Homework 2 Answer

RELEASE DATE: 2015/10/19

DUE DATE: 2015/11/02 (Mon.) 12:10pm

- Please hand in your handwriting assignment after class.
- Each question is 10 point, and the total point is 100 point.
- **Please write the solution in detail and clearly for each question; otherwise, you will lose partial point.**
- Penalty for late parts:
  90% of value for one-day late, 80% two-day late,….

The following questions are from "Chapter 2 review problem" in "Computer Science: An Overview", 12th Edition by J. Glenn Brookshear.

4. What is the value of the program counter in the machine described in Appendix C immediately after executing the instruction B0CD?

Op-code: B → Jump ◦ If reg0 = reg0, the program counter would jump to the address **CD**.

7. The following are instructions written in the machine language described in Appendix C. Translate them into English.

a. 7123: **OR** the bit pattern in **reg2 &3**, and place the result in **reg1**.

b. 40E1: **MOVE** the bit pattern in **regE** to **reg1**.

c. A304: **ROTATE** the bit pattern in **reg3** one bit to the right **4** times, and place the lower-order end bit at the higher-order end.

d. B100: **JUMP** to instruction located in memory cell **00** if bit pattern in **reg1** equal to bit pattern in **reg0**. If not, nothing will be done and program execution would continue.

e. 2BCD: **LOAD regB** with the value **CD**.

9. Translate the following instructions from English into the machine language described in Appendix C.

a. LOAD register 6 with the hexadecimal value 77. → **2677**

b. LOAD register 7 with the contents of memory cell 77. → **1777**

c. JUMP to the instruction at memory location 24 if the contents of register 0 equals the value in register A. → **BA24**

d. ROTATE register 4 three bits to the right. → **A403**

e. AND the contents of registers E and 2 leaving the result in register 1. → **81E2** or **812E**

12. Suppose the memory cells at addresses 00 through 03 in the machine described in Appendix C contain the following bit patterns:

Address	Contents
00	26
01	55
02	C0
03	00

a. Translate the first instruction into English.

	PC	Machine Language	Instructions
1st	00	2655	**LOAD** the **reg6** with the value **55**.
2nd	02	C000	halt

b. If the machine is started with its program counter containing 00, what bit pattern is in register 6 when the machine halts?

reg 6 = 55 = **$(0101\ 0101)_2$**

17. Suppose the memory cells at addresses 00 through 0D in the machine described in Appendix C contain the following bit patterns:

Address	Contents
00	20
01	04
02	21
03	01
04	40
05	12
06	51
07	12
08	B1
09	0C
0A	B0
0B	06
0C	C0
0D	00

PC	ML	Instructions
00	2004	**reg0** = **04**
02	2101	reg1 = 01
04	4012	reg2 = reg1 = 01
06	5112	reg1 = reg1 + reg2 = 01+01 = 02
08	B10C	reg1 != reg0; continue;
0A	B006	reg0 = reg0 ; jump to address 06
06	5112	reg1 = reg1 + reg2 = 02+01 = 03
08	B10C	reg1 != reg0; continue;
0A	B006	reg0 = reg0 ; jump to address 06
06	5112	**reg1** = reg1 + reg2 = 03+01 = **04**
08	B10C	reg1 == reg0; jump to address 0c;
0C	C000	halt

Assume that the machine starts with its program counter containing 00.

a. What bit pattern will be in register 0 when the machine halts? reg0 = 04 = **$(0000\ 0100)_2$**

b. What bit pattern will be in register 1 when the machine halts? reg1 = 04 = **$(0000\ 0100)_2$**

c. What bit pattern is in the program counter when the machine halts?

PC = 0E = **$(0000\ 1110)_2$**

When the machine do the instruction, PC would move to the next address.

20. Suppose the memory cells at addresses 20 through 28 in the machine described in Appendix C contain the following bit patterns:

Address	Contents
20	12
21	20
22	32
23	30
24	B0
25	21
26	24
27	C0
28	00

PC	ML	Instructions
20	1220	**reg2** = mem20 = **12**
22	3230	**mem30** = reg2 = **12**
24	B021	reg0 = reg0; jump to address 21
21	2032	reg0 = 32
23	30B0	**memB0** = **reg0** = **32**
25	2124	**reg1** = **24**
27	C000	halt

Assume that the machine starts with its program counter containing 20.

a. What bit patterns will be in registers 0, 1, and 2 when the machine halts?
reg0 = 32 = **$(0011\ 0010)_2$**; reg1 = 24 = **$(0010\ 0100)_2$** ; reg2 = 12 = **$(0001\ 0010)_2$**

b. What bit pattern will be in the memory cell at address 30 when the machine halts?
mem30 = 12 = **$(0001\ 0010)_2$**

c. What bit pattern will be in the memory cell at address B0 when the machine halts?
memB0 = 32 = **$(0011\ 0010)_2$**

22. Suppose the memory cells at addresses 00 through 05 in the machine described in Appendix C contain the following (hexadecimal) bit patterns:

If we start the machine with its program counter containing 00, when does the machine halt?

Address	Contents
00	25
01	B0
02	35
03	04
04	C0
05	00

PC	ML	Instructions
00	25B0	reg5 = B0
02	3504	mem04 = reg5 = B0
04	**B0**00	Jump to address 00
00	25B0	reg5 = B0
02	3504	mem04 = reg5 = B0
04	**B0**00	Jump to address 00

The machine would never halt because C000 is replaced with B000

28. Suppose the following program, written in the machine language of Appendix C, is stored in main memory beginning at address 30 (hexadecimal). What task will the program perform when executed?

PC	ML	Instructions
30	2003	reg0 = 03
32	2101	reg1 = 01
34	2200	reg2 = 00
36	2310	reg3 = 10
38	1400	reg4 = mem00
3A	3410	mem10 = reg4 = mem00
3C	5221	reg2 = reg2+reg1 = 01
3E	5331	reg3 = reg3+reg1 = 11
40	3239	mem39 = reg2 = 01; 38: (1400→1401)
42	333B	mem3b = reg3 = 11; 3A: (3410→3411)
44	B248	reg2 != reg0; continue;
46	B038	reg0 == reg0; jump to address 38
38	1401	reg4 = mem01
3A	3411	mem11 = reg4 = mem01
3C	5221	reg2 = reg2+reg1 = 02
3E	5331	reg3 = reg3+reg1 = 12
40	3239	mem39 = reg2 = 02; 38: (1401→1402)
42	333B	mem3B = reg3 = 12; 3A: (3411→3412)
44	B248	reg2 != reg0; continue;
46	B038	reg0 == reg0; jump to address 38
38	1402	reg4 = mem02
3A	3412	mem12 = reg4 = mem02
3C	5221	reg2 = reg2+reg1 = 03
3E	5331	reg3 = reg3+reg1 = 13
40	3239	mem39 = reg2 = 03; 38: (1402→1403)
42	333B	mem3B = reg3 = 13; 3A: (3412→3413)
44	B248	reg2 == reg0; jump to address 48
48	C000	halt

2003
2101
2200
2310
1400
3410
5221
5331
3239
333B
B248
B038
C000

It copies the data from the memory cells at addresses 00, 01, and 02 into the memory cells at addresses 10, 11, and 12.

or

03 to be placed in Register 2; 13 to be placed in Register 3; 03 to be placed in the Memory cell whose address is 39; 13 to be placed in the Memory cell whose address is 3B.

34. Perform the indicated operations:

a. 111001 AND 101001

b. 000101 AND 101010

c. 001110 AND 010101

d. 111011 AND 110111

e. 111001 OR 101001

f. 010100 OR 101010

g. 000100 OR 010101

h. 101010 OR 110101

i. 111001 XOR 101001

j. 000111 XOR 101010

k. 010000 XOR 010101

l. 111111 XOR 110101

AND			OR			XOR		
Input 1	Input 2	Output	Input 1	Input 2	Output	Input 1	Input 2	Output
0	0	0	0	0	0	0	0	0
0	1	0	0	1	1	0	1	1
1	0	0	1	0	1	1	0	1
1	1	1	1	1	1	1	1	0

a. 101001
b. 000000
c. 000100
d. 110011
e. 111001
f. 111110
g. 010101
h. 111111
i. 010000
j. 101101
k. 000101
l. 001010

42. What would be the result of performing a 2-bit right circular shift on the following bytes represented in hexadecimal notation (give your answers in hexadecimal notation)?

a. 3F = $(0011\ 1111)_2$ = $(1100\ 1111)_2$ = **CF**

b. 0D = $(0000\ 1101)_2$ = $(0100\ 0011)_2$ = **43**

c. FF = $(1111\ 1111)_2$ = $(1111\ 1111)_2$ = **FF**

d. 77 = $(0111\ 0111)_2$ = $(1101\ 1101)_2$ = **DD**