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Course Title:Operating System

CT:01

1. a) What is an operating system? Write the goals of operating system. 2+2

b) Describe about computer system structure. 4

c)What is soft real time system? Write different services provided by operating system? 2+4

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

b)Why we use system calls in operating system? 4

c) What is cloud service?Write down the three basic clouds in cloud computing? 4

3. a) Briefly explain operating system services. 4

b)Describe about user operating system interface. 4

c) What is a system call? Why do you need system calls in OS? 2+4

4. a) What is system program? Discuss about different types of system call. 2+4

b)What is precess?Explain process scheduling. 2+2

c)Describe different types of scheduler. 4

5.a) What is PCB? What is information in the PCB? 2+2

b)What do you mean by multitasking in mobile systems? 4

c) What is thread? Write some benefits about multithreading? 2+4

6. a) Write down the merits and demerits of thread ? 4

b)What do you mean by interrupt?Briefly explain Multicore programming. 2+4

c) What are the events occur when the process allocate to the CPU and is executing? 4

7.a)What do you mean by Deadlock and Starvation? 4

b)What are the classical problem of synchronization? 6

c)Describe about windows synchronization. 4

8.a) What is FCFS?Describe about disadvantage of FCPS scheduling. 2+4

b) Consider the set of 3 processes whose arrival time and burst time are given below 4

Process	Arrival time	Burst time
P1	0	18
P2	1	3
P3	2	3

If the CPU scheduling policy is FCFS, calculate the average waiting time and average turn around time.

c) What are the differences between preemptive and non-preemptive scheduling? 4

Answer to the question number (1)

a)

Operating system:

Operating system is a program that acts as an intermediary between a user of a computer and the computer hardware

Operating system goals:

- Execute user programs and make solving user problems easier
- Make the computer system convenient to use
- Use the computer hardware in an efficient manner

b)

Computer system structure:

Computer system can be divided into four components:

- Hardware – provides basic computing resources
  - CPU, memory, I/O devices
- Operating system
  - Controls and coordinates use of hardware among various applications and users
- Application programs – define the ways in which the system resources are used to solve the computing problems of the users
  - Word processors, compilers, web browsers, database systems, video games
- Users
  - People, machines, other computers

c)

It 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 (2)

a)

Kernal: 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:-

- Memory Management
- Process Management
- Disk and File System Management
- Networking
- Security
- Graphical User Interface (GUI)
- Device Driver Management

b)

We use system call in operating system for following reasons:

1.Reading and writing from files demand system calls.

2. If a file system wants to create or delete files, system calls are required.

3. System calls are used for the creation and management of new processes.

4. Network connections need system calls for sending and receiving packets.

5. Access to hardware devices like scanner, printer, need a system call.

c)

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.

Three basic clouds in cloud computing-

1. Professional cloud

2.Personal cloud

3.Performance cloud

Answer to the question number (3)

a)

Operating system services:

One set of operating-system services provides functions that are helpful to the user:

- User interface - Almost all operating systems have a user interface (UI).
  - Varies between Command-Line (CLI), Graphics User Interface (GUI), Batch
- Program execution - The system must be able to load a program into memory and to run that program, end execution, either normally or abnormally (indicating error)
- I/O operations - A running program may require I/O, which may involve a file or an I/O device
- File-system manipulation - The file system is of particular interest. Programs need to read and write files and directories, create and delete them.
- Communications – Processes may exchange information, on the same computer or between computers over a network
- Error detection – OS needs to be constantly aware of possible errors
- Resource allocation - When multiple users or multiple jobs running concurrently, resources must be allocated to each of them

b)

Operating system interface:

- User Operating System Interface – CLI
  CLI or command line interpreter allows direct command entry -
  - Sometimes implemented in kernel sometimes by systems program
  - Sometimes multiple flavors implemented – shells

- Primarily fetches a command from user and executes it
- User Operating System Interface – GUI

User-friendly desktop metaphor interface

- Usually mouse, keyboard, and monitor
- Icons represent files, programs, actions, etc

Touchscreen Interfaces:

Touchscreen devices require new interfaces -

- Mouse not possible or not desired
- Actions and selection based on gestures
- Virtual keyboard for text entry

c)

System call:

A system call is a mechanism that provides the interface between a process and the operating system. It is a programmatic method in which a computer program requests a service from the kernel of the OS.System call offers the services of the operating system to the user programs via API (Application Programming Interface). System calls are the only entry points for the kernel system.

We need system call for following reasons:

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

Answer to the question number (4)

a)

System program: System programs provide a convenient environment for program development and execution.

They can be divided into:

- File manipulation
- Status information sometimes stored in a File modification
- Programming language support
- Program loading and execution

Different types of system call:

Process control:

- create process, terminate process
- end, abort
- load, execute
- get process attributes, set process attributes

File management:

- create file, delete file
- open, close file
- read, write, reposition

Device management:

- request device, release device
- read, write, reposition

Protection:

- Control access to resources
- Allow and deny user access

b)

Process: The **system process** is responsible for the **system** memory and compressed memory in the NT kernel. This **system process** is a single thread running on each processor. ...
The **system process** in Windows 10 has a additional task, it is compressing old pages of memory so that you have more free memory to use.

Process scheluding: The process scheduling is the activity of the process manager that handles the removal of the running process from the CPU and the selection of another process on the basis of a particular strategy.

Process scheduling is an essential part of a Multiprogramming operating systems. Such operating systems allow more than one process to be loaded into the executable memory at a time and the loaded process shares the CPU using time multiplexing.

c)

Different types of scheduler:

Short-term scheduler (or CPU scheduler) –

- selects which process shouldν be executed next and allocates CPU
- Sometimes the only scheduler in a system
- Short-term scheduler is invoked frequently (milliseconds) λ fast)

Long-term scheduler (or job scheduler) –

- selects which processes shouldν be brought into the ready queue
- Long-term scheduler is invoked infrequently (seconds, minutes) (may be slow)

Processes can be described as either:

- I/O-bound process – spends more time doing I/O than computations, many short CPU bursts
- CPU-bound process – spends more time doing computations; few veryλ long CPU bursts

Long-term scheduler strives for good process mix

Answer to the question number (5)

a)

PCB: A process control block (PCB) is a data structure used by computer operating systems to store all the information about a process. It is also known as a process descriptor. Each process has a single PCB.

- When a process is created (initialized or installed), the operating system creates a corresponding process control block.
- Information in a process control block is updated during the transition of process states.
- When the process terminates, its PCB is returned to the pool from which new PCBs are drawn.
- Each process has a single PCB

b)

Multitasking, in an operating system, is allowing a user to perform more than one computer task at a time. The operating system is able to keep track of where you are in these tasks and go from one to the other without losing information. Microsoft Windows 2000, IBM's OS/390, and Linux are examples of operating systems that can do multitasking (almost all of today's operating systems can). When you open your Web browser and then open Word at the same time, you are causing the operating system to do multitasking.

Being able to do multitasking doesn't mean that an unlimited number of tasks can be juggled at the same time. Each task consumes system storage and other resources. As more tasks are started, the system may slow down or begin to run out of shared storage.

c)

Thread:A thread is a path of execution within a process. A process can contain multiple threads.

A thread is also known as lightweight process. The idea is to achieve parallelism by dividing a process into multiple threads. For example, in a browser, multiple tabs can be different threads. MS Word uses multiple threads: one thread to format the text, another thread to process inputs, etc

Benefits of Multithreading:

- Improved throughput
- Simultaneous and fully symmetric use of multiple processors for computation and I/O.
- Superior application responsiveness.
- Improved server responsiveness.
- Minimized system resource usage.
- Program structure simplification.
- Better communication.

Answer to the question number (6)

a) Advantages:

- User-level threads do not require modification to operating systems.
- Simple Representation: Each thread is represented simply by a PC, registers, stack and a small control block, all stored in the user process address space.
- Simple Management: This simply means that creating a thread, switching between threads and synchronization between threads can all be done without the intervention of the kernel.

Disadvantages:

- There is a lack of coordination between threads and operating system kernel.
- User-level threads require non-blocking systems call i.e., a multithreaded kernel.

b)

Interrupt: An interrupt is a signal sent to the processor that interrupts the current process. It may be generated by a hardware device or a software program.
A hardware interrupt is often created by an input device such as a mouse or keyboard.
Software interrupts are used to handle errors and exceptions that occur while a program is running.

Multicore programming: Multicore or multiprocessor systems putting pressure on programmers, challenges include:

- Dividing activities
- Balance
- Data splitting

- Parallelism implies a system can perform more than one taskν simultaneously
- Concurrency supports more than one task making progress

Types of parallelism:

- Data parallelism
- Task parallelism

c)

One of the following events may occur:

1.The process could issue an I/O request and places in an I/O queue.
2.The process could create a new sub process and wait for its termination.
3.The process could remove forcibly from the CPU as a result of an interrupt and be put back in the ready queue.

Answer to the question number (7)

a)

Deadlock: A deadlock is a situation in which two computer programs sharing the same resource are effectively preventing each other from accessing the resource, resulting in both programs ceasing to function. The earliest computer operating systems ran only one program at a time. This led to the problem of the deadlock.

Starvation: Starvation is the problem that occurs when high priority processes keep executing and low priority processes get blocked for indefinite time. In heavily loaded

computer system, a steady stream of higher-priority processes can prevent a low-priority process from ever getting the CPU.

b)

Classical problem of synchronization:

- Classical problems used to test newly-proposed synchronization schemes
  - Bounded-Buffer Problem
  - Readers and Writers Problem
  - Dining-Philosophers Problem

Bounded-Buffer Problem:

- n buffers, each can hold one item
- Semaphore mutex initialized to the value 1
- Semaphore full initialized to the value 0

Readers-Writers Problem:

- A data set is shared among a number of concurrent processes

  - Readers – only read the data set; they do not perform any updates
  - Writers – can both read and write

- Problem – allow multiple readers to read at the same time
  - Only one single writer can access the shared data at the same time

Dining-Philosophers Problem:

- Philosophers spend their lives alternating thinking and eating
- Don't interact with their neighbors, occasionally try to pick up 2 chopsticks (one at a time) to eat from bowl
  - Need both to eat, then release both when done

c)

Windows synschronization:

- Uses interrupt masks to protect access to global resources onv uniprocessor systems
- Uses spinlocks on multiprocessor systems
  - Spinlocking-thread will never be preempted
- Also provides dispatcher objects user-land which may actv mutexes, semaphores, events, and timers
  - Events

- An event acts much like a condition variable
- Timers notify one or more thread when time expired
- Dispatcher objects either signaled-state (object available) or non-signaled state (thread will block)

Answer to the question number (8)

a)

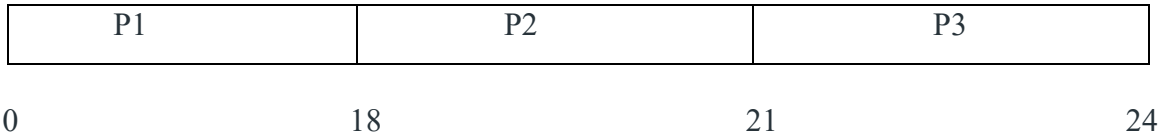
FCFS: First come, first served (FCFS) is an operating system process scheduling algorithm and a network routing management mechanism that automatically executes queued requests and processes by the order of their arrival. With first come, first served, what comes first is handled first; the next request in line will be executed once the one before it is complete.

FCFS is also known as first-in, first-out (FIFO) and first come, first choice (FCFC)

Disadvantage of FCFS scheduling:

1. The process with less execution time suffer i.e. waiting time is often quite long.
2. Favors CPU Bound process then I/O bound process.
3. Here, first process will get the CPU first, other processes can get CPU only after the current process has finished it's execution. Now, suppose the first process has large burst time, and other processes have less burst time, then the processes will have to wait more unnecessarily, this will result in more average waiting time, i.e., Convey effect.
4. This effect results in lower CPU and device utilization.
5. FCFS algorithm is particularly troublesome for time-sharing systems, where it is important that each user get a share of the CPU at regular intervals.

b)



Gannt chart

We know that

Waiting Time(WT)=starting time-arrival time

Turn around Time(TT)=burst time+waiting time

Now,

process	AT	BT	WT
P1	0	18	0-0=0
P2	1	3	18-1=17
P3	2	3	21-2=19

Now ,Average waiting time=(0+17+19)/3=12 unit

Turn around Time=Burst Time+Waiting Time

So Average Turn around Time=(18+20+22)/3=20 unit

c)

Differences between preemptive and non-preemptive scheduling are given bellow:

1. The basic difference between preemptive and non-preemptive scheduling is that in preemptive scheduling the CPU is allocated to the processes for the limited time. While in Non-preemptive scheduling, the CPU is allocated to the process till it terminates or switches to waiting state.

2.The executing process in preemptive scheduling is interrupted in the middle of execution whereas, the executing process in non-preemptive scheduling is not interrupted in the middle of execution.

3.Preemptive Scheduling has the overhead of switching the process from ready state to running state, vise-verse, and maintaining the ready queue. On the other hands, non-preemptive scheduling has no overhead of switching the process from running state to ready state.

4.In preemptive scheduling, if a process with high priority frequently arrives in the ready queue then the process with low priority have to wait for a long, and it may have to starve. On the other hands, in the non-preemptive scheduling, if CPU is allocated to the process with larger burst time then the processes with small burst time may have to starve.

5.Preemptive scheduling is quite flexible because the critical processes are allowed to access CPU as they arrive into the ready queue, no matter what process is executing currently. Non-preemptive scheduling is rigid as even if a critical process enters the ready queue the process running CPU is not disturbed.

6.The Preemptive Scheduling is cost associative as it has to maintain the integrity of shared data which is not the case with Non-preemptive Scheduling.