Homework 5 Fall 2011 Solution

Problem 1 (4 Points):

PC – 32 bits
PC contains the address of the NEXT instruction to fetch.
MAR contains the address in memory that is to be read or written
These two registers work by having the contents of PC placed into the MAR so the address in memory containing an instruction can be loaded

IR – 64 bits
IR – contains the instruction that is currently being executed
MDR contains data that is to be read/written from/to memory
During a fetch cycle the contents of memory is placed into the MDR and then placed into the IR so it can be executed

Problem 2 (6 points):

1)  
x4400  AND R3, R3, #0
x4401  ADD R3, R3, R1
x4402  ADD R2, R2, #-1
x4403  BRp 0x4401 <-3>

2)  
Assume the contents of R1 are 2 and R2 is 2, the student can enter any value:

R1 = 2
R2 = 2

Start:
X4400: R1=2, R2=2, R3=0, CC=Z
X4401: R1=2, R2=2, R3=2, CC=P
X4402: R1=2, R2=1, R3=2, CC=P

X4401: R1=2, R2=1, R3=4, CC=P
X4402: R1=2, R2=0, R3=4, CC=Z

END

For a solution there will be R2 loops, or branches.

3)  
This algorithm performs a multiply operation: R3 ← R1xR2
**Problem 3 (5 points):**  
First convert the binary to assembly:

```
0x30FF    LEA R1, 0x1
0x3100    LDR R2, R1, 0x2
0x3101    TRAP 0x25 ;HALT, look at page 543
0x3102    ADD R2, R1, R1
0x3103    ADD R2, R2, R2
```

R1 $\leftarrow$ PC + 0x1 = 0x3100 + 0x1 = 0x3101
R2 $\leftarrow$ mem[R1 + 0x2] = mem[3103] – R2 $\leftarrow$ 0001 0100 1000 0010
Program halts, so R2 contain the data at 0x3103

R2 contains 0001 0100 1000 0010, or 0x1482, or ADD R2, R2, R2

**Problem 4 (5 points):**  
First, write the assembly of this:

```
0x3100    LEA R1, 32(0x20)
0x3101    LD R2, 32(0x20)
0x3102    LDI R3, 32(0x20)
0x3103    LDR R4, R2, 1(0x1)
0x3104    TRAP 0x25 ;HALT, look at page 543
...
0x3122    0x4566
0x3123    0x4567
...
0x4567    0xABCD
0x4568    0xFED3
```

Look at contents:

```
0x3100    R1 $\leftarrow$ 0x3101+ 0x20 = 0x3121
0x3101    R2 $\leftarrow$ mem[PC + 0x20] = mem[0x3102+0x20] = mem[0x3122] = 0x4566
0x3102    R3 $\leftarrow$ mem[PC+0x20]=mem[mem[3123]]=mem[0x4567]=0xABCD
0x3103    R4 $\leftarrow$ mem[R2+0x1] = mem[0x4566+0x1] = mem[0x4567] = 0xABCD
```

So:

R1 $\leftarrow$ 0x3121
R2 $\leftarrow$ 0x4566
R3 $\leftarrow$ 0xABCD
R4 $\leftarrow$ 0xABCD
**Problem 5 (4 points):**

Students are free to pick which registers they want.

a) Assume a move from R2 to R1:
   
   AND R1, R2, 0xFFFF
   or ADD R1, R2, 0x0

b) Clear R1:
   
   AND R1, R1, 0x0

c) Shift contents of R1 to the left by one bit, same as multiplying by 2:
   
   ADD R1, R1, R1

d) (AND R1, R1, R1) or (AND R1, R1, 0xFFFF) or (ADD R1, R1, 0x0)
   
   There could be other answers as well.
Problem 6 (6 points):

Students should have the HEX value of their initials entered starting at address 0x3000.