

CSCI 4717 – Fall 2012: Sample SMP and Cache Coherence Questions

Multiprocessor System Concepts

1. For each of the examples listed below, identify which of the three configurations identified by Flynn's taxonomy (SISD, SIMD, or MIMD – MISD is not commercially applicable.)

SISD SIMD MIMD

☐	☐	☐	Weather modeling using a vector machine
☐	☐	☐	A load balancing cluster
☐	☐	☐	Our PIC32 processor boards
☐	☐	☐	Desktop machine with a single core processor
☐	☐	☐	Desktop machine with a multi-core processor

2. Multiple Instruction/Multiple Data Stream architectures are tightly coupled when: (select one)

- a.) they communicate over a local area network (LAN)
- b.) the network they are on is dedicated to the system, i.e., there is no other traffic
- c.) they share a single hard drive or RAID for storage across a network
- d.) they communicate through a shared memory
- e.) none of the above

3. Which Multiple Instruction/Multiple Data Stream architecture is better suited to processes that require a high level of interaction, loosely coupled or tightly coupled?

- a.) loosely coupled
- b.) tightly coupled

4. For each characteristic listed below, identify which SMP bus configuration is most closely associated with that characteristic, time shared (TS), multiport memory (MM), or central control (CC). **Each row will have only one checkmark.** (5 points)

TS MM CC

☐	☐	☐	has NO single point of failure besides the printed circuit, I/O, & power supply
☐	☐	☐	is most like the traditional uni-processor bus interface
☐	☐	☐	experiences the worst communication bottleneck of the three
☐	☐	☐	is the easiest to add additional processors to
☐	☐	☐	results in the most complex printed circuit board wiring
☐	☐	☐	is best able to take over an application from a failed CPU

5. Name one operating system characteristic that is unique to SMP operating systems.

6. List two of the six potential advantages of a symmetric multiprocessor (SMP) system over a cluster. (4 points)

7. List two of the four potential advantages of a cluster over a symmetric multiprocessor (SMP) system. (4 points)

Cache Coherence

8. Assume a multiprocessor system uses the MESI protocol. If the current state of a line in processor A's cache is ***invalid***, do valid copies of the data exist in other caches?
a.) yes b.) no c.) cannot tell
9. Assume a multiprocessor system uses the MESI protocol. If the current state of a line in processor A's cache is ***modified***, do valid copies of the data exist in other caches?
a.) yes b.) no c.) cannot tell
10. Assume a multiprocessor system uses the MESI protocol. If the current state of a line in processor A's cache is ***shared***, do valid copies of the data exist in other caches?
a.) yes b.) no c.) cannot tell
11. Assume a multiprocessor system uses the MESI protocol. If the current state of a line in processor A's cache is ***modified***, does a valid copy of the data exist in memory?
a.) yes b.) no c.) cannot tell
12. Assume a multiprocessor system uses the MESI protocol. If the current state of a line in processor A's cache is ***shared***, does a valid copy of the data exist in memory?
a.) yes b.) no c.) cannot tell
13. Assume a multiprocessor system uses the MESI protocol. If the current state of a line in processor A's cache is exclusive and processor B reads the same line into its cache, what is the new state of that line in processor A's cache?
a.) modified b.) exclusive c.) shared d.) invalid e.) cannot be determined
14. Assume a multiprocessor system uses the MESI protocol. If the current state of a line in processor A's cache is shared and processor A modifies that data, but does not write the new value to main memory, what is the new state of that line in processor A's cache?
a.) modified b.) exclusive c.) shared d.) invalid e.) cannot be determined
15. The snoopy protocol (distributed) is more suited to the _____ interconnection method for symmetric multiprocessors.
a.) time-shared bus b.) multiport memory c.) central controller