

CS 351 Midterm 2 Review Quiz

Your name: _____

Notes:

- You must explain your answers to receive partial credit.
- You will lose points for incorrect extraneous information, even if the answer is otherwise correct.

Question 1 [25 points].

- a. Write the term that fits each definition.

A memory access that is satisfied by the cache.

A cache of page table entries.

The range of bits of a memory address that maps to a cache set.

- b. Name one advantage and one disadvantage of increasing a cache's block size (while keeping the amount of data stored constant):

Advantage of increased block size:

Disadvantage of increased block size:

(c) Explain the series of events that must occur if a program requests a virtual address that is not currently mapped to main memory.

(d) When is a handshaking protocol used? Why?

Question 2 [15 points].

(a) What is the average memory access time for the following memory system?

- Level 1 cache: 95% hit rate, 1-cycle hit time, 10-cycle miss penalty.
- Level 2 cache: 99% hit rate, 100-cycle miss penalty

You may assume that all memory accesses are hits in main memory.

(b) Assume that the L1 and L2 caches are write-allocate and write-through and that there is no write buffer. If W is the percentage of memory accesses that are writes, how many cycles (in terms of W) do write-through operations add to the average memory access time?

Question 3 [20 points].

A byte-addressable machine with 32-bit memory addresses has a cache with the following properties:

- 8-byte cache blocks
- 16KB of data in the cache
- 2-way set-associative
- Write-back

(a) How many cache blocks are there?

(b) How many cache sets are there?

(c) How many bits of **meta**data are required for each cache entry? Explain what each is for.

(d) How many bits are needed to implement the cache (data and metadata)?

Question 4 [15 points].

A byte-addressable memory system has 32-bit virtual addresses and 24-bit physical addresses, with 4KB pages.

(a) How many virtual pages does the system have?

(b) How many physical pages does the system have?

(c) How many page table entries are needed?

(d) How many bits (data and metadata) are needed for each page table entry?

(e) How many pages does the page table occupy?

Question 5 [10 points].

(a) Does a workload consisting of many small read accesses perform better on an N-disk RAID 1 system or an N-disk RAID 3 system, where N is the total number of disks (including the redundant ones)? **Explain** for credit.

(b) Is RAID0+1 better or worse than RAID1 in the following areas? **Explain** for credit.

Reliability:

Cost overhead:

Performance on small accesses:

Performance on large accesses:

Question 6 [15 points].

A workload consists of repeated CPU processing overlapped with 8KB disk transfers. The system has the following properties:

- The CPU processing step takes 10 ms
- The disk has an average seek time of 4 ms
- The disk rotates at 7200 rpm
- The disk's average transfer speed is 20 MB/s
- The disk's controller overhead is negligible.

(a) How long does it take the disk to do an 8K transfer?

(b) If you could purchase a faster disk for \$100 for a system dedicated to this workload, should you?