

8.6/10

# COSC 450 Operating System Mini-Test #1

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## Short answer questions

- a) (0.4 pt.) A device controller is responsible for managing a specific type of I/O device. What is in charge of the device controller?

-1/4 X A piece of software called a device driver that is managed by the OS. Each I/O device has a device controller and a unique device driver.

- b) (0.4 pt.) What are five layers of an operating system we discussed during class?

- 0
- a. Memory management ✓
  - b. File management ✓
  - c. I/O management ✓
  - d. Process (thread) management ✓
  - e. Deadlock management ✓

- 0 c) (0.4 pt.) What is Von Newmann Bottleneck? – fetch cycle is slower than execute cycle, as in, data transfer slower than computation

- 1/4 Δ d) (0.4 pt.) A CPU composed with several components: ALU, control unit registers. Program counter is one of registers in CPU. What is the role of program counter – denoted as PC, the program counter points to the ~~memory~~ virtual address of the next ~~set~~ of instructions

- ✓ e) (0.4 pt.) What is **Batch System** in the second-generation computer? – Similar jobs are grouped together in a batch to perform similar tasks

- 1/4 Δ f) (0.4 pt.) What is **multiprogramming**? – multiple instruction sets are loaded into memory (RAM) at a time so that the instructions, loaded into IR, can be executed concurrently. Short-term scheduler quickly goes between tasks. multiple process

- g) (0.4 pt.) A CPU is composed of several components: ALU, Control Unit, Cache, and Registers. Depending on the architecture, CPUs may have varying numbers and types of registers, such as General Registers, Program Counter, Stack Pointer, Program Status Word, and so on. What is the role of Stack Pointer?

-1/4 X The stack pointer is a pointer to a virtual address at the top of the stack, <sup>1</sup> that address being to currently running process

h) (0.4 pt.) What is the reaction of operating system when the CPU is interrupted by any I/O devices?

Once interrupted, the OS stops the current process and moves to fixed location of interrupt service routine for execution, handles the interrupt (checks it), checks for errors, then goes back to the previous task prior to interruption.

i) (0.4 pt.) What is a role of interrupt-request line?

Recognize and handle an interrupt signal by catching the signal accessing the pointer table (interrupt vector), then has OS handle interruption by executing interrupt service routine at the vector index.

j) (0.2 pt.) The form of interrupt-driven I/O is fine for moving small amounts of data but can produce high overhead when used for bulk data movement. What is the solution to reduce the overhead?

Direct Access Memory (DMA)

k) (0.4 pt.) Why deadlocks between processes are necessary, if OS do not take care of deadlock?

Processes can get stuck in a blocked state as processes share resources, and when running concurrently can conflict, and cause an indefinite wait for a shared resource.

l) (0.4 pt.) Microkernel is one of the operating system structures. Briefly explain the basic idea of the microkernel. Each layer of the OS has a microkernel of its own, but only one can use kernel mode to execute instruction and the rest use user mode.

m) (0.4 pt.) What are three main functions for OS to control each of I/O devices

1. Recognize an interrupt signal (check for signal)
2. Handle interrupt signal by going to interrupt routine and servicing request
3. Executions
4. Handle errors and return to process

n) (0.4 pt.) What are four necessary conditions for a deadlock?

1. Mutual exclusion
2. Wait cycle
3. Wait status
4. Recursion

o) (0.4 pt.) Adding additional CPU to a multiprocessor system will increase computing power. Why adding many CPU will cause performance degrade?

Increasing CPUs in a multiprocessor will increase computer power such that for every  $n$  additional CPUs, there is less than  $n$  increase in performance due to immense overhead to communicate between the CPUs. Eventually, the bus will become overwhelmed with data transfers for overhead and cause severe latency, degrading performance.

- p) (0.4 pt.) What is the potential drawback in non-Uniform memory access in multi-processor system?

Increased latency can hinder performance due to accessing virtual memory, rather than direct local memory

- q) (0.4 pt.) Explain briefly Asymmetric and Symmetric clustering

- **Asymmetric clustering** - All devices in cluster work together to perform tasks, except for one device which is in host standby mode and will check/handle errors
- **Symmetric clustering** - Every device in a cluster works simultaneously and checks its neighbor for errors and will handle a fail

- r) (0.4 pt.) What are the three major activities of OS with regard to memory management?

1. Check what memory is being used/accessed
2. memory allocation and deallocation / data transfers to IR / memory requests
3. freeing up memory space when finished

- s) (0.4 pt.) An operating system for a computer is responsible for activities for secondary storage management. List five activities you can think of.

1. mounting and unmounting
2. Protection
3. allocation and deallocation
4. free-space
5. Partitioning
6. disk management

- t) (0.4 pt.) Most CPUs feature two interrupt request lines: the non-maskable interrupt line (NMI) and the maskable interrupt line. Let's briefly explore both.

- Non-maskable interrupt line - errors 0-31, hardware error signals
- Maskable interrupt line - errors 32-255, interrupt signals such that i/o devices request service



u) (0.4 pt.) What are three components for an most of I/O device? –

1. mechanical component (physical device)
2. electrical component (connection)
3. software component (device driver)

v) (0.4 pt.) What is **Spooling**?

Spooling is when process instructions and related information is temporarily stored in a file to later be executed. This optimizes execution while waiting for slow devices such as Network printers

w) (0.4 pt.) An operating system keeps a process table for each process. Name four contents of process table.

1. Scheduling information
2. Status
3. I/O requests
4. memory allocation
5. pointer to next process

x) (0.4 pt.) What are three main functions of OS for supporting multiprogramming?

1. Fetch – get needed instructions (RAM) and load to IR, update PC
2. Decode – Convert to machine language, ready to process
3. Execute – compute and execute instructions

process Scheduling, memory allocation/deallocation, and error handling is also important

y) (0.4 pt.) Why a CPU performance can be improved by using pipelined design?

It uses the instruction cycle in a looping and layered way, such that it uses Fetch, decode, and execute to minimize bottleneck

z) (0.4 pt.) **Timesharing**

multiple monitors are connected to a single device and share the computational resources. The CPU is scheduled time incrementally to speed on the tasks (process) completions requested one one end and once the time is up, it comes to the next scheduled process