

Operating systems

Sheet2

(EED)

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1-What are the areas of services provided by the OS? Describe briefly 3 of those?

ANSWER)

- Program development:
Editors, debuggers, frameworks
- Program execution:
Firstly, load the program in the main memory, initialize the I/O device, then do scheduling resources to serve different processes.
- Access I/O devices:
Provides interface to be able to access I/O devices.
- Controlled access to files:
operating systems control access to files through various mechanisms to ensure security and data integrity.
- System access:
Operating systems play a crucial role in managing access to system resources, including files, hardware devices, and network connections.
- Error detection and response:
The operating system clears the errors and respond report or end program.
- Accounting:
Statistics to monitor performance to be able to manage resources effectively.

2- What is the OS kernel? Where is it saved?

ANSWER)

Os kernel is containing the most frequently used functions, it's stored in main memory and the rest in the storage (less used functions).

3-What are the resources managed by OS?

ANSWER)

1. Processor (CPU)
2. I/O devices
3. Main memory
4. Storage devices
5. Processes & threads

Os manages all this resources to get maximum utilization of resources.

4-Why are two modes (user and kernel) needed?

Two modes are needed in operating systems to provide a balance between system security and efficiency.

In user mode:

User program executes in user mode, Certain areas of memory protected from user access & Certain instructions.

In kernel mode:

Monitor executes in kernel mode, Privileged instructions may be executed & all memory accessible.

5-What is time slicing?

ANSWER)

Time slicing is a scheduling technique used by operating systems to allocate CPU time to multiple users in a fair and efficient manner. In systems that support time sharing, where users processes compete for CPU resources, time slicing ensures that each user gets a fair share of CPU time for execution.

6- Define the essential properties of the following types of systems?

Serial:

Programmers interact with hardware manually, tasks are executed sequentially, it's simple design with low overhead.

Batch:

In Batch systems tasks are executed in batches, batch system is good if less interaction needed.

Multiprogramming:

In multiprogramming processor executes many programs simultaneously with a single processor by rapidly switching between them, processes share the time of CPU.

Time sharing systems:

Time sharing systems Supports interactive user sessions, CPU time divided into time slots, processor switches among users in a high speed.

Real-time systems:

Real-time systems are used in a dedicated application and must respond within a fixed amount of time to ensure correct performance, so it has timing constraints.

7-In a batch operating system, three jobs are submitted for execution. Each job involves an I/O activity, CPU time, and another I/O activity of the same time span as the first. Job JOB1 requires a total of 23 ms, with 3 ms CPU time; JOB2 requires a total time of 29 ms with 5 ms CPU time; JOB3 requires a total time of 14 ms with 4 ms CPU time. Illustrate their execution and find CPU utilization for uniprogramming and multiprogramming systems?

JOB1: total time = 23 ms, CPU time = 3 ms.

JOB2: total time = 29 ms, CPU time = 5 ms.

JOB3: total time = 14 ms, CPU time = 4 ms.

Uniprogramming:

Job1 i/o 10ms

Cpu 3ms

i/o 10ms

Job2 i/o 12ms

Cpu 5ms

i/o 12ms

Job3 i/o 5ms

Cpu 4ms

i/o 5ms

utilization= $12/66 \times 100\% = 18.1818\%$

multiprogramming

JOB1: execute i/o 10 ms

JOB2: execute i/o 12 ms

JOB3: execute i/o 5ms wait 5ms

JOB3: 4 ms cpu wait 4ms

JOB3: 5 ms i/o wait 1ms

JOB1: 3 ms cpu wait 3ms

JOB1 :10ms i/o

JOB2: 5 ms cpu wait 1ms

Job3: exit wait 4ms

Job2: 12 ms i/o wait 5ms

Job1: exit wait 7ms

Job2: exit

utilization= $12/30 \times 100\% = 40\%$

8-With many jobs running at the same time, Errors are very hard to be reproduced, due to the absence of some systematic means of coordination and cooperation among activities, describe the main 4 types of such errors?

ANSWER)

- **Improper synchronization:**

Improper design of signaling mechanism may cause signals loss or duplication.

- **Failed mutual exclusion:**

It happens due to sharing resources at the same time.

- **Non-determinate program operation:**

This error happens when programs overwrite common memory as they are sharing memory.

- **Deadlocks:**

Happens when Two or more programs hang waiting for each other.

9-What are the main 3 components of a process?

ANSWER)

1. Executable program
2. The associated data needed by the program.
3. The execution context

10- List and briefly explain five storage management responsibilities of a typical OS?

1-Process isolation: The OS must prevent processes from interfering with each other, both data and instructions.

2-Automatic allocation and management: Programs should be dynamically allocated across the memory hierarchy as required.

3-Support of modular programming: Programmers should be able to define program modules.

4-Protection and access control:

The OS must allow portions of memory to be accessible in various ways by various users.

Long-term storage: Many application programs require means for storing information for extended periods of time after the computer has been powered down.

11-What 3 factors must be considered by any resource allocation and scheduling policy?

1- Fairness:

Give equal and fair access to resources.

2-Differential responsiveness:

Discriminate among different classes of jobs.

3- Efficiency:

Maximize throughput, minimize response time.

12-Suppose we have four jobs in a computer system, in the order JOB1, JOB2, JOB3 and JOB4. JOB1 requires 8 s of CPU time and 8 s of I/O time; JOB2 requires 4 s of CPU time and 14 s of disk time; JOB3 requires 6 s of CPU time; and, JOB4 requires 4 s of CPU time and 16 s of printer time. Define the following quantities for system utilization:

- **Turnaround time = actual time to complete a job**
- **Throughput = the average number of jobs completed per period T**
- **Processor utilization = percentage of time that the processor is active (not waiting) Compute these quantities (with illustrations if needed) in each of the following systems:**
 - a. A uniprogramming system, whereby each job executes to completion before the next job can start its execution.**

Turn around time:

$$\text{Job1} = 8 + 8 = 16\text{s}$$

$$\text{Job2} = 4 + 14 = 18\text{s}$$

$$\text{Job3} = 6\text{s}$$

$$\text{Job4} = 4 + 16 = 20\text{s}$$

$$\text{total time} = 16 + 18 + 6 + 20 = 60\text{s}$$

$$\text{Throughput} = 4/60 = 1/15$$

$$\text{Processor utilization} = 22/60 * 100\% = 36.67\%$$

b. A multiprogramming system that follows a simple round-robin scheduling. Each process gets 2 s of CPU time turn-wise in a circular manner?

Turn around time:

Job1=22+8=30s

Job2=12+14=26s

Job3=20s

Job4=16+16=32s

total time=32s

Throughput=4/32=1/8=0.125

Processor utilization=22/32*100%=68.75%

13- Explain the difference between a monolithic kernel and a microkernel?

A monolithic kernel consolidates all essential operating system functionalities, such as process management, memory management, and device drivers, within a single address space, enabling fast communication between components but potentially leading to larger kernel size and less modularity.

In microkernel

it delegates only essential functions like memory management to the kernel, with other services running as user-level processes, resulting in a smaller and more modular kernel design.

14-Distinguish between multiprogramming and multiprocessing. What are the key motivations for the development of each?

Multiprogramming: involves running multiple programs concurrently on a single processor by rapidly switching between them, utilizing idle CPU time for efficient resource utilization and improved throughput.

Motivation to use multiprogramming is to maximize the processor utilization.

Multiprocessing: involves running multiple processes concurrently on multiple processors or cores allowing true parallel execution of tasks. The motivation for multiprocessing is to improve system performance and scalability by distributing tasks among multiple processors.

15-Describe 2 techniques used by OS to support fault tolerance?

Process isolation: processes are generally isolated from one another in terms of main memory, file access, and flow of execution.

Virtual machines: Virtual machines provide a greater degree of application isolation and hence fault isolation. Virtual machines can also be used to provide redundancy, with one virtual machine serving as a backup for another.

16- Describe 2 ways of extracting parallelism from computing workloads?

Parallelism within Applications: Most applications can, in principle, be subdivided into multiple tasks that can execute in parallel.

Virtual Machine Approach: involves emulating a complete hardware environment within software, enabling the execution of multiple OS instances concurrently on a single physical machine.