



York University
Lassonde School of Engineering
Dept. of Electrical Engineering and Computer Science
Fall 2016

EECS4201	Midterm	Computer Architecture
Tuesday, Nov. 1 st 2016		10:00 – 11:00

Last Name _____ First name _____

ID _____

Instructions to students:

- Answer all questions.
- Marks are shown in front of each question number.
- Show your work
- Be neat and clean while drawing your logic, block, or state diagrams.

This examination consists of **5** questions

Problem	Points
1	/4
2	/4
3	/4
4	/4
5	/4
Total	/20

Problem 1 (4 points)

Assume you have two choices in designing the L1 cache of your company's next super-duper processor:

- A. a 32KB 2-way associative cache with 16 bytes cache block
- B. a 32KB direct-mapped cache with 64 bytes cache blocks

The performance is very much the same; the number of transistors in the cache is the tie breaker (proportional to power consumption). Which cache you choose? Justify your answer.

Problem 2 (4 points)

A combined 64KB cache with one cycle access time and a miss rate of 2%. What is the average stall cycles per instruction if the miss penalty is 100 cycles and 30% of instructions are memory access?

Problem 3 (4 points)

A byte-addressable memory system has 48-bit virtual addresses and 32-bit physical addresses, with 8KB pages.

(a) How many virtual pages does each process's page table have?

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(b) How many physical pages does each process's page table 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?

Problem 4 (4 points)

What is the TLB? And how it is used?

Problem 5 (4.points)

Assume the following code

```
Loop: L.D      F0,0(R1)
      ADD.D    F4,F0,F2
      S.D      F4,0(R1)
      DADDUI   R1,R1,#-8
      BNE     R1,R2,Loop
```

Assume 3 cycles delay between producing and consuming FP numbers

1 cycle between loading a value and using it in an operation

2 cycles between producing FP value and storing it

1 cycle branch delay

1 cycle between calculating an integer and using it in a branch

How many cycles per iteration of the above loop without any changes?

Unroll the loop by a factor of 2. How many cycles per iteration? (You can rearrange instructions to minimize stalls)