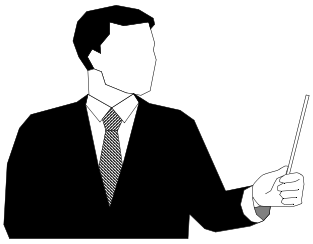
CS2214 COMPUTER ARCHITECTURE & ORGANIZATION SPRING 2010



EXAM I

110 MINUTES

WORK ALL PROBLEMS ***OPEN BOOK***

(55 pts)

1) Consider the following piece of EMY mnemonic machine language program :

400300	LW	R9, 0(R8)	# R8 initially has 10000000
400304	ANDI	R10, R9, 8000	
400308	BEQ	R10, R0, 3	
40030C	LUI	R11, FFFF	
400310	OR	R9, R11, R9	
400314	SW	R9, 0(R8)	
400318	ADDI	R8, R8, 4	
40031C	ADDI	R12, R12, $(-1)_{10}$	# R12 initially has 1
400320	BNE	R12, R0, $(-9)_{10}$	
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10000000	A5F2		

a) Obtain a table that shows the values of registers and memory locations used by the above piece of EMY code as shown in class. Also **show** the number of memory accesses made for each instruction. Determine what this piece of code does. That is, what is its **purpose** ?

b) Convert the mnemonic machine language instructions in locations 400304 - 400310 to machine language instructions. That is, **clearly** show the **four** instructions in terms of **1s** and **0s**.

c) Invent a new EMY instruction that implements the instructions in locations 400304 - 400310 above : Indicate **only** the following : Its syntax, semantics, format and the memory accesses made. Then, rewrite the above code starting at 400000 so that the **new** EMY instruction is used.

(35 pts)

2) Consider the following pseudoinstruction in the mnemonic machine language notation :

MULTM Rd, (Rs), (Rt) ===> (Rd, Rd + 1) ◄—— (M[Rs]) * (M[Rt])

Register Rd is stored the most significant bits of the multiplication result. For example :

MULTM R8, (R10), (R11) ===> (R8, R9) ◄—— (M[R10]) * (M[R11])

a) Implement the instruction

MULTM R8, (R10), (R11)

by using a few actual EMY instructions in the mnemonic notation. Your piece of code starts at 400A00. Use software conventions discussed in class. **Add** comments to your code.

b) Then, **obtain** a table that shows the values of registers and memory locations used by the piece of EMY code in part (a) as shown in class. Also **show** the number of memory accesses made for each instruction. Assume that R10 and R11 contain 10000000 and 10008000, respectively. Finally, assume that the numbers multiplied are 6 and 2.

c) Assume that this instruction is added to the EMY instruction set. **Indicate** its format, arguments, addressing modes, memory accesses made, etc. If there is a **new** addressing mode that is **not** discussed in class, indicate so.

d) Consider the following piece of EMY mnemonic machine language code that uses the **new** instruction :

```
400F00   MULTM   R8, (R10), (R11)
400F04   SW      R8, 0(R12)
400F08   ????
400F0C   ADDI    R10, R10, 4
400F10   ????
400F14   ADDI    R12, R12, 8
400F18   ADDI    R13, R13, (-1)10      # R13 has 1 initially
400F1C   BNE     R13, R0, (-7)10
```

Assume that R10, R11 and R12 contain 10000000, 10008000 and 1000A000, respectively. Also assume that the numbers multiplied are 6 and 2.

Determine the instructions in locations 400F08 and 400F10 in the code. **Explain** your decision for each instruction. **Determine** what this piece of code does ! That is, what is its **purpose** ?

(10 pts)

3) Convert the following decimal number to a **single-precision** IEEE-754-format FP number as shown **in class** such that all calculations are manual :

$$(134)_{10} = (?)_{\text{IEEE-754}}$$

Make sure to show **all** the intermediate steps.