

CMSC 411 Sample Final Exam Questions

General instructions.

Be complete, yet concise. You may leave arithmetic expressions in any form that a calculator could evaluate.

1. Storage systems

- (a) Use the data in the following table to compute the average disk access time for one sector, in milliseconds.

average seek time	7 ms
transfer rate	8MB/sec
rotation speed	5000 RPM
sector size	2048 bytes
controller overhead	1 ms

- (b) What is the speedup for disk accesses if we use a disk with more tracks so that average seek time is 9ms, but the disk is faster, rotating at 9000 RPM and with a transfer rate of 10MB/sec?

2. Caches

We have a 500 MHz processor with 2 levels of cache, plus Main Memory. Assume that the first level cache contains separate instruction and data caches, while the second level cache is unified. The memory system has the following parameters:

	Hit Time	Miss Rate	Block Size
First-Level Cache	1 cycle	4% - Data 1% - Instructions	64 bytes
Second-Level Cache	20 cycles	2%	128 bytes
Main Memory	50 cycles	-	16 Kbytes

Finally, the bus parameters are as follows:

- L1 cache - L2 cache bus : 1 cycle / word
- L2 cache - Memory bus : 5 cycles / word

You can also assume that 1 word is 8 bytes.

(a) What is the average memory access time in nanoseconds for instructions?

(b) What is the average memory access time in nanoseconds for data reads?

3. CPU performance

Suppose we have the following instruction mix and clock cycles per instruction.

Instruction	Frequency	Cycles
ALU operations	40%	1
Load	15%	2
Store	10%	2
Branches	20%	3
Floating point operations	15%	6

Suppose our computer has the following specifications:

- CPU - 720MHZ
- Main Memory - 128MB

(a) What is the overall CPI of this machine?

(b) What is the MIPS rating of this machine?

(c) Consider improving this computer's performance by enhancing the speed of the floating point instructions. What is the best possible overall speedup that we could obtain?

4. Short answers

Each question should be answered in no more than three or four (not too long) sentences.

(a) Storage Systems

In a RAID system, why does using a single parity disk cause performance problems? Name one method for alleviating the performance problems. If one of the disks (data or parity) fails, what information is needed to reconstruct the data for a block-interleaved parity RAID system?

(b) Hardware ILP

What performance benefits can hardware-based speculation provide that branch prediction with dynamic scheduling cannot? What are the associated costs?

(c) Buses

Describe one advantage a synchronous bus has over an asynchronous bus, and one advantage an asynchronous bus has over a synchronous bus.

(d) Multiprocessors

Describe one feature that is shared between snooping and directory based multiprocessor cache coherence protocols. Also describe one difference between the 2 types of protocols.