

COSC 450 Operating System Mini-Test #1

09/12/2024

Name:_____.

(Each question is worth 0.4 points)

1. **Third-generation computers employed three techniques to improve CPU utilization. What are these three techniques?**

Answer) Multiprogramming, spooling, and time-sharing.

2. **Why does the von Neumann bottleneck occur?**

Answer) The CPU processes data faster than it can be transferred between memory and the CPU.

3. **What is the 'throughput' in a computer system?**

Answer) the number of units of information a system can process in a given amount of time.

4. **What is multiprogramming, and how does it contribute to CPU utilization in third-generation operating systems?**

Answer) Multiprogramming is a technique where multiple programs are loaded into memory and executed by the CPU. It improves CPU utilization by allowing the CPU to switch between programs, ensuring that it is always working and not left idle during input/output operations.

5. **What three components make up a modern general-purpose computer system?**

Answer) A modern general-purpose computer system consists of **one or more CPUs**, **memory**, and **several I/O devices**, all connected through a common bus that allows communication between I/O devices and shared memory.

6. **What is the role of a device controller in a modern computer system?**

Answer) A device controller is responsible for controlling a specific type of I/O device, managing data movement between the device and its local buffer storage, and interacting with the system's shared memory through the bus.

7. **What local resources does a device controller typically maintain?**

Answer) A device controller typically maintains **local buffer storage** and a set of **special-purpose registers** to assist in controlling data transfer between peripheral devices and its local buffer.

8. What is role of Process Table?

Answer) When a process changes state from running state to block state or ready state, the operating system saves all necessary information to its Process Table to continue the process from where it left off when it resumes execution

9. How does the pipelined design in CPUs improve performance?

Answer) A pipelined design improves CPU performance by allowing the CPU to perform multiple stages (fetch, decode, and execute) simultaneously. While one instruction is being executed, another instruction can be decoded, and a third can be fetched.

10. Describe the process of reading data from an I/O device to RAM by device controller.

Answer) When reading data, the device controller transfers data from the I/O device to its local buffer. After the data transfer is complete, the controller checks for any errors, and then informs the device driver that the data is ready to be processed by the operating system by interrupt.

11. What happens when the CPU receives an interrupt signal?

Answer) When the CPU receives an interrupt signal, it stops its current task and immediately transfers execution to a fixed location where the interrupt service routine is located. After handling the interrupt, the CPU resumes the interrupted computation

12. There are two types of events typically trigger interrupts in a computer system. What are these?

Answer) Interrupts can be triggered by **device controllers** (such as I/O devices) or **hardware faults** (such as memory or processing errors).

13. What is the purpose of the interrupt vector table, and where is it located?

Answer) The interrupt vector table is used by the operating system to store pointers to interrupt service routines. This table allows the CPU to quickly locate and execute the appropriate service routine when an interrupt occurs. It is typically stored in low memory to ensure fast access.

14. How do modern computers ensure that the most urgent tasks are handled first when multiple interrupts occur?

Answer) Modern computers use a system of interrupt priorities to ensure that the most urgent interrupts are handled first.

15. What is the purpose of Direct Memory Access (DMA), and how does it solve the problem of high overhead in bulk data movement?

Answer) DMA (Direct Memory Access) allows data to be transferred directly between an I/O device (such as a disk drive) and system memory without involving the CPU. This reduces

overhead and speeds up the overall operation of the system, particularly when handling bulk data transfers.

16. What is Symmetric Multiprocessing (SMP) in a multiprocessor system?

Answer) Each CPU has its own set of registers and possibly cache memory. Each CPU performs all tasks including OS functions and user processes. All processors share a common physical memory over the system bus.

17. What is Non-Uniform Memory Access in a multiprocessor system?

(Answer) Each CPU has its own local memory that is accessed via a small, fast local bus. CPU are connected by a shared system interconnect, so that all CPUs share one physical address space.

18. There are two types in clustered system Asymmetric and Symmetric clustering. What is Asymmetric clustering?

Answer) In Asymmetric clustering, one machine is in hot-standby mode. Hot-standby host machine does just monitor the active server. If that server fails, the hot-standby host becomes the active server

19. There are two types in clustered system Asymmetric and Symmetric clustering. What is Symmetric clustering?

Answer) In Symmetric clustering, two or more hosts are running application and monitoring each other. This model is more efficient but it does require that more than one application be available to run.

20. What are four necessary conditions for a deadlock?

Answer)

- a. Mutual exclusion
- b. Circular Wait
- c. Hold and Wait
- d. No Preemption

21. What is the potential drawback in non-Uniform memory access in multi-processor system?

Answer) Increased latency when a CPU must access remote memory across the system interconnect, creating a possible performance penalty

22. Operating System maintain a process table for each process. What is the role of process table?

Answer) The main role of the process table is to store and manage key information about each process, enabling the operating system to track, schedule, and control processes effectively

23. A process can be in one of three states: Running, Blocked (or Waiting), and Ready. Briefly explain each state.

Answer)

- **Running:** The process is currently being executed by the CPU.
- **Blocked (or Waiting):** The process is waiting for some event, such as I/O completion or resource availability, and cannot proceed.
- **Ready:** The process is prepared to run and is waiting for CPU time but is not currently being executed.

24. The microkernel is one type of operating system structure. Briefly explain the basic idea of a microkernel.

Answer) To achieve high reliability, OS is broken into small well-defined module. Only one module (Microkernel) run in kernel mode and the rest run as user mode.

25. What are the three main functions of the operating system to control I/O devices?

Answer)

- Issue I/O commands to devices.
- Catch interrupts from I/O devices.
- Handle errors during I/O operations.