Operating System
Capstone Assignment

Ayush Gupta
2301010206
BTech CSE (Core)

Ans1) OS Reliance: Modern System rely on OS for abstractions that manage complex hardware and simplify programming.
→ Process, Memory, I/O management : OS provides process abstraction Virtual Memory abstraction, and I/O abstraction (via drivers).

Ans2) OS Structure: Microkernel is best for a distributed web application.
→ Justification: High reliability and maintainability due to modular design, where service failures don't crash the minimal kernel.

Ans3) Thread Efficiency: Correct Threads are more efficient than processes.
→ Reason: Thread share the processor's address space. Context switching is faster and resource usage is lower than creating a new Process Control Block (PCB).

Ans4) Memory Allocation (Processes: 12MB, 18MB, 6MB: Block: 20 MB, 10 MB, 15MB).
→ First-fit: P1 (20MB), P3 (15MB). P2 (18MB) unallocated. High internal (17MB) and External (19MB) fragmentation
→ Best-fit: P1 (15MB), P2 (20MB), P3 (10MB). All allocated. Low internal (9MB) fragmentation.

Ans5) Scheduling (P_1: 5ms @0, P_2: 3ms @1, P_3: 8ms @2, P_4: 3ms @3)
• Gantt Charts
→ FCFS = |P_1 (5) | P_2 (3) | P_4 (3) | P_3 (8) | Total (19).
→ RR (q=4): |P_1 (4) | P_2 (3) | P_3 (4) | P_4 (3) | P_1 (1) | P_3 (4)|
(Total 19)

Avg Times: SJF has the lowest Average waiting Time (4.5 and Turn around Time (9.25ms).

- Best Balance: SJF: Best Balance of throughput (low ATT) and efficiency.

Ans6) Deadlock in Banking:

a) Banker's Algorithm: Checks if granting a lock request leaves the system in a safe state, preventing the dangerous condition Requires knowing maximum needs.

b) Detection and Recovery: Detect deadlocks by checking for cycles in the wait-for graph (WFG). Recover by selecting a victim transaction and performing rollback / termination.

Ans7) Producer - Consumer with semaphores.

→ use mutex for mutual exclusion when accessing the buffer capacity for the producer, full counts items for the consumer.

Ans8) Page Replacement:

→ FIFO: 3 page faults (Replace the oldest page: 2, 1, 4, 2, 3 (replaces 2), 4 (replaces 1), 3)

→ LRU: 5 page faults (Replace the ~~too~~ least recently used page: 2, 1, 4, 2, 3 (replaces 1), 4 (replaces 2), 3).

Ans 9) Distributed File System:

a) Critical Issues: Cache Coherence (ensuring all copies of a file are consistent) and Transparency / Naming (providing a unified, location-Independent file view).

b) Architectural Approaches: Client Server Model (eg:- NFS, using client caching for speed) and clustering / symmetric Distribution (for high parallelism and fault tolerance.

Ans 10) Synchronous Checkpointing:

→ Mechanism: All processes coordinate and stop to take a local checkpoint simultaneously, creating a single consistent global state for failure recovery.

→ Evaluation strength - Guaranteed consistency. Weakness - High overhead and low performance due to required coordination.

Ans 11) Smart Home Design:

a) Scheduling Strategy: Preemptive Priority Scheduling.
Justification: Prioritizes mission-critical task by immediately interrupting low priority tasks to ensure real-time responsiveness.

b) IPC methods:

→ Shared Memory: Used for high throughput data transfer (eg:- raw sensor data) due to speed and minimal system calls.

(4)

→ Message passing :- suitable for distributed / loosely coupled device communication and control commands.

Ans12) LINUX Case Study (System Call):

→ System Call: Using python's os.open() (which map to the linux open() system call) to create a file.

→ Relevance: Demonstrate the OS's system Interface - which forces a mode switch from user mode to kernel mode to execute privileged operations (like disk access), ensuring resource protection and controlled hardware access.

Satinder
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