

CMSC 411 Practice Exam 1

General instructions.

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

1. CPU performance

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

Instruction	Frequency	Cycles
ALU operations	30%	1
Load	20%	2
Store	10%	2
Branches	20%	3
Floating point operations	20%	5

- (a) What is the overall CPI of this machine?
- (b) If the CPU runs at 750MHz, what is the MIPS rating of this machine? For this question, count floating point operations in the MIPS rating.
- (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?

3. MIPS ISA

- (a) Suppose that `a` is stored in memory location 10, `b` is stored in memory location 20, and `c` is stored in memory location 30. Assume that all three variables are double word integers. Write MIPS assembly code equivalent to the following C code fragment:

```
a = 4;  
c = a + b;
```

Don't worry about the exact syntax of the MIPS instructions (but get the addressing mode right). However, you must make your intent for each instruction clear. Remember that there is no load immediate MIPS instruction, to put a constant in a register.

- (b) Give 2 reasons why the MIPS architecture can get away with only 2 addressing modes, immediate and displacement.

4. Basic pipelining

Consider the following MIPS code:

```
I1: DADD R1, R5, R3
I2: DADD R3, R1, R5
I3: SD    R5, 10(R1)
I4: DADD R5, R1, R3
```

Suppose we have the simple MIPS 5-stage pipeline from Appendix A in the book (and every instruction must go through all 5 stages).

- (a) Fill in the first pipeline table showing execution of the instructions assuming that no forwarding is available, then fill out the second table assuming that forwarding is available in the pipeline wherever it is needed.

Without forwarding

	1	2	3	4	5	6	7	8	9	10	11	12	13
I1	IF	ID	EX	MEM	WB								
I2													
I3													
I4													

With forwarding

	1	2	3	4	5	6	7	8	9	10	11	12	13
I1	IF	ID	EX	MEM	WB								
I2													
I3													
I4													

- (b) Show and classify all the potential data hazards (RAW, WAR, WAW). Which of the potential RAW data hazards are eliminated because of forwarding?