KATHMANDU UNIVERSITY
End Semester Examination [C]
December, 2024

Marks Scored:

Level : B.E./B.Sc.
Year : III

Course : COMP 307
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 20 DEC 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle in the most appropriate option:

1. Which of the following scheduling algorithms can result in starvation?
   a. First-Come, First-Served (FCFS)
   b. Round-Robin
   c. Shortest Job First (SJF)
   d. Priority Scheduling with aging

2. In a distributed system, which transparency hides the location of resources?
   a. Replication Transparency
   b. Access Transparency
   c. Location Transparency
   d. Failure Transparency

3. What is the main purpose of a virtual machine monitor (VMM)?
   a. Managing physical resources directly
   b. Translating virtual addresses to physical addresses
   c. Enabling multiple operating systems to run on the same hardware
   d. Scheduling real-time tasks

4. Which condition is necessary for a deadlock to occur?
   a. Circular Wait
   b. No Preemption
   c. Hold and Wait
   d. All of the above

5. In the Banker's Algorithm, the system is in a safe state if:
   a. It can allocate resources to each process without running into a deadlock.
   b. There is at least one process that can complete.
   c. All available resources are exhausted.
   d. No process is waiting.

6. Which of the following is true for segmented memory management?
   a. Each segment has the same length.
   b. Segments are contiguous in physical memory.
   c. External fragmentation can occur.
   d. It uses fixed-size partitions.

7. Which scheduling algorithm is most suitable for a time-sharing system?
   a. Shortest Job First (SJF)
   b. First-Come, First-Served (FCFS)
   c. Round-Robin
   d. Priority Scheduling

8. In a paging system, what is the purpose of the Translation Lookaside Buffer (TLB)?
   a. Store the page table in main memory
   b. Cache recently accessed page table entries
   c. Translate logical addresses to physical addresses directly
   d. Handle page faults

9. Which disk scheduling algorithm is often referred to as the "elevator algorithm"?
   a. FCFS
   b. SCAN
   c. LOOK
   d. C-SCAN

10. Thrashing occurs when:
    a. CPU is underutilized due to many processes being in the waiting state.
    b. Too many processes are in the ready queue.
    c. The system spends more time paging than executing processes.
    d. Deadlocks are not detected.

11. What is the purpose of the fork() system call in UNIX?
    a. To create a new process
    b. To terminate the current process
    c. To request memory allocation
    d. To execute a new program

12. In inter-process communication (IPC), which method allows processes to synchronize by using signals?
    a. Message passing b. Semaphores c. Shared memory d. Pipes

13. Which of the following is not a valid file access method?
    a. Sequential Access
    b. Random Access
    c. Indexed Access
    d. Real-Time Access

14. In the context of distributed systems, what is a "distributed mutual exclusion"?
    a. A system where processes on different machines share a common clock
    b. Ensuring that only one process accesses a shared resource at a time across different machines.
    c. Replicating resources to avoid access conflicts.
    d. A method to synchronize threads within a single process.

15. Which of the following techniques is used for deadlock prevention?
    a. Killing one of the processes involved
    b. Releasing resources in a particular order
    c. Allowing circular wait conditions
    d. Granting all requested resources simultaneously

16. In a multi-threaded environment, which of the following models allows one-to-one mapping of user threads to kernel threads?
    a. Many-to-One b. One-to-One c. Many-to-Many d. Hybrid

17. In memory management, which type of address is generated by the CPU?
    a. Physical address b. Logical address c. Effective address d. Absolute address

18. Which component of an operating system performs context switching?
    a. Memory Manager
    b. Process Scheduler
    c. Device Driver
    d. File System Manager

19. The main disadvantage of using a linked allocation for file storage is:
    a. High memory overhead
    b. Difficulty in accessing a file randomly
    c. Inefficient disk space utilization
    d. Complexity of file deletion

20. Which of the following is true for a real-time operating system (RTOS)?
    a. Processes are executed in a first-come, first-served manner.
    b. Meeting deadlines is more critical than system throughput.
    c. They are not suitable for embedded systems.
    d. They avoid using priority scheduling.

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F. M. : 50

SECTION "B"
[6 Q. × 4 = 24 marks]

Attempt ANY SIX questions.

1. Given the following processes with their burst times, calculate the average waiting time using the **Shortest Job First (SJF)** scheduling algorithm:
   - Processes: P1, P2, P3, P4
   - Burst Times: 6, 8, 7, 3

2. Explain the key differences between **multiprogramming** and **time-sharing systems**. What are the main advantages and challenges of each approach?

3. Consider a system with five processes P0 through P4 and three resources of type A, B, C. Resource type A has 10 instances, B has 5 instances and type C has 7 instances. Suppose at time t0, the following snapshot of the system has been taken:

Process	Allocation	Max	Available
	A B C	A B C	A B C
P_0	0 1 0	7 5 3	3 3 2
P_1	2 0 0	3 2 2	
P_2	3 0 2	9 0 2	
P_3	2 1 1	2 2 2	
P_4	0 0 2	4 3 3	

   a. What will be the need matrix?
   b. Is the system in a safe state? If Yes, then what is the safe sequence?

4. Describe the role of **system calls** in an operating system. Provide examples of **process control** and **file management** system calls.

5. Consider a system with **4 frames** and the reference string **1, 3, 0, 3, 5, 6, 3, 0, 3, 7**. Calculate the number of page faults using the **FIFO page replacement algorithm**.

6. Explain the structure and functioning of the **Kernel I/O subsystem**. What are the main differences between **blocking** and **non-blocking I/O**?

7. What are the primary challenges in designing a **distributed operating system**? Discuss the importance of **transparency** in distributed systems.

P.T.O.

SECTION "C"

[2 Q. × 8 = 16 marks]

Attempt ANY TWO questions.

8. Explain the concept of **paging** in memory management. Given the logical address **0x3F4** and the following page table, calculate the corresponding **physical address**:
   - Page Size: 512 bytes
   - Page Table:
     - Page 0: Frame 3
     - Page 1: Frame 5
     - Page 2: Frame 1

9. Describe the structure and functionalities of a **directory** in a file system. Compare and contrast **single-level**, **two-level**, and **tree-structured directories** with examples.

10. Discuss **inter-process communication (IPC)** and its importance. Explain the **Producer-Consumer problem** using **semaphores**. Provide a code snippet to illustrate the solution.