other applications or by the operating system.

 It is processes, rather than applications, that the operating system controls and schedules for execution by the CPU. In a singletasking system, the schedule is straightforward.

 The operating system allows the application to begin running,

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suspending the execution only long enough to deal with

interrupts and user input.

 The five major activities of an operating system in regard to

process management are

1. Creation and deletion of user and system processes.

2. Suspension and resumption of processes.

3. A mechanism for process synchronization.

4. A mechanism for process communication.

5. A mechanism for deadlock handling.

3. With neat diagram explain inter process communication model.

Inter-process communication: Cooperating processes require an Interprocess communication (IPC) mechanism that will allow them to exchange data and information.

There are two models of IPC

1. Shared memory

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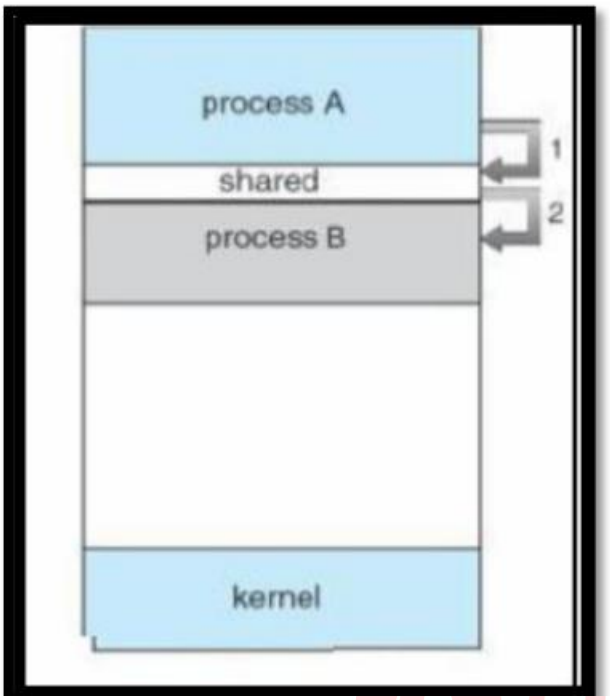

In this, all processes who want to communicate with other processes can access a region of the memory residing in an address space of a process creating a shared memory segment.

 All the processes using the shared memory segment should attach to the address space of the shared memory. All the processes can exchange information by reading and/or writing data in shared memory segment.

 The form of data and location are determined by these processes who want to communicate with each other.

 These processes are not under the control of the operating system.

 The processes are also responsible for ensuring that they are not

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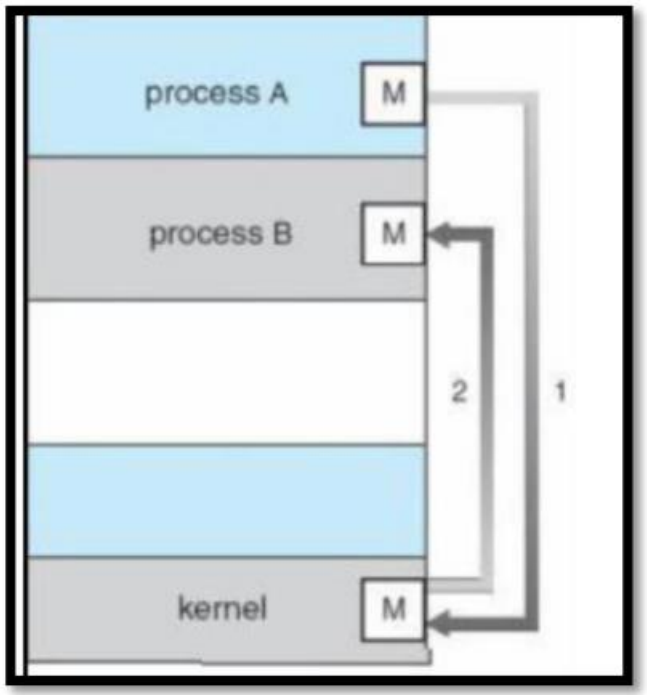
writing to the same location simultaneously.

 After establishing shared memory segment, all accesses to the shared memory segment are treated as routine memory access and without assistance of kernel.

2. Message Passing



 In this model, communication takes place by exchanging messages between cooperating processes.

 It allows processes to communicate and synchronize their action without sharing the same address space.

 It is particularly useful in a distributed environment when communication process may reside on a different computer connected by a network.

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 Communication requires sending and receiving messages through the kernel.

The processes that want to communicate with each other must have a communication link between them. Between each pair of processes exactly one communication link.

4. Describe I/O Burst and CPU Burst cycle with neat diagram.

CPU burst cycle: It is a time period when process is busy with CPU.

I/O burst cycle: It is a time period when process is busy in working with I/O resources.

 A process execution consists of a cycle of CPU execution and I/O wait.

 A process starts its execution when CPU is assigned to it, so process execution begins with a CPU burst cycle.

 This is followed by an I/O burst cycle when a process is busy doing I/O operations.

 A process switch frequently from CPU burst cycle to I/O burst cycle and vice versa.

 The complete execution of a process starts with CPU burst cycle, followed by I/O burst cycle, then followed by another CPU burst cycle, then followed by another I/O burst cycle and so on.

 The final CPU burst cycle ends with a system request to

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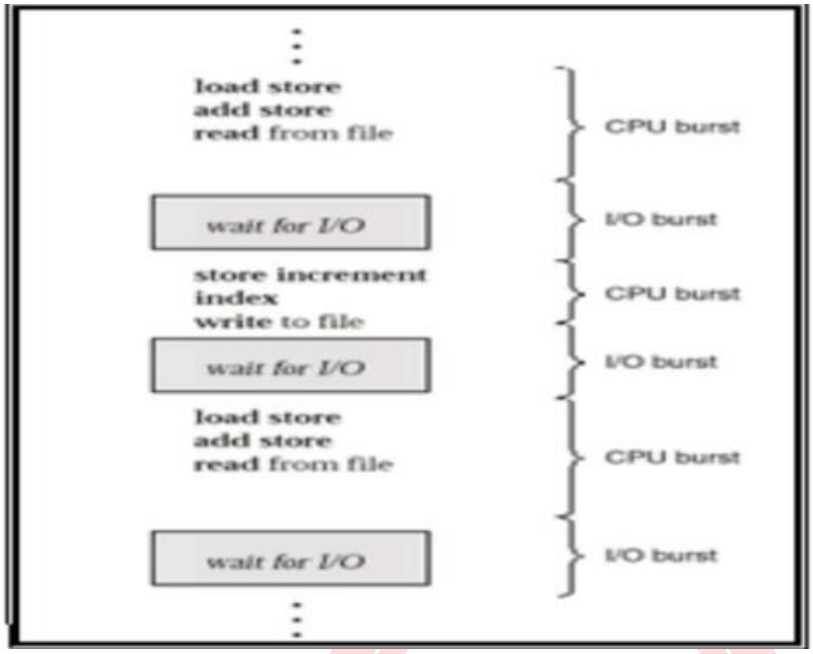
terminate execution.



5. Explain 'PS' command with any four options.

ps command: It is used to display the characteristics of a process. This command when execute without options, it lists the processes associated with a user at a particular terminal.

Syntax: $ ps [options]

Example: $ ps

output:

```
  PID TTY          TIME CMD
12330 pts/0    00:00:00 bash
21621 pts/0    00:00:00 ps
```

Each line in the output shows PID, the terminal with which the process is associated, the cumulative processor time that has been consumed

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since the process has been started and the process name.

Options:

-f : It is used to display full listing of attributes of a process. It includes UID (user ID),PPID(Parent ID),C(amount of CPU time consumed by the process) and STIME(chronological time that has elapsed since the process started).

Example: $ ps -f

```
UID          PID  PPID  C STIME TTY          TIME CMD
root           1     0  0 19:58 ?        00:00:01 /sbin/ini
root           2     0  0 19:58 ?        00:00:00 [kthreadd
root           3     2  0 19:58 ?        00:00:00 [ksoftirq
```

-u: Shows the activities of any specified user at any time. Example: $ ps -u abc

```
  PID TTY          TIME CMD
 1053 ?        00:00:00 systemd
 1062 ?        00:00:00 (sd-pam)
 1074 tty1     00:00:00 zsh
```

-a: It shows the processes of all users. Example: $ ps -a

```
  PID TTY          TIME CMD
27011 pts/0    00:00:00 man
27016 pts/0    00:00:00 less
27499 pts/1    00:00:00 ps
```

-e: It displays processes including user and system processes.

example: $ ps -e

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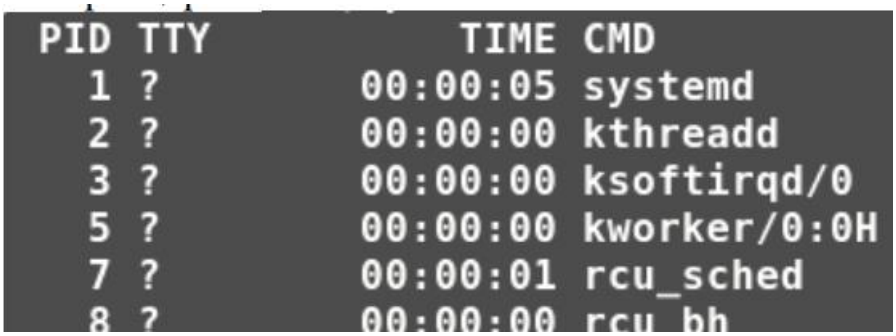

```
PID TTY          TIME CMD
  1 ?        00:00:05 systemd
  2 ?        00:00:00 kthreadd
  3 ?        00:00:00 ksoftirqd/0
  5 ?        00:00:00 kworker/0:0H
  7 ?        00:00:01 rcu_sched
  8 ?        00:00:00 rcu_bh
```

6. Explain deadlock? What are necessary conditions for deadlock?

In multiprogramming environment, several processes may compete for a finite number of resources. A process requests resources and if the resources are not available then the process enters into the waiting state. Sometimes a waiting process is never again able to change its status because the resources requested by it are held by other waiting processes. This situation is called as deadlock. When a process request for resources held by another waiting process which in turn is waiting for resources held by another waiting process and not a single process can execute its task, then deadlock occurs in the system.

Example: Consider a system with three disk drives and three processes. When each process request one disk drive, system allocates one disk drive to each process. Now there is no more drive available in the system. If all three processes request for one more disk drive, then all three processes will go into the waiting state and system will go in deadlock state. Because any one process from the three can execute only when one of them will release the disk drive allocated to it.

Necessary Conditions:

1. Mutual exclusion: At least one resource must be held in a nonsharable mode; that is, only one process at a time can use the resource.

2. Hold and Wait: A process must be holding at least one resource and

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waiting to acquire additional resources that are currently being held by other processes.

3. No pre-emption: Resources cannot be pre-empted i.e a resource can be released only voluntarily by the process holding it.

4. Circular wait: A set {P0,P1…Pn} of waiting processes must exist such that P0 is waiting for a resource held by P1,P1 is waiting for a resource held by P2,…,Pn-1 is waiting for a resource held by Pn and Pn is waiting for a resource held by P0. Each process is waiting for the resources held by other waiting processes in circular form.

7. Explain partitioning and its types.

An important operation of memory management is to bring programs into main memory for execution by the processor. Partitioning is a technique that divides a memory into multiple partitions. These partitions can be of different size or same size.

Types of partitioning

- Fixed partitioning i.e. static partitioning
- Variable partitioning i.e. dynamic partitioning

Fixed Partitioning: Main memory is divided into multiple partitions of fixed size at the time of system generation. A process may be loaded into a partition of equal size or greater size. Partitions can be of equal size or unequal size.

Equal size partitioning: Main memory is divided into equal size partitions. Any process with less or equal size can be loaded in any available partition.

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OR

Unequal size partitioning: Main memory is divided into multiple partitions of unequal size. Each process can be loaded into the smallest partition within which the process will fit.

Variable partitioning: When a process enters in main memory, it is allocated exact size that is required by that process. So in this method, partitions can vary in size depending on memory space required by a process entering in main memory. Operating system maintains a table indicating which parts of memory are available and which are occupied. When new process arrives and it needs space, system searches for available memory space in main memory. If it is available, then memory is allocated to the process by creating a partition in memory.

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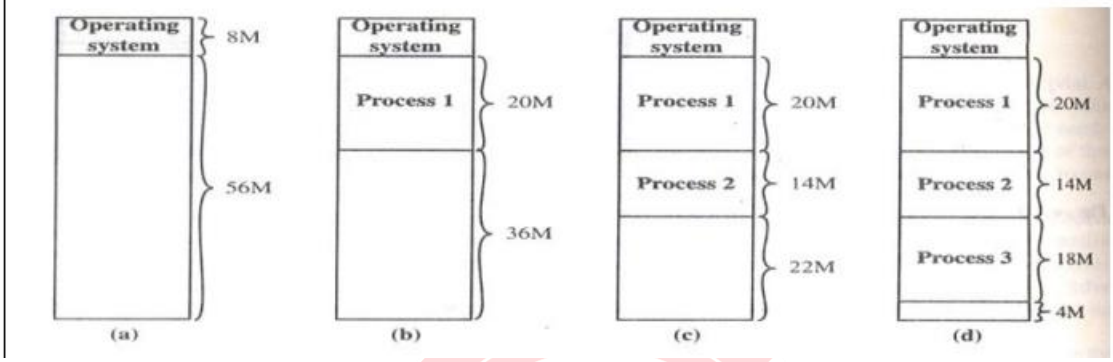
For example: Consider following table with process and memory space.

Process	Memory space
P1	20 M
P2	14 M
P3	18 M



8. Describe sequential and direct access method

Sequential access: Information from the file is processed in order i.e. one record after another. It is commonly used access mode. For example, editors and compilers access files in sequence.

A read operation read information from the file in a sequence i.e. read next reads the next portion of the file and automatically advances a file pointer.

A write operation writes information into the file in a sequence i.e. write next appends to the end of the file and advances to the end of the newly written material. Such a file can be reset to the beginning.

In some operating systems, a program may be able to skip forward or backward n records for some integer n.

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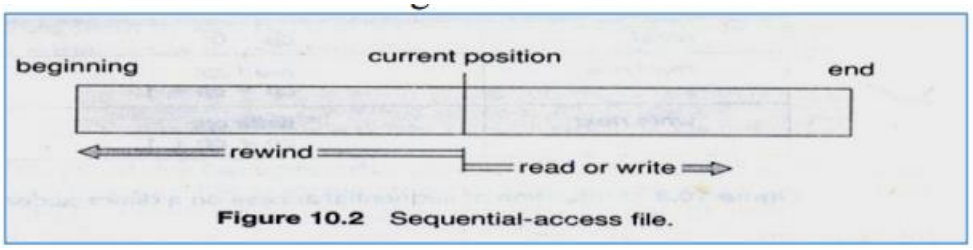

Figure 10.2 Sequential-access file.

As shown in above diagram, a file can be rewind (moved in backward direction) from the current position to start with beginning of the file or it can be read or write in forward direction.

Direct access: It is also called as relative access. A file is made up of fixed length logical records that allow programs to read and write records rapidly in no particular order. Direct access method is based on disk model of a file which allows random access to any file block.
For direct access a file is viewed as a numbered sequence of blocks or records. So we can directly read block 14, then block 53 and so on. This method is used for immediate access to large amount of information. Database can be accessed with direct access method. For example, when a query concerning a particular subject arrives, we compute which block contains the answer and then read that block directly to provide the desired information.
Read n operation is used to read the nth block from the file whereas write n is used to write in that block. The block numbers provided by the user to the operating system is a relative block number. A relative block number is an index relative to the beginning of the file. The first

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relative block of file is 0; the next is 1 and so on. Actual absolute disk address of the block is different from the relative address. The use of relative block numbers allow the operating system to decide where the file should be placed and helps t prevent the user from accessing portions of the file system that may not be part of his file.

9.Write Unix command for following: i) create a folder OSY ii) create a file FIRST in OSY folder iii) List/display all files and directories. iv) Write command to clear the screen

i) create a folder OSY:

$mkdir OSY

ii)create a file FIRST in OSY folder:

$cd OSY

$cat>FIRST or $ touch FIRST

iii) List/display all files and directories:

$ls

iv) to clear screen:

$clear

10.What is purpose of system call? State two system calls with their functions.

System call provides an interface between a running program and operating system. It allows user to access services provided by operating system. This system calls are procedures written using C, C++ and assembly language instructions. Each operating system has its own name for each system call. Each system call is associated with a number that identifies itself.

System calls:

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Process Control: Program in execution is a process. A process to be executed must be loaded in main memory. while executing it may need to wait, terminate or create & terminate child processes.

- end, abort
- load, execute
- create process, terminate process

get process attributes, set process attributes

- wait for time
- wait event, signal event
- allocate and free memory

File Management: System allows us to create and delete files. For create and delete operation system call requires the name of the file and other attributes of the file. File attributes include file type, file size, protection codes, accounting information and so on. Systems access these attributes for performing operations on file and directories. Once the file is created, we can open it and use it. System also allows performing reading, writing or repositioning operations on file.

- create file, delete file
- open, close
- read, write, reposition
- get file attributes, set device attributes
- logically attach or detach devices

3. Device Management: When a process is in running state, it requires

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several resources to execute. These resources include main memory, disk drives, files and so on. If the resource is available, it is assigned to the process. Once the resource is allocated to the process, process can read, write and reposition the device.

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

4. Information Maintenance: Transferring information between the user program and the operating system requires system call. System information includes displaying current date and time, the number of current user, the version number of the operating system, the amount of free memory or disk space and so on. Operating system keeps information about all its processes that can be accessed with system calls such as get process attributes and set process attributes.

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

5. Communication: Processes in the system, communicate with each other. Communication is done by using two models: message passing and shared memory. For transferring messages, sender process connects itself to receiving process by specifying receiving process

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name or identity. Once the communication is over system close the connection between communicating processes.

- create, delete communication connection
- send, receive messages
- transfer status information
- attach or detach remote devices

11. State and describe types of scheduler.

There are three types of scheduler:

- Long term scheduler
- Short term scheduler
- Medium term scheduler

1. Long term scheduler: It selects programs from job pool and loads them into the main memory. It controls the degree of multiprogramming. The degree of multiprogramming is the number of processes loaded (existing) into the main memory. System contains I/O bound processes and CPU bound processes. An I/O bound process spends more time for doing I/O operations whereas CPU bound process spends more time in doing computations with the CPU. So It is the responsibility of long term scheduler to balance the system by loading some I/O bound and some CPU bound processed into the main memory. Long term scheduler executes only when a process leaves the system, so it executes less frequently. When long term scheduler selects a process from job pool, the state of process changes from new

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to ready state.

2. Short term scheduler: It is also known as CPU scheduler. This scheduler selects processes that are ready for execution from the ready queue and allocates the CPU to the selected process. Frequency of execution of short term scheduler is more than other schedulers. When short term scheduler selects a process, the state of process changes from ready to running state.

3.Medium term scheduler: When a process is in running state, due to some interrupt it is blocked. System swaps out blocked process and store it into a blocked and swapped out process queue. When space is available in the main memory, the operating system looks at the list of swapped out but ready processes. The medium term scheduler selects one process from that list and loads it into the ready queue. The job of medium term scheduler is to select a process from swapped out process queue and to load it into the main memory. This scheduler works in close communication with long term scheduler for loading process into the main memory.

12. Explain Round Robin algorithm with suitable example.

It is preemptive scheduling algorithm. A small unit of time known as a time quantum or time slice is used for pre-emption of a currently running process. Ready queue is implemented as a circular queue. CPU is assigned to the entire processes one by one, on first come first serve basis, for a specific time period. Every process executes for specified

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time period and CPU is given to the next process when time quantum expires.

A new process is added at the tail of the ready queue when it enters the system. CPU scheduler selects first process from head of the ready queue and executes it for a specified time quantum. Once the time quantum expires, dispatcher is invoked to pre-empt current running process and CPU is given to the next process placed at the head of the ready queue. The running process may have a CPU burst time less or greater than time quantum. If burst time of running process is less than the time quantum then, the process itself releases the CPU. The scheduler then selects next process from ready queue and executes it. If burst time of running process is longer than time quantum then, context switch occurs and the process is place at the tail of ready queue for remaining burst time execution.

Example:

Process Burst Time

P1 24

P2 3

P3 3

Time quantum: 4 ms

The resulting RR schedule is as follows:

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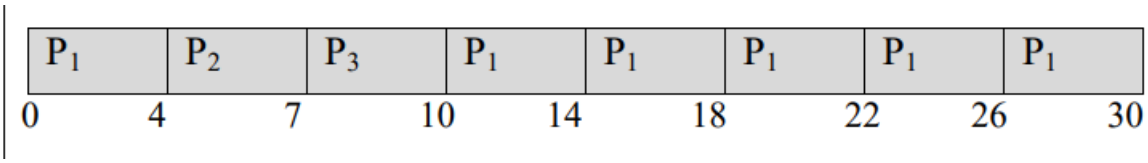

CPU is allocated to process P1 for 4 ms. Since it requires another 20 milliseconds, it is preempted after the first time quantum and the CPU is given to the next process in the queue, process P2. Process P2 does not need 4 milliseconds, so it quits before its time quantum expires. The CPU is then given to the next process, process P3. Once each process has received 1 time quantum, the CPU returns to process P1 for an additional time quantum.

13. Explain PCB with diagram.

Each process is represented as a process control block (PCB) in the operating system. It contains information associated with specific process.

Process State: It indicates current state of a process. Process state can be new, ready, running, waiting and terminated.

Process number: Each process is associated with a unique number which is known process identification number.

Program Counter: It indicates the address of the next instruction to be executed for the process.

CPU Registers: The registers vary in number and type depending on the computer architecture. Register includes accumulators, index registers, stack pointers and general purpose registers plus any

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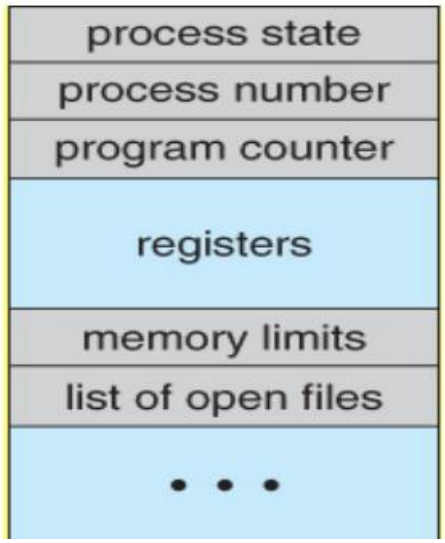
condition code information.

Memory Management Information: It includes information such as value of base and limit registers, page tables, segment tables, depending on the memory system used by OS.

Accounting Information: This information includes the amount of CPU used, time limits, account holders, job or process number and so on. It also includes information about listed I/O devices allocated to the process such as list of open files.

Each PCB gives information about a particular process for which it is Designed.



14. Explain Time sharing O.S.

In time sharing system, the CPU executes multiple jobs by switching among them. The switches occur so frequently that the users can

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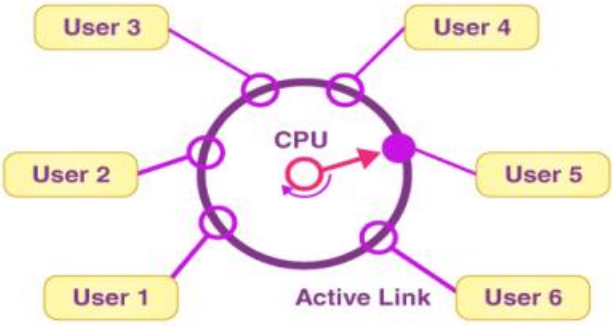
interact with each program while it is running. It includes an interactive computer system which provides direct communication between the user and the system. A time-sharing system allows many users to share the computer resources simultaneously. The timesharing system provides the direct access to many users where CPU time is divided among all the users on scheduled basis. The operating system allocates a time slice to each user. When this time is expired, it passes control to the next user on the system. The time allowed is extremely small and the users are given the impression that each of them has their own CPU and they are the sole owner of the CPU. In this time slice each user gets attention of the CPU. The objective of time-sharing system is to minimize response time of process.

Example: The concept of time-sharing system is shown in figure:



In above figure, the user 5 is active but user 1, user 2, user 3, and user 4 are in waiting state whereas user 6 is in ready status

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15. Describe any two components of O.S. List of System Components: 1. Process management 2. Main memory management 3. File management 4. I/O system management 5. Secondary storage management

1.Process Management:

A program is a set of instructions. When CPU is allocated to a program, it can start its execution. A program in execution is a process. A word processing program run by a user on a PC is a process. A process needs various system resources including CPU time, memory, files and I/O devices to complete the job execution. These resources can be given to the process when it is created or allocated to it while it is running.

The operating system responsible for the following activities in connection with process management:

- Creation and deletion of user and system processes.
- Suspension and resumption of processes.
- A mechanism for process synchronization.
- A mechanism for process communication.
- A mechanism for deadlock handling.

2. Main-Memory Management

Main memory is a large array of words or bytes, ranging in size from hundreds of thousands to billions. Each word or byte has its own address. Main memory is a repository of quickly accessible data shared by the CPU and I/O devices. The central processor reads instructions from main memory during the instruction fetch cycle and

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both reads and writes data from main memory during the data fetch cycle. The main memory is generally the only large storage device that the CPU is able to address and access directly.

The operating system responsible for the following activities in connection with main memory s management:

 Keeping track of which parts of memory are currently being used and by whom.

 Deciding which processes (or parts thereof) and data to move into and out of memory. 3. Allocating and deallocating memory space as needed.

3. File Management

A file is a collected of related information defined by its creator. Computer can store files on the disk (secondary storage), which provide long term storage. Some examples of storage media are magnetic tape, magnetic disk and optical disk. Each of these media has its own properties like speed, capacity, and data transfer rate and access methods. A file system normally organized into directories to ease their use. These directories may contain files and other directions.

The operating system responsible for the following activities in connection with file management:

 The creation and deletion of files.

 The creation and deletion of directions.

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 The support of primitives for manipulating files and directions.

 The mapping of files onto secondary storage.

 The backup of files on stable storage media.

4. I/O device Management

Input / Output device management provides an environment for the better interaction between system and the I / O devices (such as printers, scanners, tape drives etc.). To interact with I/O devices in an effective manner, the operating system uses some special programs known as device driver. The device drivers take the data that operating system has defined as a file and then translate them into streams of bits or a series of laser pulses (in regard with laser printer).

The I/O subsystem consists of several components:

 A memory management component that includes buffering, caching, spooling

 A general device driver interface

 Drivers for specific hardware devices

5. Secondary-Storage Management

The computer system provides secondary storage to back up main memory. Secondary storage is required because main memory is too small to accommodate all data and programs, and the data that it holds is lost when power is lost. Most of the programs including compilers, assemblers, word processors, editors, and formatters are stored on a disk until loaded into memory. Secondary storage consists

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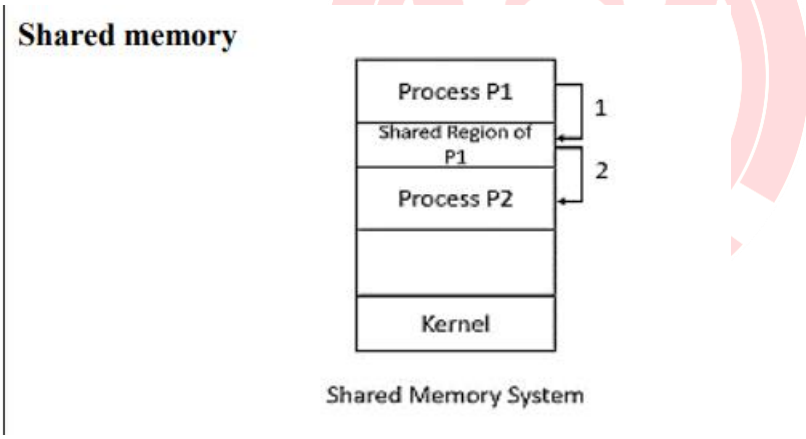
of tapes drives, disk drives, and other media.

The operating system is responsible for the following activities in connection with disk management:

- Free space management
- Storage allocation
- Disk scheduling.

16. Explain shared memory model of Interprocess communication (IPC)

Inter-process communication: Cooperating processes require an Inter- process communication (IPC) mechanism that will allow them to exchange data and information.



In this, all processes who want to communicate with other processes can access a region of the memory residing in an address space of a process creating a shared memory segment.

- All the processes using the shared memory segment should attach to the address space of the shared memory. All the processes can

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exchange information by reading and/or writing data in shared memory segment.

- The form of data and location are determined by these processes who want to communicate with each other.
- These processes are not under the control of the operating system.
- The processes are also responsible for ensuring that they are not writing to the same location simultaneously.
- After establishing shared memory segment, all accesses to the shared memory segment are treated as routine memory access and without assistance of kernel.

17. Describe different scheduling criteria

- CPU utilization: - In multiprogramming the main objective is to keep CPU as busy as possible. CPU utilization can range from 0 to 100 percent.
- Throughput: - It is the number of processes that are completed per unit time. It is a measure of work done in the system. When CPU is busy in executing processes, then work is being done in the system. Throughput depends on the execution time required for any process.
- Turnaround time: -The time interval from the time of submission of a process to the time of completion of that process is called as turnaround time. It is the sum of time period spent waiting to get into the memory, waiting in the ready queue,

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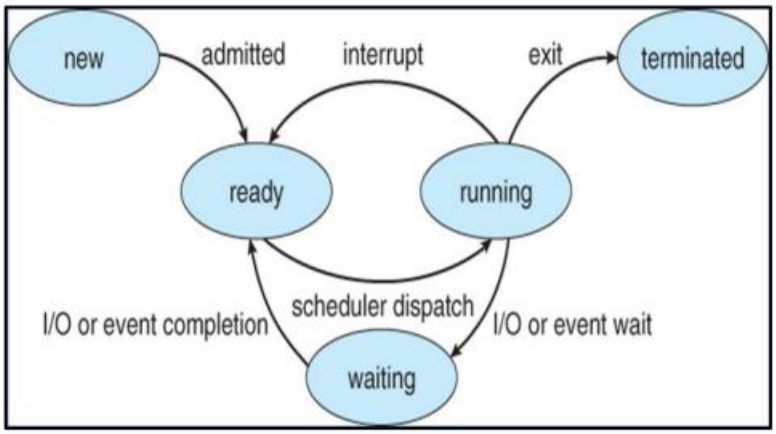
executing with the CPU, and doing I/O operations.

 Waiting time: - It is the sum of time periods spent in the ready queue by a process. When a process is selected from job pool, it is loaded into the main memory. A process waits in ready queue till CPU is allocated to it.

18. Draw and explain process state diagram.

Different process states are as follows:

1. New
2. Ready
3. Running
4. Waiting
5. Terminated



New: When a process enters into the system, it is in new state. In this state a process is created. In new state the process is in job pool.

Ready: When the process is loaded into the main memory, it is ready

for execution. In this state the process is waiting for processor allocation.

Running: When CPU is available, system selects one process from main memory and executes all the instructions from that process. So, when a process is in execution, it is in running state. In single user system, only one process can be in the running state. In multiuser system, there can be multiple processes which are in the running state.

Waiting State: When a process is in execution, it may request for I/O resources. If the resource is not available, process goes into the waiting state. When the resource is available, the process goes back to ready state.

Terminated State:

When the process completes its execution, it goes into the terminated state. In this state the memory occupied by the process is released.

19. Describe conditions for deadlock prevention.

By ensuring that at least one of below conditions cannot hold, we can prevent the occurrence of a deadlock.

1.Mutual Exclusion:

The mutual-exclusion condition must hold for non-sharable resources. Sharable resources do not require mutually exclusive access, thus cannot be involved in a deadlock.

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2.Hold and Wait:

One way to avoid this Hold and Wait is when a process requests a resource; it does not hold any other resources.

•One protocol that can be used requires each process to request and be allocated all its resources before it begins execution.

•Another protocol that can be used is, to allow a process to request resources only when the process has none. A process may request some resources and use them. Before it requests any additional resources, it must release all the resources that are currently allocated to it.

3.No Preemption:

If a process that is holding some resources requests another resource that cannot be immediately allocated to it, then all resources currently being held are preempted. That is these resources are implicitly released. The preempted resources are added to the list of resources for which the process is waiting. Process will be restarted only when all the resources i.e. its old resources, as well as the new ones that it is requesting will be available.

4.Circular Wait

Circular-wait condition never holds is to impose a total ordering of all resource types, and to require that each process requests resources in an increasing order of enumeration.

Let R = {R1, R2, ..., Rn} be the set of resource types. We assign to

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each resource type a unique integer number, which allows us to compare two resources and to determine whether one precedes another in our ordering. Formally, define a one-to-one function F: R _ N, where N is the set of natural numbers.

20. Explain fixed size memory partitioning.

Fixed Size Memory Partitioning (Static)

 Memory is divided into number of fixed size partitions, which is called as fixed or static memory partitioning.

 Each partition contains exactly one process.

 The number of programs to be executed depends on number of partitions.

 When the partition is free, a selected process from the input queue is loaded into the free partition.

 When the process terminates, the partition becomes available for another process.

 The operating system keeps a table indicating parts of memory which are available and which are occupied.

 Initially, all memory is available for user processes and it is considered as one large block of available memory, a hole.

 When a process arrives, large enough hole of memory is allocated to the processes.

21.Explain linked file allocation method.

Linked Allocation:

 This allocation is on the basis of an individual block. Each block

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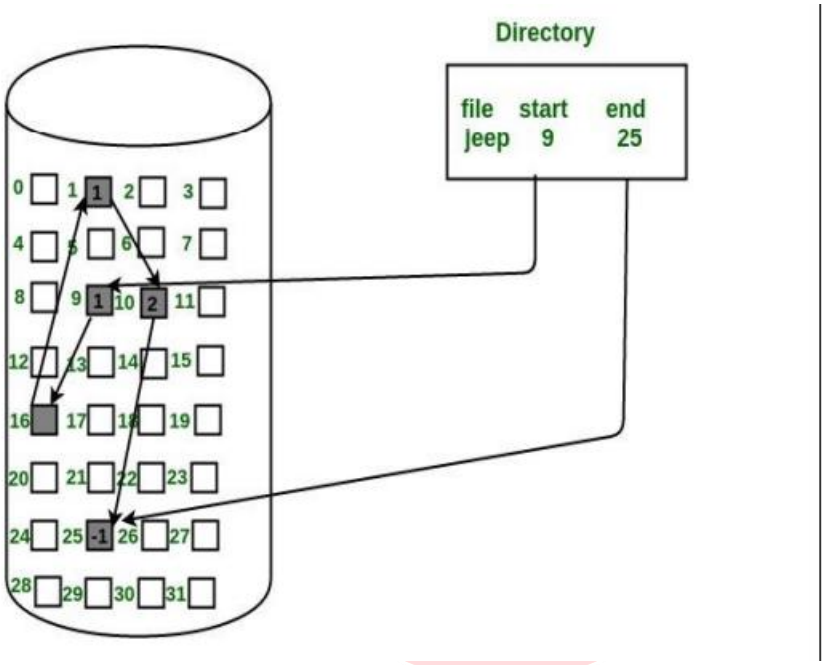
contains a pointer to the next block in the chain.

 The disk block can be scattered anywhere on the disk.

The directory contains a pointer to the first and the last blocks of the file.

 To create a new file, simply create a new entry in the directory.



 The above figure shows the linked allocation.

 There is no external fragmentation since only one block is needed at a time.

 The size of a file need not be declared when it is created.

 A file can continue to grow as long as free blocks are available

 This method is used only for a sequential access files

 This method requires more space to store pointers

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 So instead of blocks, clusters are used for allocation but this creates internal fragmentation.

22. Compare between command line and Graphical user interface. (Any four points)

Parameter	Command Line Interface(CLI)	Graphic User Interface(GUI)
Definition	Interaction is by typing commands	Interaction with devices is by graphics and visual components and icons
Understanding	Commands need to be memorized	Visual indicators and icons are easy to understand
Memory	Less memory is required for storage	More memory is required as visual components are involved.
Working Speed	Use of keyboard for commands makes CLI quicker.	Use of mouse for interaction makes it slow
Resources used	Only keyboard	Mouse and keyboard both can be used
Accuracy	High	Comparatively low
Flexibility	Command line interface does not change, remains same over time	Structure and design can change with updates

23. Write any four systems call related to file management.

System calls related to file management are:

1. create new file

2. delete existing file

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3. open file

4. close file

5. create directories

6. delete directories

7. read, write, reposition in file

8. getfile attributes

9. set file attributes

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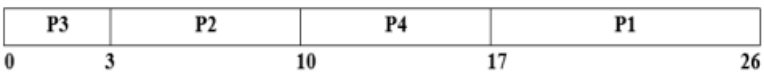
24. Compare between Long term and short term scheduler. (Any four points)

Sr. No	Long Term Scheduler	Short Term Scheduler
1	It is job scheduler	It is CPU scheduler
2	It selects processes from job pool and loads them into memory for execution	It selects processes from ready queue which are ready to execute and allocates CPU to one of them
3	Access job pool and ready queue	Access ready queue and CPU
4	It executes much less frequently. It executes when memory has space to accommodate new process.	It executes frequently. It executes when CPU is available for allocation
5	Speed is less than short term scheduler	Speed is fast
6	It controls the degree of multiprogramming	It provides lesser control over degree of multiprogramming
7	It chooses a good process that is a mix-up of input/output bound and CPU bound.	It chooses a new process for a processor quite frequently.

25. Solve given problem by using SJF and FCFS scheduling algorithm using Gantt chart. Calculate the average waiting time for each algorithm.

Process	Burst time (in ms)
P1	9
P2	7
P3	3
P4	7

Gantt Chart SJF



Waiting Time

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P1=17

P2=3

P3=0

P4=10

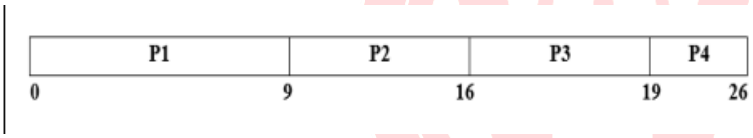
Average waiting time=Waiting time of all processes / Number of processes

=(17+3+0+10) /4

=30/4

=7.5 milliseconds (ms)

Gantt Chart FCFS



Waiting Time

P1=0

P2=9

P3=16

P4=19

Average waiting time=Waiting time of all processes / Number of processes

=(0+9+16+19) /4

=44/4

=11 milli seconds (ms)

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26. Describe free space management technique. (Any two)

A file system is responsible to allocate the free blocks to the file therefore it has to keep track of all the free blocks present in the disk.There are mainly four approaches by using which, the free blocks in the disk are managed.

1. Bit Vector
2. Linked List

1)Bit Vector:

The free-space list is implemented as a bit map or bit vector.

Each block is represented by 1 bit. If the block is free, the bit is 1; if the block is allocated, the bit is 0.

For example, consider a disk where blocks 2, 3, 4, 5, 8, 9, 10, 11, 12, 13 are free and the rest of the blocks are allocated.

The free-space bit map would be : 0011110011111100

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	1	1	1	1	0	0	1	1	1	1	1	1	0	0

1=Free block

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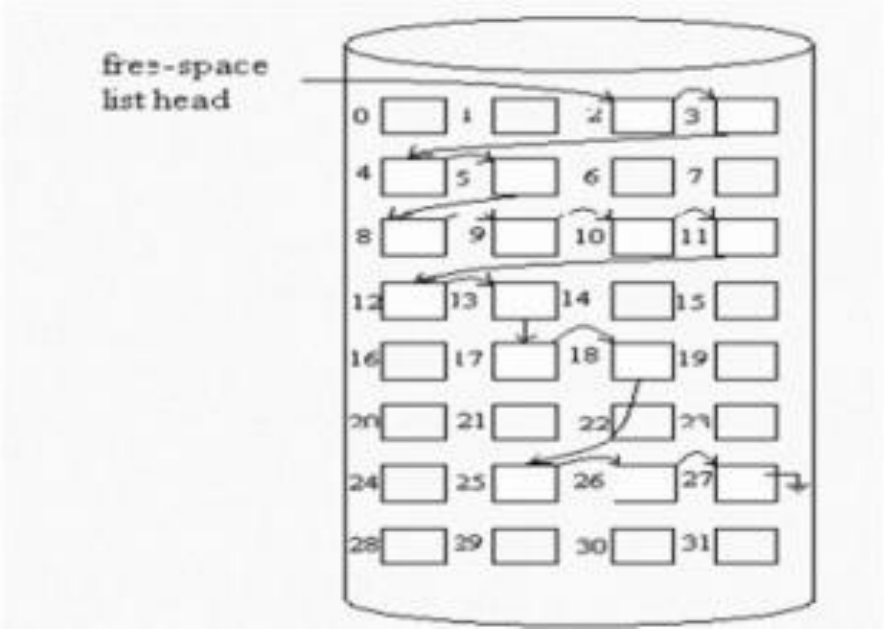
0= Allocated block

The main advantage of this approach is its relative simplicity and its efficiency in finding the first free block or n consecutive free blocks on the disk.

2) Linked List

In this approach, the free disk blocks are linked together i.e. a free block contains a pointer to the next free block. The block number of the very first disk block is stored at a separate location on disk and is also cached in memory. In this approach, link all the disk blocks together, keeping a pointer to the first free block. This block contains a pointer to the next free disk block, and so on.



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6 Marks Questions

1.Enlist the operating system tools. Explain any two in detail.

Following are the operating tools:

- User Management
- Security policy
- Device Management
- Performance Monitor
- Task Scheduler

A) User management:

- User management includes everything from creating a user to deleting a user on your system. User management can be done in three ways on a Linux system.
- Command line tools include commands like useradd, userdel, usermod, passwd, etc. These are mostly used by the server administrators.

Useradd: With useradd commands you can add a user

Syntax: useradd -m -d /home/<userName> -

c "<userName>" <userName>

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Example: useradd -m -d /home/xyz -c "xyz" xyz

File /etc/default/useradd contains some user default options.

The command useradd -D can be used to display this file.

Syntax: useradd -D

Userdel: To delete a user account userdel command is used.

Syntax: userdel -r <userName>

Usermod: The command usermod is used to modify the properties of an existing user.

Syntax: usermod -c <'newName'> <oldName>

Example: usermod -c 'vppoly' john

Using passwd command

Passwd: A user can set the password with the command passwd. Old password has to be typed twice before entering the new one.

Syntax: passwd <userName>

Example: passwd vppoly

B) Device Management:

Device management is the process of managing the implementation, operation and maintenance of a physical and/or virtual device.

All Linux device files are located in the /dev directory, which is an integral part of the root (/) filesystem because these device files must be available to the operating system during the boot process.

Example: ls –l /dev

Above example gives the list of device file from kernel.

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Udev supplies a dynamic device directory containing only the nodes for devices which are connected to the system. It creates or removes the device node files in the /dev directory.

C) Performance Monitor:

It is very tough job for every system or network administrator to monitor and debug Linux System Performance problems every day. The commands discussed below are some of the most fundamental commands when it comes to system analysis and debugging Linux server issues such as:

1) vmstat: Virtual memory statistics

The vmstat command reports information about processes, memory, paging, block IO, traps, and cpu activity.

$ vmstat 3

2)top: Process activity monitoring command

top command display Linux processes. It provides a dynamic real-time view of a running system i.e. actual process activity. By default, it displays the most CPU-intensive tasks running on the server and updates the list every five seconds.

$ top

3) free: Show Linux server memory usage

free command shows the total amount of free and used physical and swap memory in the system, as well as the buffers used by the kernel.

free

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4) iostat: Montor Linux average CPU load and disk activity

iostat command report Central Processing Unit (CPU) statistics and input/output statistics for devices, partitions and network filesystems (NFS).

iostat

5) netstat Linux network and statistics monitoring tool

netstat command displays network connections, routing tables, interface statistics, masquerade connections, and multicast memberships.

netstat –tulpn

2.Explain multithreading model in detail.

Many systems provide support for both user and kernel threads, resulting in different multithreading models.

Following are three multithreading model:

Many-to-One Model

- The many-to-one model maps many user-level threads to one kernel thread.
- Thread management is done by the thread library in user space, so it is efficient; but the entire process will block if a thread makes a blocking system call.
- Also, because only one thread can access the kernel at a time, multiple threads are unable to nm in parallel on

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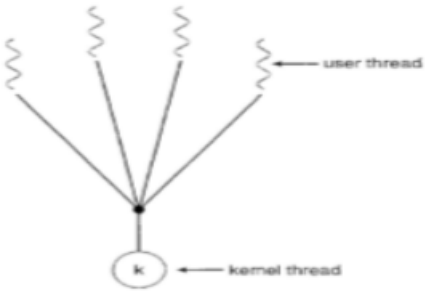
multiprocessors.

 Example: Green threads- a thread library available for Solaris



Advantages:

 More concurrency because of multiple threads can run in parallel on multiple CPUs.

 Less complication in the processing.

Disadvantages:

 Thread creation involves light-weight process creation.

 Kernel thread is an overhead.

 Limiting the number of total threads.

One-to-One Model

 The one-to-one model maps each user thread to a kernel thread.

 It provides more concurrency than the many-to-one model by allowing another thread to run when a thread makes a blocking system call; it also allows multiple threads to run in parallel on multiprocessors.

 The only drawback to this model is that creating a user thread requires creating the corresponding kernel thread.

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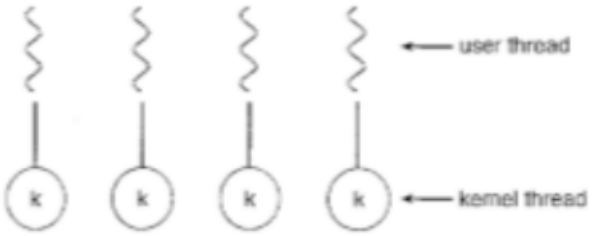
 Because the overhead of creating kernel threads can burden the performance of an application, most implementations of this model restrict the number of threads supported by the system.

 Linux, along with the family of Windows operating systems, implement the one-to-one model.



Advantages:

 Mainly used in language system, portable libraries.

 One kernel thread controls multiple user thread.

Disadvantages:

 Parallelism is not supported by this model.

 One block can blocks all user threads.

Many-to-Many Model

 The many-to-many model multiplexes many user-level threads to a smaller or equal number of kernel threads.

 The number of kernel threads may be specific to either a particular application or a particular machine (an application

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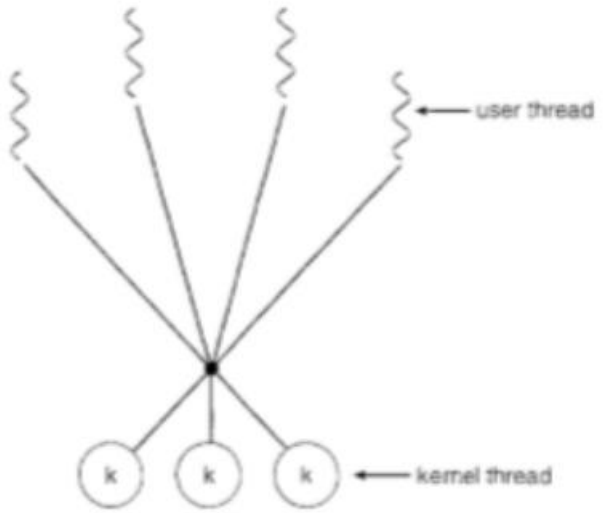
may be allocated more kernel threads on a multiprocessor than on a uniprocessor).

The one-to-one model allows for greater concurrency, but the developer has to be careful not to create too many threads within an application (and in some instances may be limited in the number of threads she can create).

 The many-to-many model suffers from neither of these shortcomings: developers can create as many user threads as necessary, and the corresponding kernel threads can run in parallel on a multiprocessor.

 Also, when a thread performs a blocking system call, the kernel can schedule another thread for execution.



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Advantages:

- Many threads can be created as per user's requirement.
- Multiple kernel or equal to user threads can be created.

Disadvantages:

- True concurrency cannot be achieved.
- Multiple threads of kernel is an overhead for operating system

3.Explain LRU page replacement algorithm for following reference string. 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1 Calculate the page fault.

LRU:

- The Least Recently Used (LRU) page replacement policy replaces the page that has not been used for the longest period of time.
- LRU replacement associates with each page the time of that page's last use.
- When a page must be replaced, LRU chooses the page that has not been used for the longest period of time.
- The LRU policy is often used as a page-replacement algorithm and is considered to be good.
- An LRU page-replacement algorithm may require substantial hardware assistance.

Counters:

- In the simplest case, we associate with each page-table entry a time-of-use field and add to the CPU a logical clock or counter.
- The clock is incremented for every memory reference.

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 Whenever a reference to a page is made, the contents of the clock register are copied to the time-of-use field in the pagetable entry for that page.

 In this way, we always have the "time" of the last reference to each page. We replace the page with the smallest time value.

Stack:

 Another approach to implementing LRU replacement is to keep a stack of page numbers.

 Whenever a page is referenced, it is removed from the stack and put on the top.

 In this way, the most recently used page is always at the top of the stack and the least recently used page is always at the bottom.

Reference String: 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1

(Frame size have not mentioned in question so assume frame size as 3 or 4)

LRU: Assume frame size=3

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
7	7	7	2		2		4	4	4	0			1		1	*	1		*
	0	0	0	*	0	*	0	0	3	3	*		3		0		0	*	
		1	1		3		3	2	2	2		*	2	*	2		7		

Page Fault=12

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Assume frame size=4

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
7	7	7	7		3		3		*		*		3				7		
	0	0	0	*	0	*	0			*			0		*		0	*	
		1	1		1		4						1			*	1		*
			2		2		2	*				*	2	*			2		

Page fault=08

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4.The jobs are scheduled for execution as follows: i) SJF ii) FCFS Also find average waiting time using Gantt chart.

Process	Arrival Time	Burst Time
P1	0	7
P2	1	4
P3	2	10
P4	3	6
P5	4	8

SJF:

Non-Preemptive SJF

Gantt Chart:

P1	P2	P4	P5	P3

0 7 11 17 25 35

Process	Arrival Time	Burst Time	Waiting Time
P1	0	7	0
P2	1	4	7-1=6
P3	2	10	25-2=23
P4	3	6	11-3=8
P5	4	8	17-4=13

Average waiting Time=(0+6+23+08+13)/5 = 50/5=10

OR

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Preemptive SJF

Gantt Chart:

P1	P2	P1	P4	P5	P3

0 1 5 11 17 25 35

Process	Arrival Time	Burst Time	Waiting Time
P1	0	7	0+(5-1)=4
P2	1	4	1-1=0
P3	2	10	25-2=23
P4	3	6	11-3=8
P5	4	8	17-4=13

Average Waiting Time=4+0+23+8+13/5=9.6

ii) FCFS Gantt chart:

Gantt chart:

P1	P2	P3	P4	P5

0 7 11 21 27 35

Process	Arrival Time	Burst Time	Waiting Time
P1	0	7	0-0=0
P2	1	4	7-1=6
P3	2	10	11-2=9
P4	3	6	21-3=18
P5	4	8	27-4=23

Average waiting Time=0+6+9+18+23/5 =56/5=11.2

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5. List free space management techniques? Describe any one in detail.

A file system is responsible to allocate the free blocks to the file therefore it has to keep track of all the free blocks present in the disk. There are mainly four approaches by using which, the free blocks in the disk are managed.

- Bit Vector
- Linked List
- Grouping
- Counting

Bit Vector:

- The free-space list is implemented as a bit map or bit vector.
- Each block is represented by 1 bit. If the block is free, the bit is 1; if the block is allocated, the bit is 0.
- For example, consider a disk where blocks
- 2, 3, 4, 5, 8, 9, 10, 11, 12, 13 are free and the rest of the blocks are allocated.
- The free-space bit map would be : 0011110011111100

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	1	1	1	1	0	0	1	1	1	1	1	1	0	0

0=Free block

1= Allocated block

The main advantage of this approach is its relative simplicity and its

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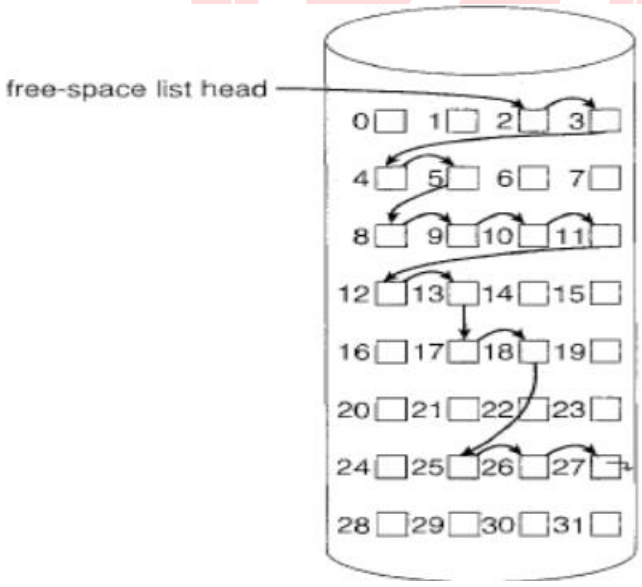
efficiency in finding the first free block or n consecutive free blocks on the disk.

Linked List

- In this approach, the free disk blocks are linked together i.e. a free block contains a pointer to the next free block.
- The block number of the very first disk block is stored at a separate location on disk and is also cached in memory.
- In this approach, link all the disk blocks together, keeping a pointer to the first free block.
- This block contains a pointer to the next free disk block, and so on.



6. Enlist different file allocation methods? Explain contiguous allocation method in detail.

From the user's point of view, a file is an abstract data type. It can be created,

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opened, written, read, closed and deleted without any real concern for its implementation. The implementation of a file is a problem for the operating system.

The main problem is how to allocate space to these files so that disk space is effectively utilized and files can be quickly accessed.

Three major methods of allocating disk space are in wide use:

- Contiguous
- Linked
- Indexed

Contiguous Allocation

• The contiguous allocation method requires each file to occupy a set of contiguous addresses on the disk. Disk addresses define a linear ordering on the disk. Contiguous allocation of a file is defined by the disk address of the first block and its length. If the file is 'n' blocks long and starts at location 'b', then it occupies blocks b, b+1, b+2, - - - - - b+n-1. The directory entry for each file indicates the address of the starting block and the length of the area allocated for this file.

• Contiguous allocation supports both sequential and direct access.

• For direct access to block 'i' of a file, which starts at block 'b', we can immediately access block b+i. The difficulty with contiguous allocation is finding space for a new file.

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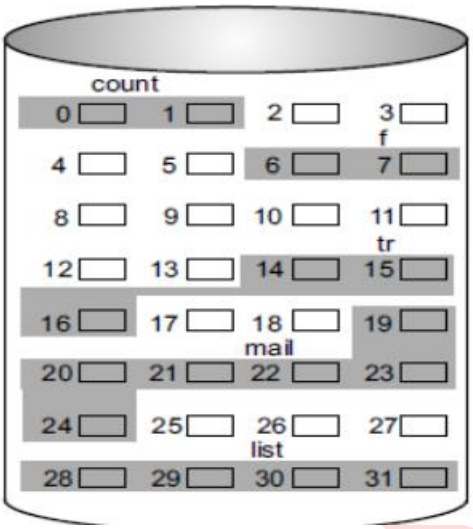
• For direct access to block ‘i’ of a file, which starts at block ‘b’, we can immediately access block b+i.

• The difficulty with contiguous allocation is finding space for a new file.

• If file to be created are ‘n’ blocks long, we must search free space list for ‘n’ free contiguous blocks



Directory

File	Start	Length
count	0	2
tr	14	3
mail	19	6
list	28	4
f	6	2

Advantages of Contiguous File Allocation Method:

1. Supports both sequential and direct access methods.

2. Contiguous allocation is the best form of allocation for sequential files. Multiple blocks can be brought in at a time to improve I/O performance for sequential processing.

3. It is also easy to retrieve a single block from a file. For example, if a file starts at block ‘n’ and the ith block of the file is wanted, its location on secondary storage is simply n + i.

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4. Reading all blocks belonging to each file is very fast.

5. Provides good performance.

Disadvantages of Contiguous File Allocation Method:

1. Suffers from external fragmentation.

2. Very difficult to find contiguous blocks of space for new files.

3. Also with pre-allocation, it is necessary to declare the size of the file at the time of creation which many a times is difficult to estimate.

4.Compaction may be required and it can be very expensive.

7. Write two uses of following O.S. tools (i) Device Management (ii) Performance monitor (iii) Task Scheduler

i) Device management:

- Managing all the hardware or virtual devices of computer system.
- Allow interaction with hardware devices through device driver.
- Used to install device and component-level drivers as well as associated software.
- Allocate devices to the process as per process requirement and priority.
- Deallocate devices either temporarily or permanently depending on condition.
- Keeping track of all device's data and location.
- Monitoring device status like printers, storage drivers and other devices.
- Used to enforce the predetermined policies and decides which

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process receives the device when and for how long.

ii) Performance monitor

1. Monitor various activities on a computer such as CPU or memory usage.

2. Used to examine how programs running on their computer affect computer's performance

3. It is used to identify performance problems or bottleneck that affect operating system or installed applications.

4. Used to observe the effect of system configuration changes

iii) Task scheduler

1. Assign processor to task ready for execution

2. Executing predefined actions automatically whenever a certain set of condition is met.

(Any two relevant uses shall be considered)

8. Write the outputs of following commands (i) Wait 2385018 (ii) Sleep 09(iii) PS –u Asha

i) Wait command waits until the termination of specified process ID 2385018

ii) Sleep command is used to delay for 9 seconds during the execution of a processi.e. it will pause the terminal for 9 seconds.

iii) ps command with -u is used to display data/processes for the specific user Asha

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9. Given a page reference string with three (03) page frames. Calculate the page faults with 'Optimal' and 'LRU' page replacement algorithm respectively. '7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1 (Representation of frame can be in any order)

i) Optimal

Ref	7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
F1	7	7	7	2	2	2	2	2	2	2	2	2	2	2	2	2	2	7	7	7
F2		0	0	0	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0	0
F3			1	1	1	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1
Fault	F	F	F	F		F		F			F			F				F		

Total page faults- 9

ii) LRU

Ref	7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
F1	7	7	7	2	2	2	2	4	4	4	0	0	0	1	1	1	1	1	1	1
F2		0	0	0	0	0	0	0	0	3	3	3	3	3	3	0	0	0	0	0
F3			1	1	1	3	3	3	2	2	2	2	2	2	2	2	2	7	7	7
Fault	F	F	F	F		F		F	F	F	F			F		F		F		

Total page faults-12

10. Solve given problem by using (i) Pre-emptive SJF (ii) Round Robin (Time Slice = 3 ms) Calculate average waiting time using Gantt Chart

Process	A.T.	B.T. (in ms)
P_{11}	0	8
P_{12}	1	4
P_{13}	2	9
P_{14}	3	5

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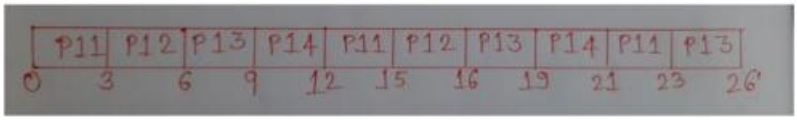
(i) Pre emptive SJF:

Waiting Time= (Total completion time –Burst time) – Arrival time

P11 –(17-8)-0 = 9ms,
P12- (5 – 4) -1 =0ms,
P13- (26-9)-2 =15ms,
P14- (10-5)-3 =2ms
Average waiting time :- (9+0+15+2)/4= 26/4=6.5 ms

(ii) Round Robin (Time Slice = 3 ms)



Waiting time: - P11 = (23-8)-0 =15ms,
P12-(16 – 4)- 1 =11ms,
P13-(26-9)-2 =15ms,
P14-(21-5)-3 =13ms
Average waiting time:- (15+11+15+13)/4=54/4= 13.5ms

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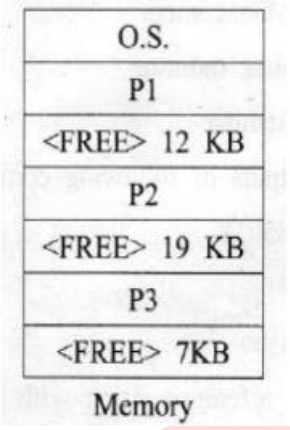
11. Consider the following memory map and assume a new process P4 comes with memory requirements of 6 KB. Locate (Draw) this process in memory using. i) First fit ii) Best Fit iii) Worst Fit



First Fit: Allocate the first free block to the new process P4.	Best Fit: Allocate the smallest free block that is big enough to accommodate new process P4.	Worst fit: Allocate the largest free block to the new process P4.
O. S.	O. S.	O. S.
P1	P1	P1
P4 6KB	<FREE> 12 KB	<FREE> 12 KB
<FREE> 6KB	P2	P2
P2	<FREE> 19 KB	**P4 6 KB**
<FREE> 19 KB	P3	**<FREE> 13 KB**
P3	**P4 6 KB**	P3
<FREE> 7 KB	**<FREE> 1 KB**	<FREE> 7 KB

12. Construct and explain directory structure of a file system in terms of two level and tree structure

1) Two-level directory: -

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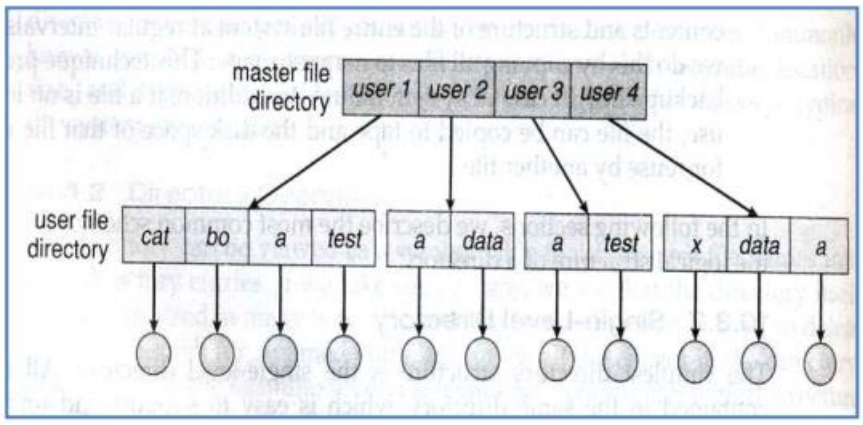
In the two-level structures, each user has its own user file directory (UFD). The UFD lists only files of a single user. System contains a master file directory (MFD) which is indexed by user name or account number. Each entry in MFD points to the UFD for that user. When a user refers to a particular file, only his own UFD is searched. Different users can have files with the same name, as long as all the file names within each UFD are unique.

When we create a file for a user, operating system searches only that user's UFD to find whether same name file already present in the directory. For deleting a file again operating system checks the file name in the user' UFD only.



2. Tree structure:-

In this directory structure user can create their own sub-directories and organize their files. The tree has a root directory and every file

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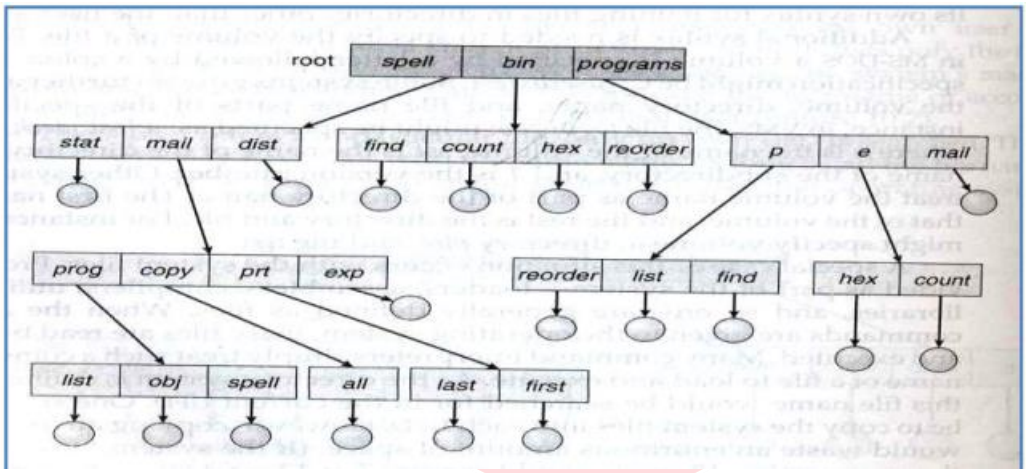
has a unique path name. A directory contains a set of files or subdirectories. All directories have the same internal format. One bit in each directory entry defines the entry as a file (0) or as a subdirectory (1). Each process has a current directory. Current directory contains files that are currently required by the process. When reference is made to a file, the current directory is searched. If a file needed that is not in the current directory, then the user usually must either specify a path name or change the current directory.



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