Name: Sayma Akter Shumi **ID:IT-18032**

1. a) What is an operating system? Explain the main purposes of an operating system? 2+3

b) Write down some features of operating system? 4

c) What is interrupt? What are the advantages & Disadvantages of interrupt? 2+3

2. a) What is I/O system in OS? What are the characteristics of I/O devices? 2+2

b) What is memory management in OS? What is demand paging? 2+2

c) Define virtual memory? What are the advantages and disadvantages of virtual memory? 2+4

3. a) What is kernel? What are the tasks performed by kernel? 2+4

b) What is system call? Why do you need system call in OS? 2+2

c) Write down the types of system call in OS? 4

4. a) What is real time operating system? Write down the important application of real time operating system? 2+4

b) What is process? Why process management is important in OS? 2+3

c) What are the responsibilities of OS with process management activities?

5. a) What is thread? Why do you need thread in OS ? 2+4

b) What are types of thread in OS? 2

c)Write down the advantages & disadvantages of threads? 6

6. a) What is multithreading? Write some benefits of multithreading? 2+4

b) What is dispatcher? What are the responsibilities of dispatcher? 2+2

c) Difference between dispatcher & scheduler? 4

7. a) What is cloud service? How do OS use the cloud? 2+3

b) What are the advantages of cloud computing? 4

c) Write different services provided by operating system? 5

8. a) What is FCFS? What are the CPU scheduling algorithm criteria? 2+4

b) What is SJF? Discuss disadvantages of SJF? 1+3

c) Write down the advantages & disadvantages of FCFS? 4

Answer to the question number (1)

a)

An operating system (OS) is the program that, after being initially loaded into the computer by a boot program, manages all of the other application programs in a computer. The application programs make use of the operating system by making requests for services through a defined application program interface (API). In addition, users can interact directly with the operating system through a user interface, such as a command-line interface (CLI) or a graphical UI (GUI).

Main purposes of an operating system:

- Controls the backing store and peripherals such as scanners and printers.
- Deals with the transfer of programs in and out of memory.
- Organises the use of memory between programs.
- Organises processing time between programs and users.
- Maintains security and access rights of users.
- Deals with errors and user instructions.
- Allows the user to save files to a backing store.
- Provides the interface between the user and the computer - for example, Windows Vista and Apple OSX. For more information, see the user interfaces study guide.
- Issues simple error messages.

In a larger computer such as a mainframe the operating system works on the same principles.

b)

Features of operating system (OS):

Here is a list important features of OS:

- Protected and supervisor mode
- Allows disk access and file systems Device drivers Networking Security
- Program Execution
- Memory management Virtual Memory Multitasking
- Handling I/O operations
- Manipulation of the file system
- Error Detection and handling
- Resource allocation
- Information and Resource Protection.

c)

Interrupt: An interrupt is a signal from a device attached to a computer or from a program within the computer that requires the operating system to stop and figure out what to do next.

Advantages of interrupt:

- It increases the efficiency of CPU.
- It decreases the waiting time of CPU.
- Stops the wastage of instruction cycle.

Disadvantages of interrupt:

- CPU has to do a lot of work to handle interrupts, resume its previous execution of program.

Answer to the question number (2)

a)

Input-output (I/O) system transfer information between computer main memory and the outside world. An I/O system is composed of I/O devices (peripherals), I/O control units, and software to carry out the I/O transaction through a sequence of I/O operation.

Characteristics of I/O devices:

- Most devices can be characterized as either block I/O, character I/O, memory mapped file access, or network sockets. ...
- Most OSes also have an escape, or back door, which allows applications to send commands directly to device drivers if needed.

b)

Memory management:

Memory management is the functionality of an operating system which handles or manages primary memory and moves processes back and forth between main memory and disk during execution. Memory management keeps track of each and every memory location, regardless of either it is allocated to some process or it is free. It checks how much memory is to be allocated to processes. It decides which process will get memory at what time. It tracks whenever some memory gets freed or unallocated and correspondingly it updates the status.

Demand paging:

In computer operating systems, demand paging is a method of virtual memory management. It follows that a process begins execution with none of its pages in physical memory, and many page faults will occur until most of a process's working set of pages are located in physical memory.

c)

Virtual memory:

A computer can address more memory than the amount physically installed on the system. This extra memory is actually called virtual memory and it is a section of a hard disk that's set up to emulate the computer's RAM.

Advantages of virtual memory:

Here, are pros/benefits of using Virtual Memory:

- Virtual memory helps to gain speed when only a particular segment of the program is required for the execution of the program.
- It is very helpful in implementing a multiprogramming environment.
- It allows you to run more applications at once.
- It helps you to fit many large programs into smaller programs.
- Common data or code may be shared between memory.
- Process may become even larger than all of the physical memory.
- Data / code should be read from disk whenever required.
- The code can be placed anywhere in physical memory without requiring relocation.
- More processes should be maintained in the main memory, which increases the effective use of CPU.
- Each page is stored on a disk until it is required after that, it will be removed.
- It allows more applications to be run at the same time.
- There is no specific limit on the degree of multiprogramming.
- Large programs should be written, as virtual address space available is more compared to physical memory.

Disadvantages of virtual management:

Here, are drawbacks/cons of using virtual memory:

- Applications may run slower if the system is using virtual memory.
- Likely takes more time to switch between applications.
- Offers lesser hard drive space for your use.
- It reduces system stability.
- It allows larger applications to run in systems that don't offer enough physical RAM alone to run them.
- It doesn't offer the same performance as RAM.
- It negatively affects the overall performance of a system.
- Occupy the storage space, which may be used otherwise for long term data storage.

Answer to the question number (3)

a)

Kernel s actually the heart of operating systems. It acts as an interface between the

applications and actual data processing done at hardware level (CPU, disk memory etc.).

Kernel lies in the center of the operating system which manages the communication the user

level applications and the hardware installed on the system.

There are following main tasks performed by kernel :-

1. Memory Management

2. Process Management

3. Disk and File System Management

4. Networking

5. Security

6. Graphical User Interface (GUI)

7. Device Driver Management.

b)

System call:

A system call is a way for programs to interact with the operating system. A computer program makes a system call when it makes a request to the operating system's kernel. System call provides the services of the operating system to the user programs via Application Program Interface (API).

Following are situations which need system calls in OS:

- Reading and writing from files demand system calls.
- If a file system wants to create or delete files, system calls are required.
- System calls are used for the creation and management of new processes.
- Network connections need system calls for sending and receiving packets.
- Access to hardware devices like scanner, printer, need a system call.

c)

Types of system call in OS:

Here are the five types of system calls used in OS:

- **Process Control**
  These system calls deal with processes such as process creation, process termination etc.
- **File Management**
  These system calls are responsible for file manipulation such as creating a file, reading a file, writing into a file etc.
- **Device Management**
  These system calls are responsible for device manipulation such as reading from device buffers, writing into device buffers etc.
- **Information Maintenance**
  These system calls handle information and its transfer between the operating system and the user program.
- **Communication**
  These system calls are useful for interprocess communication. They also deal with creating and deleting a communication connection.

Answer to the question number (4)

a)

Real time operating system:

A real-time operating system (RTOS) is an operating system (OS) intended to serve real-time applications that process data as it comes in, typically without buffer delays. ... A real-time system is a time-bound system which has well-defined, fixed time constraints.

Application of real time operating system:

Real-time systems are used in:

- Airlines reservation system.
- Air traffic control system.
- Systems that provide immediate updating.
- Used in any system that provides up to date and minute information on stock prices.
- Defense application systems like RADAR.
- Networked Multimedia Systems
- Command Control Systems
- Internet Telephony
- Anti-lock Brake Systems
- Heart Pacemaker.

b)

Process:

In computing, a process is the instance of a computer program that is being executed by one or many threads. It contains the program code and its activity. Depending on the operating system (OS), a process may be made up of multiple threads of execution that execute instructions concurrently.

Importance of process management:

A process is a program in execution. An integral part of any modern-day operating system. The OS must allocate resources to processes, enable processes to share and exchange information, protect the resources of each process from other processes and enable synchronization among processes.

c)

Five Major Activities of an Operating System With Respect to Process Management:

The operating system on a computer manages the applications running on it. Each running program on a computer has at least one process associated with it. A process therefore represents some or all of a program while it is running. Most of the

time when you use a computer, more than one application will be running. The operating system has to manage the resources on the computer to make this possible. This process management operation requires a range of activities, all administered by the operating system.

Creating and Deleting:

Some of the processes on your computer may run for short periods of time, with others running continuously over longer periods. For example, some background processes will begin when the computer first boots up, such as those associated with input and output. Other processes will start when you launch applications. The processes created when a software application is launched will typically then stop when you exit or quit the application. The operating system manages the creation and deletion of all running processes.

Suspending and Resuming:

Although the processes on a computer may appear to be running continuously, they will often enter paused states for short periods of time. If a process is not currently executing -- for example, if it is waiting for an input or output operation to complete -- it may be suspended. The operating system manages the suspension and resumption of such processes when the required resources become available.

Synchronizing:

A computer has a finite range of processing resources that must be shared between all running processes. The operating system creates the impression that several processes are being executed at the same time, but the available resources are in fact being switched between them so quickly that they appear to be running simultaneously. The operating system carries out process synchronization to keep any running programs functional and available for user interaction.

Communicating:

In order to keep the running processes synchronized and receiving the necessary resources, the operating system must be able to communicate with the processes. For example, the operating system must be able to determine when a process is suspended or ready for resource allocation. If processes need access to the same system resource, this communication activity becomes even more vital.

Deadlock Handling:

When a number of running processes are all in a paused state, each one waiting for resources currently being used by another running process, deadlock can occur. This could cause all programs to halt indefinitely if the operating system did not intervene. The operating system can take steps both to avoid and end deadlock should it occur. Operating systems use various strategies to handle deadlock.

Answer to the question number (5)

a)

Thread:

A thread is a basic unit of CPU utilization, consisting of a program counter, a stack, and a set of registers, Traditional 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.

Necessary of thread:

Threads provide a way to improve application performance through parallelism. Threads represent a software approach to improving performance of OS by reducing the overhead thread is equivalent to a classical process. Each thread belongs to exactly one process and no thread can exist outside a process.

b)

Types of thread:

1.User threads:

These threads are implemented and used in the user library. They cannot be created using the system. While doing thread switching, if the OS is called there will be distractions. The user thread avoids all distractions and does not interrupt the kernel system. These threads are considered as single-threaded processes by the kernel. These are implemented on the systems that do not support multithreading as it is a single thread process. These are simply represented with a single, register, counter and stack. The user threads do not create any separate tasks for creation. The switching is also fast as there is no OS intervention. There is no coordination between threads and kernel and hence if one thread breaks, the entire process is blocked.

2.Kernel threads:

Kernel manages the threads and knows each and every thread. This is a multithreading type. The kernel manages a table to track the threads in each process. Also, there is a separate table to track the processes and update whenever the changes are made. OS makes the changes in the thread while creating and managing them. Knowledge of threads is shared with the kernel and hence the time for each process is scheduled according to the execution. Kernel threads are used for applications that break in between the process. Kernel threads are slow when compared with user threads. The thread control block is needed to control the tasks.

c)

Advantages of Threads in Operating System:

Below are the following advantages of threads in OS.

- The context switching time is reduced using threads. With traditional methods, it takes longer to switch the contexts between different processes even though they belong to the same OS. This helps in managing the time of the tasks.
- While using threads, one task after the other is carried out without being instructed always. Hence concurrency is achieved for the entire process using threads.
- Communication between threads and communication between processes is made efficient with the help of threads. This helps to manage the process without being tracking the entire process using a tracker. This reduces costs.
- Since it is easy to do context switching, the cost is less and hence the entire process is economical to create and manage and switch the threads between the processes.
- Multiprocessors are used in large scale by threads as both have the same characteristics. Building multiprocessor is easy and reliable when compared to other processors.
- When multithreading is employed, it responds to the user every now and then and hence customer satisfaction is achieved.

Disadvantages of Threads in Operating System:

- All the variables both local and global are shared between threads. This creates a security issue as the global variables give access to any process in the system.
- When the entire application is dependent on threads, if a single thread breaks, the entire process is broken and blocked. Thus the application is crashed. This particularly happens when the application runs the process with a single thread. When many threads are used, the threads crash each other making the communication difficult.
- Threads depend on the system and the process to run. It is not independent. Also, the execution of the process via threads is time consuming. But processes cannot be run without threads.
- Threads are not reusable and it requires more hardware than software due to application changes from the base. Threads cannot be made work without process as they do not have their own address space.

Answer to the question number (6)

a)

Multithreading:

Multithreading is the ability of a program or an operating system process to manage its use by more than one user at a time and to even manage multiple requests by the same user without having to have multiple copies of the programming running in the computer.

Benefits of multithreading:

Some of the benefits of multithreading are given as follows –

- **Resource Sharing:**

  All the threads of a process share its resources such as memory, data, files etc. A single application can have different threads within the same address space using resource sharing.

- **Responsiveness:**

  Program responsiveness allows a program to run even if part of it is blocked using multithreading. This can also be done if the process is performing a lengthy operation. For example - A web browser with multithreading can use one thread for user contact and another for image loading at the same time.

- **Utilization of Multiprocessor Architecture:**

  In a multiprocessor architecture, each thread can run on a different processor in parallel using multithreading. This increases concurrency of the system. This is in direct contrast to a single processor system, where only one process or thread can run on a processor at a time.

- **Economy:**

  It is more economical to use threads as they share the process resources. Comparatively, it is more expensive and time-consuming to create processes as they require more memory and resources. The overhead for process creation and management is much higher than thread creation and management.

b)

Dispatcher:

The dispatcher is the module that gives a process control over the CPU after it has been selected by the short-term scheduler. This function involves the following: Switching context. Switching to user mode. Jumping to the proper location in the user program to restart that program.

A dispatcher has the following responsibilities:

- **Switching to user mode**: All of the low level operating system processes run on the kernel level security access, but all of the application code and user issued processes run in the application space or the user permission mode. Dispatcher switches the processes to the user mode.

- **Addressing:** The program counter (PC) register points towards the next process that is to be executed. The dispatcher is responsible for addressing that address.

- **Initiation of context switch:** A context switch is when a currently running process is halted and all of its data and its process control block (PCB) are stored in main memory, and another process is loaded in its place for execution.

- **Managing dispatch latency:** Dispatch latency is calculated as the time it takes to stop one process and start another. The lower the dispatch latency, the more efficient the software for the same hardware configuration.

c)

Difference between Dispatcher and Scheduler:

we will see the difference between a dispatcher and a scheduler.

- The scheduler selects a process from a list of processes by applying some process scheduling algorithm. On the other hand, the dispatcher transfers the process selected by the short-term scheduler from one state to another.
- The scheduler works independently, while the dispatcher has to be dependent on the scheduler i.e. the dispatcher transfers only those processes that are selected by the scheduler.
- For selecting a process, the scheduler uses some process scheduling algorithm like FCFS, Round-Robin, SJF, etc. But the dispatcher doesn't use any kind of scheduling algorithms.
- The only duty of a scheduler is to select a process from a list of processes. But apart from transferring a process from one state to another, the dispatcher can also be used for switching to user mode. Also, the dispatcher can be used to jump to a proper location when the process is restarted.

Answer to the question number (7)

a)

Cloud service:

Cloud service is used to build cloud applications using the server in a network through internet. It provides the facility of using the cloud application without installing it on the computer. It also reduces the maintenance and support of the application which are developed using cloud service.

Combining a browser with a basic operating system allows the use of cloud computing, in which applications and data "live and run" on the Internet instead of the hard drive. Cloud can be installed and used together with other operating systems, or act as a standalone operating systems.

b)

Advantages of using cloud computing are-

- Data backup and storage of data
- Powerful server capabilities
- SaaS (Software as a service)
- Information technology sandboxing capabilities
- Increase in productivity
- Cost effective & Time saving.

c)

An operating system provides priority to the tasks based on their criticality. It does not guarantee completion of critical tasks in time.

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.

Answer to the question number (8)

a)

- The process which arrives first in the ready queue is firstly assigned the CPU.
- In case of a tie, process with smaller process id is executed first.
- It is always non-preemptive in nature.

The criteria include the following:

1. CPU utilization. Keep the CPU as busy as possible. In a real system, it should range from 40 percent (for a lightly loaded system) to 90 percent (for a heavily used system).

2. Throughput. The number of processes that are completed per time unit.

3. Turnaround time (TAT). The interval from the time of submission of a process to the time of completion. TAT=execution time + waiting time.

4. Waiting time. It is the sum of the periods spent waiting in the ready queue.

5. Response time. It is the time it takes to start responding, not the time it takes to output the response.

b)

- SJF Scheduling can be used in both preemptive and non
- Preemptive mode of Shortest Job First is called as (SRTF)

Disadvantages-

1.It can not be implemented practically since burst time of the processes can not be known in advance.
2. It leads to starvation for processes with larger burst time.
3. Priorities can not be set for the processes.
4. Processes with larger burst time have poor response time.

c)

FCFS advantages and disadvantages-

Advantages:

1. It is simple and easy to understand.
2. It can be easily implemented using queue data structure.

3. It does not lead to starvation.

Disadvantages-

1. It does not consider the priority or burst time of the processes.
2. It suffers from convoy effect.