CS(405) CBGS

B.Tech.,IVsem

Examination, Nov 2019

Total No. of Questions : 8] *[Total No. of Printed Pages : 3*

Roll No .....

CS-405 (CBGS)

B.Tech., IV Semester

Examination, November 2019

Choice Based Grading System (CBGS)

Operating System

Time : Three Hours ***Maximum Marks : 70***

Note: i) Attempt any five questions.
किन्ही पाँच प्रश्नों को हल कीजिए।

ii) All questions carry equal marks.
सभी प्रश्नों के समान अंक हैं।

iii) In case of any doubt or dispute the English version question should be treated as final.
किसी भी प्रकार के संदेह अथवा विवाद की स्थिति में अंग्रेजी भाषा के प्रश्न को अंतिम माना जायेगा।

1. a) What are System call? Explain briefly about various types of system call provided by an operating system.
सिस्टम कॉल क्या है? ऑपरेटिंग सिस्टम द्वारा प्रदान किए गऐ विभिन्न प्रकार के सिस्टम कॉल के बारे में संक्षेप में बताइये।

   b) What are the various services provided by Operating system?
ऑपरेटिंग सिस्टम द्वारा प्रदान की जानेवाली विभिन्न सेवाएँ क्या है?

2. a) What is File? What are the different File attributes and operations?
फाईल क्या है? विभिन्न फाईल विशेषता और संचालन क्या है?

   b) What are points to be consider in file system design? Explain linked list allocation in detail.
फाईल सिस्टम डिजाईन में किन बिंदुओ पर विचार किया जाना है। लिक्ड सूची आवंटन की विस्तार से व्याख्या करे।

3. What do you mean by PCB? Where is it used? What are its contents? Explain.
पी सी बी का क्या मतलब है? इसका उपयोग कहाँ किया जाता है? इसकी क्या सामग्री है। के बारे में बताइए।

4. Consider the following page reference string
निम्नलिखित पृष्ठ सदर्भ स्ट्रिंग पर विचार करें।
1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5. How many page faults would occur for the following replacement algorithm, assuming four frame:
   a) FIFO
   b) LRU
1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5. निम्नलिखित प्रतिस्थापन एल्गोरिथम के लिए चार फ्रेम वाले कितने पृष्ठ दोष होंगे?
   a) FIFO
   b) LRU

5. Explain the following term.
निम्नलिखित शब्द की व्याख्या करे।
   a) Real and virtual concurrency
   b) Critical section
   c) Mutual exclusion
   d) I/O Interfaces

6. On a simple paging system with 2^{24} bytes of physical memory, 256 pages of logical address space and a page size 2^{10} bytes, How many bits are in logical address.
भौतिक स्मृति के 2^{24} bytes के साथ साधारण पेजिंग सिस्टम पर, तार्किक पते के 256 पेज स्पेस और 2^{10} bytes के पेज आकार, तार्किक पते में कितने Bits हैं?

7. a) What is Binary and Counting semaphores?
Binary और Counting semaphore क्या है?

   b) Describe necessary conditions for a deadlocks situation to arise.
एक गतिरोध की स्थिति उत्पन्न होने के लिये आवश्यक शर्तो का वर्णन करे।

8. Write a short notes (Any three)
एक छोटा नोट लिखे। (कोई तीन)
   a) Multi processor operating system
   b) Distributed operating system
   c) Threads
   d) File protection

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Operating system paper solution

1(a)What are system calls.? Explain briefly about various types of system calls provided by operating system.

Ans:- System call **provides** the services of the operating system to the user programs via Application Program Interface(API). It provides an interface between a process and operating system to allow user-level processes to request services of the operating system. System calls are the only entry points into the kernel system. All programs needing resources must use system calls.

Services Provided by System Calls :

1. Process creation and management
2. Main memory management
3. File Access, Directory and File system management
4. Device handling(I/O)
5. Protection
6. Networking, etc.

Types of System Calls : There are 5 different categories of system calls –

1. **Process control:** end, abort, create, terminate, allocate and free memory.
2. **File management:** create, open, close, delete, read file etc.
3. Device management
4. Information maintenance
5. Communication

Example of System Call

For example if we need to write a program code to read data from one file, copy that data into another file. The first information that the program requires is the name of the two files, the input and output files.

In an interactive system, this type of program execution requires some system calls by OS.

- First call is to write a prompting message on the screen
- Second, to read from the keyboard, the characters which define the two files.

1.(b) what are different services provided by operating system.

Ans. An Operating System provides services to both the users and to the programs.

- It provides an environment to execute program.
- It provides users the services to execute the programs in a convenient manner.

Following are a few common services provided by an operating system –

- Program execution
- I/O operations
- File System manipulation
- Communication

- Error Detection
- Resource Allocation
- Protection

2(a) what is file. what are different file attributes and file operations.

Ans.A file is a collection of related information that is recorded on secondary storage. Or file is a collection of logically related entities.

Attributes of the File

1.Name

Every file carries a name by which the file is recognized in the file system. One directory cannot have two files with the same name.

2.Identifier

Along with the name, Each File has its own extension which identifies the type of the file. For example, a text file has the extension **.txt,** A video file can have the extension **.mp4.**

3.Type

In a File System, the Files are classified in different types such as video files, audio files, text files, executable files, etc.

4.Location

In the File System, there are several locations on which, the files can be stored. Each file carries its location as its attribute.

5.Size

The Size of the File is one of its most important attribute. By size of the file, we mean the number of bytes acquired by the file in the memory.

6.Protection

The Admin of the computer may want the different protections for the different files. Therefore each file carries its own set of permissions to the different group of Users.

7.Time and Date

Every file carries a time stamp which contains the time and date on which the file is last modified.

Operations on the File

There are various operations which can be implemented on a file. We will see all of them in detail.

1.Create

Creation of the file is the most important operation on the file. Different types of files are created by different methods for example text editors are used to create a text file, word processors are used to create a word file and Image editors are used to create the image files.

2.Write

Writing the file is different from creating the file. The OS maintains a write pointer for every file which points to the position in the file from which, the data needs to be written.

3.Read

Every file is opened in three different modes : Read, Write and append. A Read pointer is maintained by the OS, pointing to the position up to which, the data has been read.

4.Re-position

Re-positioning is simply moving the file pointers forward or backward depending upon the user's requirement. It is also called as seeking.

5.Delete

Deleting the file will not only delete all the data stored inside the file, It also deletes all the attributes of the file. The space which is allocated to the file will now become available and can be allocated to the other files.

6.Truncate

Truncating is simply deleting the file except deleting attributes. The file is not completely deleted although the information stored inside the file get replaced.

2(b) What are points to be consider in file system design. Explain linked list allocation in details.

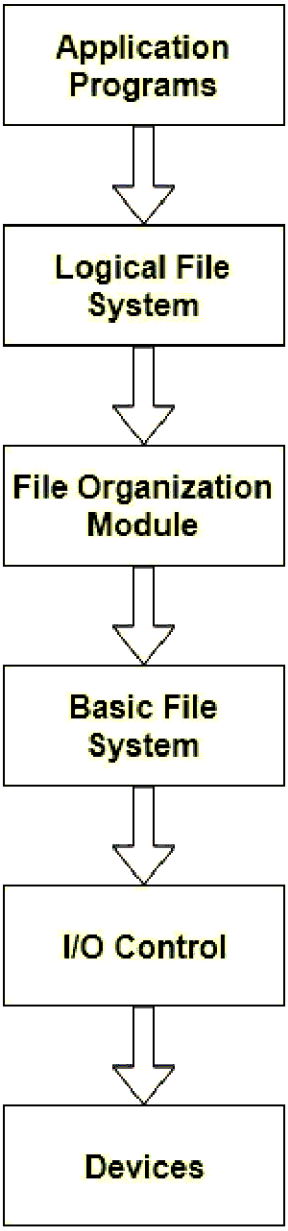
Ans

File System Structure

File System provide efficient access to the disk by allowing data to be stored, located and retrieved in a convenient way. A file System must be able to store the file, locate the file and retrieve the file.

Most of the Operating Systems use layering approach for every task including file systems. Every layer of the file system is responsible for some activities.

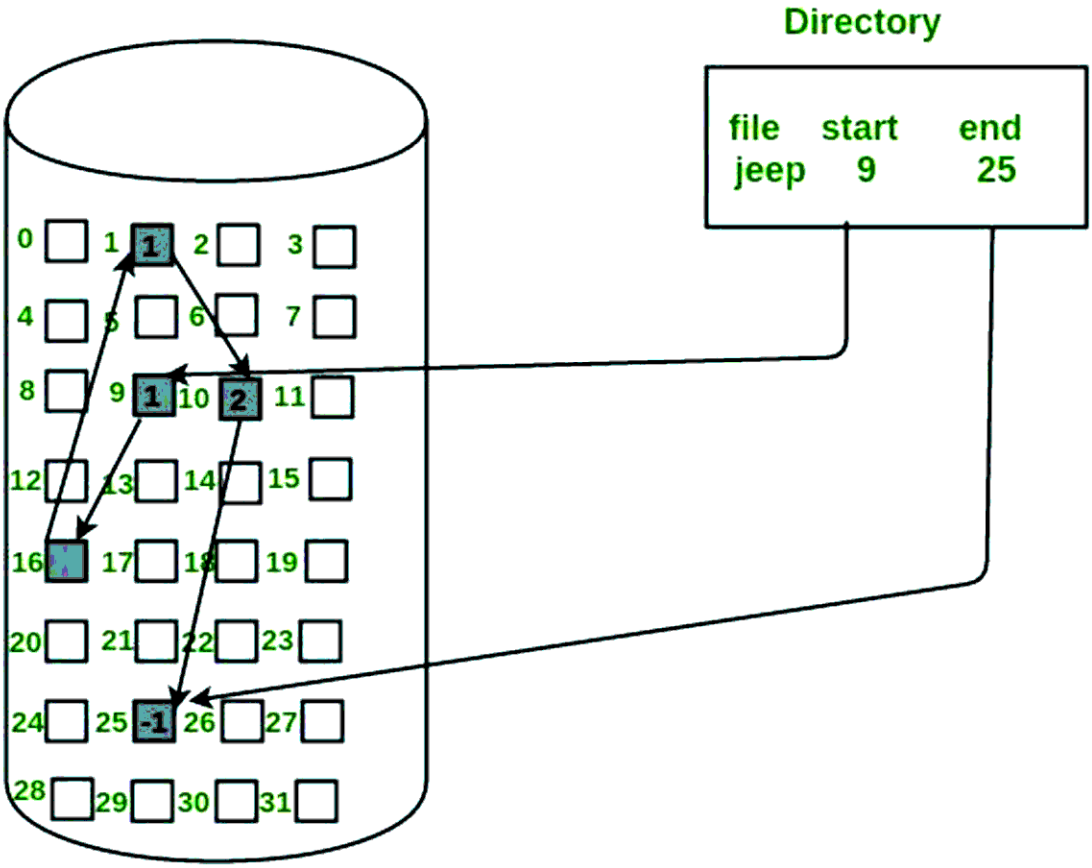
The image shown below, elaborates how the file system is divided in different layers, and also the functionality of each layer.



Linked list allocation method

In this scheme, each file is a linked list of disk blocks which **need not be** contiguous. The disk blocks can be scattered anywhere on the disk.

The directory entry contains a pointer to the starting and the ending file block. Each block contains a pointer to the next block occupied by the file.



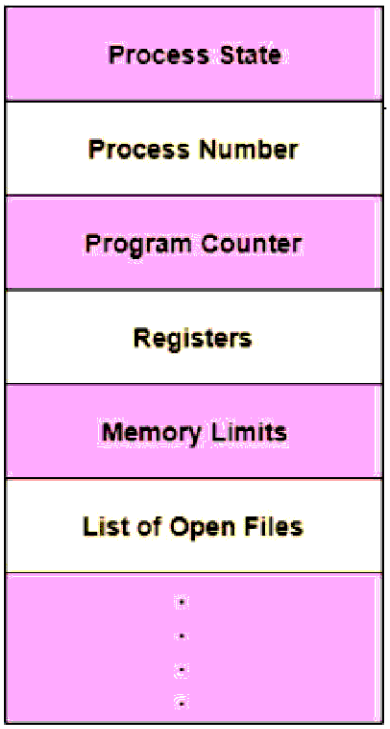
Q.3 What do you mean by PCB…….

Ans:- 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.

It is very important for process management as the data structuring for processes is done in terms of the PCB. It also defines the current state of the operating system.

Structure of the Process Control Block

The process control stores many data items that are needed for efficient process management. Some of these data items are explained with the help of the given diagram:



Process Control Block (PCB)

The following are the data items:

Process State

This specifies the process state i.e. new, ready, running, waiting or terminated.

Process Number

This shows the number of the particular process.

Program Counter

This contains the address of the next instruction that needs to be executed in the process.

Registers

This specifies the registers that are used by the process. They may include accumulators, index registers, stack pointers, general purpose registers etc.

List of Open Files

These are the different files that are associated with the process

CPU Scheduling Information

The process priority, pointers to scheduling queues etc. is the CPU scheduling information that is contained in the PCB. This may also include any other scheduling parameters.

Memory Management Information

The memory management information includes the page tables or the segment tables depending on the memory system used. It also contains the value of the base registers, limit registers etc.

I/O Status Information

This information includes the list of I/O devices used by the process, the list of files etc.

Accounting information

The time limits, account numbers, amount of CPU used, process numbers etc. are all a part of the PCB accounting information.

Location of the Process Control Block

The process control block is kept in a memory area that is protected from the normal user access. This is done because it contains important process information. Some of the operating systems place the PCB at the beginning of the kernel stack for the process as it is a safe location.

Q.4

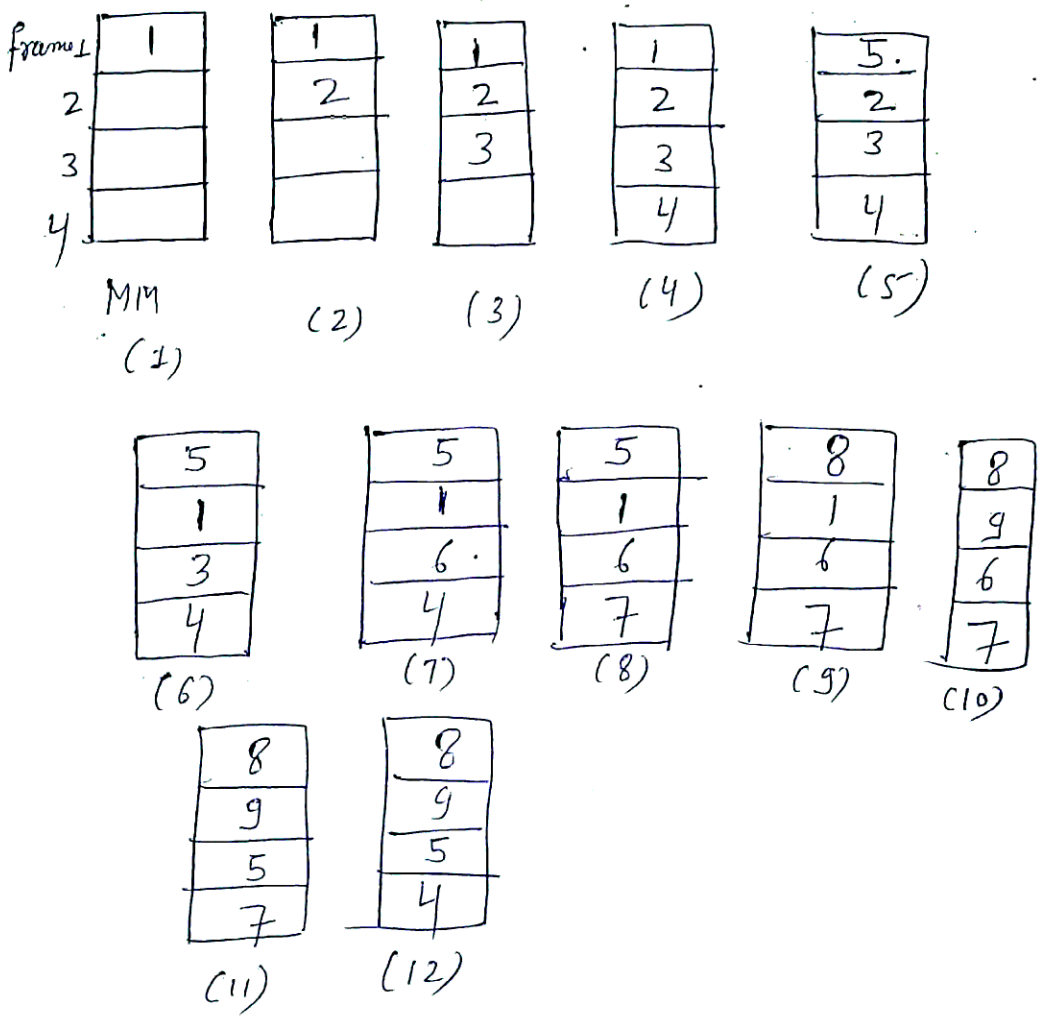
Sol

Solution → Page reference string

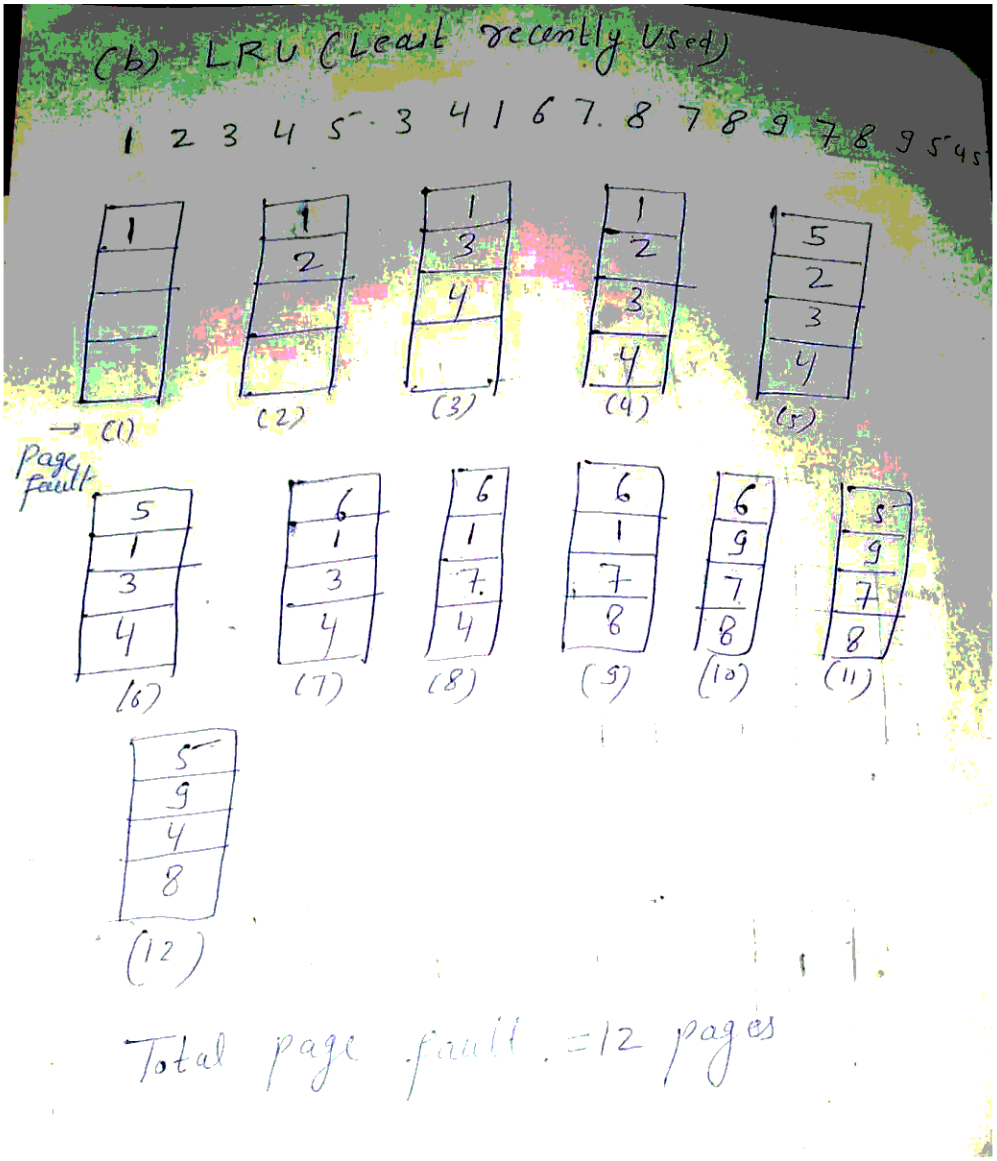
1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5

No. of frames = 4

a) FIFO → Calculate page fault



Total page fault = 12 pages.



Q.5Explain the following terms

(a) Real and virtual concurrency

Ans:-Concurrency is the execution of several instruction sequences at the same time**.** In an operating system, this happens when there are several process threads running in parallel. These threads may communicate with each other through either shared memory or message passing.

Concurrency results in sharing of resources result in problems like:- deadlocks and resources starvation.

It helps in techniques like coordinating execution of processes,memory allocation and execution scheduling for maximizing throughput.

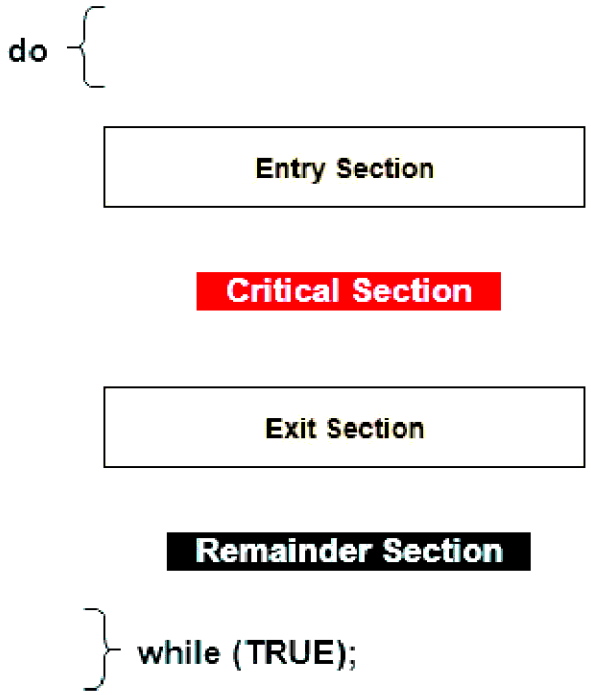
Problems in Concurrency:-

- sharing global resources safely is difficult;
- optimal allocation of resources is difficult;
- locating programming errors can be difficult, because the contexts in which errors occur cannot always be reproduced easily

(b) critical section

Anshe critical section is a code segment where the shared variables can be accessed. An atomic action is required in a critical section i.e. only one process can execute in its critical section at a time. All the other processes have to wait to execute in their critical sections.

A diagram that demonstrates the critical section is as follows −



In the above diagram, the entry section handles the entry into the critical section. It acquires the resources needed for execution by the process. The exit section handles the exit from the critical section. It releases the resources and also informs the other processes that the critical section is free.

Solution to the Critical Section Problem

The critical section problem needs a solution to synchronize the different processes. The solution to the critical section problem must satisfy the following conditions −

- **Mutual Exclusion**

  Mutual exclusion implies that only one process can be inside the critical section at any time. If any other processes require the critical section, they must wait until it is free.

- **Progress**

  Progress means that if a process is not using the critical section, then it should not stop any other process from accessing it. In other words, any process can enter a critical section if it is free.

- **Bounded Waiting**

  Bounded waiting means that each process must have a limited waiting time. Itt should not wait endlessly to access the critical section.

(c) Mutual exclusion

Ans :-Mutual exclusion is a property of process synchronization which states that "no two processes can exist in the critical section at any given point of time". Any process synchronization technique being used must satisfy the property of mutual exclusion, without which it would not be possible to get rid of a race condition.

(d) I/O interface

The method that is used to transfer information between internal storage and external I/O devices is known as I/O interface. The CPU is interfaced using special communication links by the peripherals connected to any computer system. These communication links are used to resolve the differences between CPU and peripheral. There exists special hardware components between CPU and peripherals to supervise and synchronize all the input and output transfers that are called interface units.

Mode of Transfer:

The binary information that is received from an external device is usually stored in the memory unit. The information that is transferred from the CPU to the external device is originated from the memory unit. CPU merely processes the information but the source and target is always the memory unit. Data transfer between CPU and the I/O devices may be done in different modes.

Data transfer to and from the peripherals may be done in any of the three possible ways

1. Programmed I/O.
2. Interrupt- initiated I/O.
3. Direct memory access(DMA).

Now let's discuss each mode one by one.

1. **Programmed I/O:** It is due to the result of the I/O instructions that are written in the computer program. Each data item transfer is initiated by an instruction in the program. Usually the transfer is from a CPU register and memory. In this case it requires constant monitoring by the CPU of the peripheral devices.

   Example of Programmed I/O: In this case, the I/O device does not have direct access to the memory unit. A transfer from I/O device to memory requires the execution of several instructions by the CPU, including an input instruction to transfer the data from device to the CPU and store instruction to transfer the data from CPU to memory. In programmed I/O, the CPU stays in the program loop until the I/O unit indicates that it is ready for data transfer. This is a time consuming process since it needlessly keeps the CPU busy. This situation can be avoided by using an interrupt facility. This is discussed below.

2. **Interrupt- initiated I/O:** Since in the above case we saw the CPU is kept busy unnecessarily. This situation can very well be avoided by using an interrupt driven method for data transfer. By using interrupt facility and special commands to inform the interface to issue an interrupt request signal whenever data is available from any device. In the meantime the CPU can proceed for any other

program execution. The interface meanwhile keeps monitoring the device. Whenever it is determined that the device is ready for data transfer it initiates an interrupt request signal to the computer. Upon detection of an external interrupt signal the CPU stops momentarily the task that it was already performing, branches to the service program to process the I/O transfer, and then return to the task it was originally performing.

3. **Direct Memory Access**: The data transfer between a fast storage media such as magnetic disk and memory unit is limited by the speed of the CPU. Thus we can allow the peripherals directly communicate with each other using the memory buses, removing the intervention of the CPU. This type of data transfer technique is known as DMA or direct memory access. During DMA the CPU is idle and it has no control over the memory buses. The DMA controller takes over the buses to manage the transfer directly between the I/O devices and the memory unit.

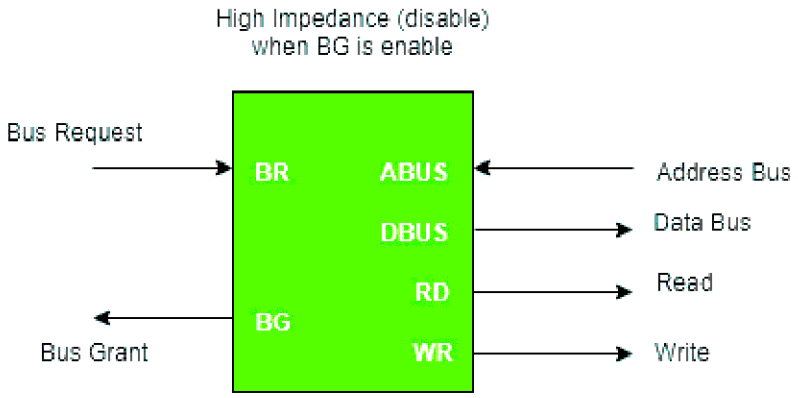


Figure - CPU Bus Signals for DMA Transfer

Bus Request : It is used by the DMA controller to request the CPU to relinquish the control of the buses.
Bus Grant : It is activated by the CPU to Inform the external DMA controller that the buses are in high impedance state and the requesting DMA can take control of the buses. Once the DMA has taken the control of the buses it transfers the data. This transfer can take place in many ways.

Q.6

Sol

Soln:- physical memory $= 2^{24}$ byte

logical address space $= 256$ pages $= 2^8$

page size $= 2^{10}$ byte

Calculate no. of bits in logical address.

The logical address space contains 256 pages $= 2^8$

That means the no. of bits required for the page no. is 8

page size $= 2^{10}$

That means the no. of bits required for the page offset is 10

Logical address = page no. + page_offset

$= 8 + 10$

$= 18$ bits

So logical address is in 18 bits

Q.7(a)what is binary ……

Ans. Counting Semaphores

This type of Semaphore uses a count that helps task to be acquired or released numerous times. If the initial count = 0, the counting semaphore should be created in the unavailable state.

Binary Semaphores

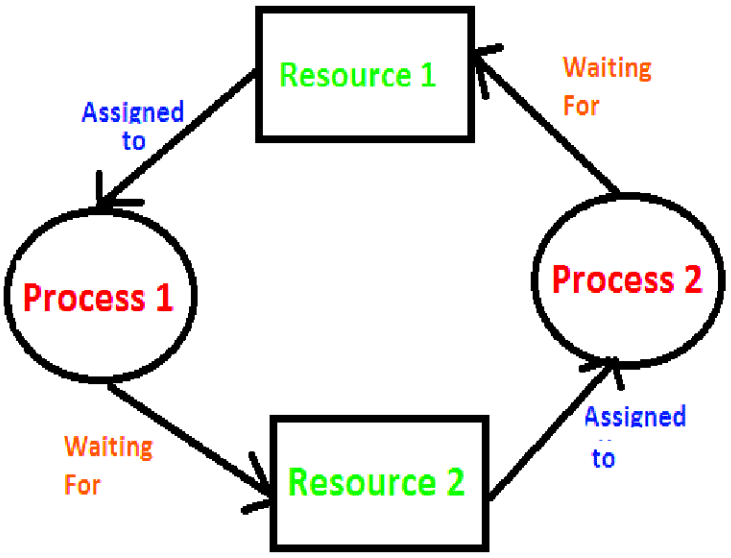
The binary semaphores are quite similar to counting semaphores, but their value is restricted to 0 and 1. In this type of semaphore, the wait operation works only if semaphore = 1, and the signal operation succeeds when semaphore= 0. It is easy to implement than counting semaphores.

Q.7(b)Describe necessary condition for deadlock……..

Ans*Deadlock* is a situation where a set of processes are blocked because each process is holding a resource and waiting for another resource acquired by some other process.

Consider an example when two trains are coming toward each other on same track and there is only one track, none of the trains can move once they are in front of each other. Similar situation occurs in operating

systems when there are two or more processes hold some resources and wait for resources held by other(s). For example, in the below diagram, Process 1 is holding Resource 1 and waiting for resource 2 which is acquired by process 2, and process 2 is waiting for resource 1.



Deadlock can arise if following four conditions hold simultaneously (Necessary Conditions)

Mutual Exclusion: One or more than one resource are non-sharable (Only one process can use at a time)

Hold and Wait: A process is holding at least one resource and waiting for resources.

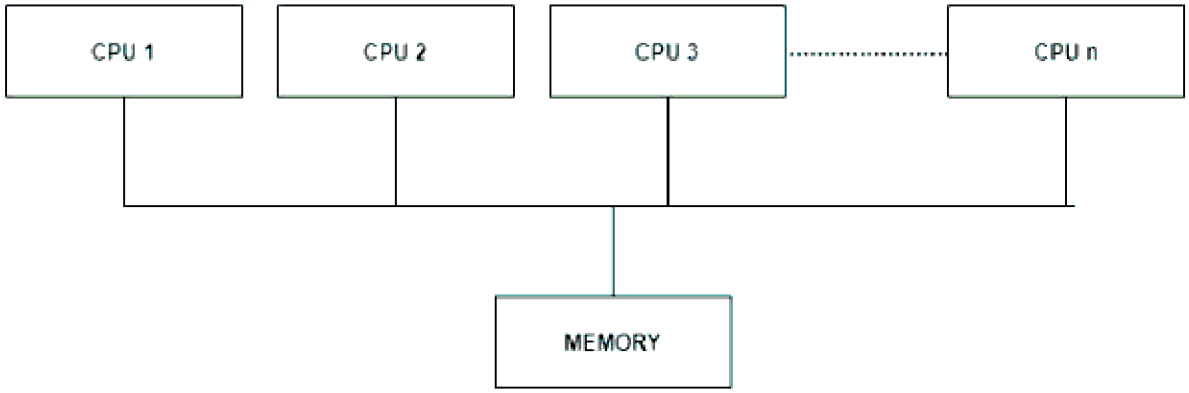
No Preemption: A resource cannot be taken from a process unless the process releases the resource.

Circular Wait: A set of processes are waiting for each other in circular form.

Q.8 Write short note

(a) Multiprocessor system

These systems have multiple processors working in parallel that share the computer clock, memory, bus, peripheral devices etc. An image demonstrating the multiprocessor architecture is:



Multiprocessing Architecture

Types of Multiprocessors

There are mainly two types of multiprocessors i.e. symmetric and asymmetric multiprocessors. Details about them are as follows:

Symmetric Multiprocessors

In these types of systems, each processor contains a similar copy of the operating system and they all communicate with each other. All the processors are in a peer to peer relationship i.e. no master - slave relationship exists between them.

An example of the symmetric multiprocessing system is the Encore version of Unix for the Multimax Computer.

Asymmetric Multiprocessors

In asymmetric systems, each processor is given a predefined task. There is a master processor that gives instruction to all the other processors. Asymmetric multiprocessor system contains a master slave relationship.

Asymmetric multiprocessor was the only type of multiprocessor available before symmetric multiprocessors were created. Now also, this is the cheaper option.

Advantages of Multiprocessor Systems

There are multiple advantages to multiprocessor systems. Some of these are:

More reliable Systems

In a multiprocessor system, even if one processor fails, the system will not halt. This ability to continue working despite hardware failure is known as graceful degradation. For example: If there are 5 processors in a multiprocessor system and one of them fails, then also 4 processors are still working. So the system only becomes slower and does not ground to a halt.

Enhanced Throughput

If multiple processors are working in tandem, then the throughput of the system increases i.e. number of processes getting executed per unit of time increase. If there are N processors then the throughput increases by an amount just under N.

More Economic Systems

Multiprocessor systems are cheaper than single processor systems in the long run because they share the data storage, peripheral devices, power supplies etc. If there are multiple processes that share data, it is better to schedule them on multiprocessor systems with shared data than have different computer systems with multiple copies of the data.

Disadvantages of Multiprocessor Systems

There are some disadvantages as well to multiprocessor systems. Some of these are:

Increased Expense

Even though multiprocessor systems are cheaper in the long run than using multiple computer systems, still they are quite expensive. It is much cheaper to buy a simple single processor system than a multiprocessor system.

Complicated Operating System Required

There are multiple processors in a multiprocessor system that share peripherals, memory etc. So, it is much more complicated to schedule processes and impart resources to processes.than in single processor systems. Hence, a more complex and complicated operating system is required in multiprocessor systems.

Large Main Memory Required

All the processors in the multiprocessor system share the memory. So a much larger pool of memory is required as compared to single processor systems.

(b)Distributed system

A distributed operating system is a software over a collection of independent, networked, communicating, and physically separate computational nodes. They handle jobs which are serviced by multiple CPUs. These systems are referred as *loosely coupled systems* where each processor has its own local memory and processors communicate with one another through various communication lines, such as high speed buses or telephone lines

(c) Threads

- A ***thread*** is a basic unit of CPU utilization, consisting of a program counter, a stack, and a set of registers, (and a thread ID.)
- Traditional (heavyweight) processes have a single thread of control - There is one program counter, and one sequence of instructions that can be carried out at any given time.
- As shown in Figure 4.1, multi-threaded applications have multiple threads within a single process, each having their own program counter, stack and set of registers, but sharing common code, data, and certain structures such as open files.

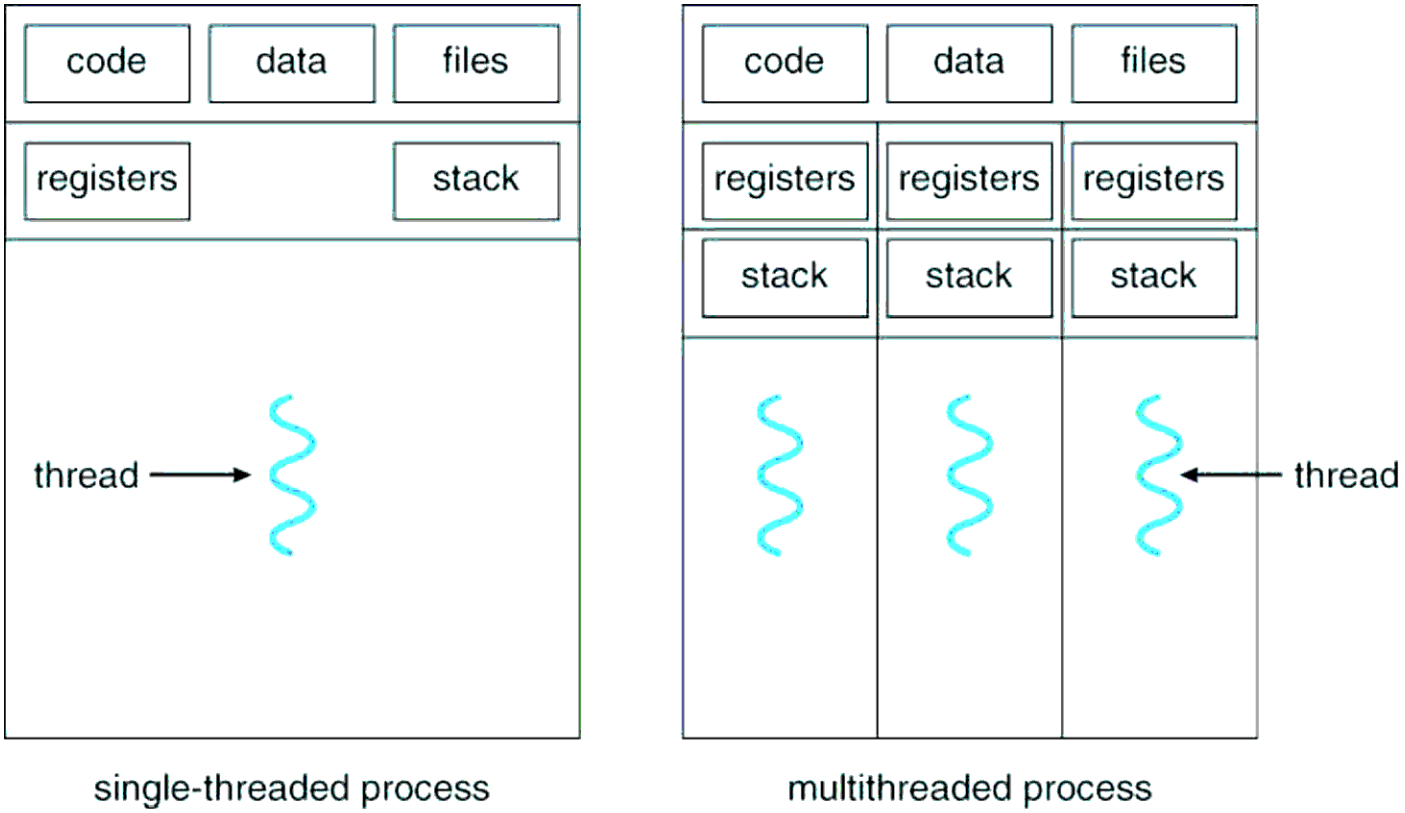


Figure 4.1 - Single-threaded and multithreaded proce

(d) File protection

Preventing accidental erasing of data. Physical file protection is provided on the storage medium by turning a switch, moving a lever or covering a notch. Writing is prohibited even if the software directs the computer to do so. For example, on the eariler half-inch tape, a plastic ring in the center of the reel was removed (no ring-no write).

Logical file protection is provided by the operating system, which can designate files as read only. This allows both regular (read/write) and read only files to be stored on the same disk volume. Files can also be designated as hidden files, which makes them invisible to most software programs.