COSC 290.003

Class Exercises #9

* + - 1. Consider the MARIE program below.

Hex Address Label Instruction Hexadecimal code for each instruction

100 Start, LOAD X 1 109

101 SUBT Y 4 10A

102 ADD Z 3 10B

103 STORE W 2 10C

104 CLEAR A 000

105 LOAD Y 1 10A

106 SUBT W 4 10C

107 STORE W 2 10C

108 HALT 7 000

109 X, HEX 00FF 00FF

10A Y, DEC 15 000F

10B Z, HEX 0010 0010

10C W, HEX 0000 0000

1. Draw the symbol table

| X | 109 |
| --- | --- |
| Y | 10A |
| Z | 10B |
| W | 10C |

1. What is the value store in the AC, X, Y, Z, W when the program terminates.

| AC | FF0F |
| --- | --- |
| X | 00FF |
| Y | 000F |
| Z | 0010 |
| W | FF0F |

1. Write the following code segment in MARIE’s assembly language.

If X < Y then

X = X \* Y

else

Y = X + Y + Z;

| Hex Address | Label | Instruction |
| --- | --- | --- |
| 100 | Start (If), | LOAD X |
| 101 |  | SUBT Y |
| 102 |  | SKIPCOND 000 |
| 103 |  | JUMP Else |
| 104 | Then, | LOAD Y |
| 105 |  | STORE CTR |
| 106 | Loop | LOAD Sum |
| 107 |  | ADD X |
| 108 |  | STORE Sum |
| 109 |  | LOAD Y |
| 10A |  | SUBT One |
| 10B |  | STORE Y |
| 10C |  | SKIPCOND 000 |
| 10D |  | JUMP Loop |
| 10E |  | LOAD Sum |
| 10F |  | STORE X |
| 110 |  | JUMP Endif |
| 111 | Else | LOAD X |
| 112 |  | ADD Y |
| 113 |  | ADD Z |
| 114 |  | STORE Y |
| 115 | Endif | Halt |
| 116 | One | HEX 0001 |
| 117 | Sum | HEX 0000 |
| 118 | X | Can be any numerical value |
| 119 | Y | Can be any numerical value |
| 11A | Z | Can be any numerical value |

1. Given the following program:

Address Instruction

100 Load X

101 Store Temp

102 JnS Subr / Store return address, jump to procedure

103 Store X

104 Load Y

105 Store Temp

106 JnS Subr / Store return address, jump to procedure

107 Store Y

108 Halt

109 X, Hex 10 /(IM ASSUMING THIS MEANS 000A16, NOT 0010)

10A Y, Hex 20 /(IM ASSUMING THIS MEANS 001416, NOT 0020)

10B Z, Hex 5

10C Temp, Hex 0

10D Subr, Hex 0 /Store return address here

10E Load Temp

10F Add Temp

110 subt Z

111 Jumpi Subr /Return to calling code

END

Provide a trace and give the contents (in **Hexadecimal** number) of PC **after execution of each instruction.** What are the values of X, Y, Temp, Subr after running of this program?

| **Instruction** | **PC** |
| --- | --- |
| Load X | 101 |
| Store Temp | 102 |
| JnS Subr | 10E |
| Load Temp | 10F |
| Add Temp | 110 |
| Subt Z | 111 |
| Jumpi Subr | 103 |
| Store X | 104 |
| Load Y | 105 |
| Store Temp | 106 |
| JnS Subr | 10E |
| Load Temp | 10F |
| Add Temp | 110 |
| Subt Z | 111 |
| Jumpi Subr | 107 |
| Store Y | 108 |
| Halt | 109 |

X: 000F16

Y: 002316

Temp: 001416

Subr: 010616

1. Write the following code segment in MARIE assembly language using given set of variables(symbols).

Sum = 0;

X = 5;

While X < 10 do

Sum = Sum + X;

X = X + 1;

**Assembly program:**

Load X

Add One

Store X

Loop, LOAD Sum

ADD X

STORE Sum

LOAD X

ADD One

STORE X

LOAD X

SUBT Ten

SKIPCOND 400

JUMP Loop

Endloop, Load Sum

Output

Halt

Sum, Dec 0

X, Dec 5

One, Dec 1

Ten, Dec 10

1. Consider the MARIE program.
   1. List the hexadecimal code for each instruction.
   2. Draw the symbol table.
   3. What is the value stored in the AC when the program terminates?

Hex Address Label Instruction Hexadecimal code for each instruction

100 Start, LOAD A 1 108

101 ADD B 3 109

102 STORE D 2 10B

103 CLEAR A 000

104 OUTPUT 6 000

105 ADDI D B 10B

106 STORE B 2 109

107 HALT 7 000

108 A, HEX 00FC 00FC

109 B, DEC 14 000E

10A C, HEX 0108 0108

10B D, HEX 0100 0100

Symbol Table:

| A | 108 |
| --- | --- |
| B | 109 |
| C | 10A |
| D | 10B |

AC After Program Termination: 110816

1. Write the assembly language equivalent of the following MARIE machine language instructions:
2. 0000 0101 1100 0000 – JnS 5C016
3. 0001 1011 1001 0010 – LOAD B9216
4. 1100 1001 0110 1011 – JUMPI 96B16
5. Write the following code segment in MARIE’s assembly language:

if X > 2 then

{

Y = X + X;

}

else

{

Y = Y + 2;

}

X = X + Y;

| Hex Address | Label | Instruction |
| --- | --- | --- |
| 100 | Start (If), | LOAD X |
| 101 |  | SUBT Two |
| 102 |  | SKIPCOND 800 |
| 103 |  | JUMP Else |
| 104 | Then, | LOAD X |
| 105 |  | ADD X |
| 106 |  | STORE Y |
| 107 |  | JUMP Endif |
| 108 | Else | LOAD Y |
| 109 |  | ADD Two |
| 10A |  | STORE Y |
| 10B | Endif | LOAD X |
| 10C |  | ADD Y |
| 10D |  | STORE X |
| 10E |  | HALT |
| 10F | Two | HEX 0002 |
| 110 | X | Can be any numvalue |
| 111 | Y | Can be any numerical value |

1. Write the following code segment in MARIE’s assembly language:

if X <= Y then

Y = Y - 1;

else if X != Z

then Y = Y + 1;

else Z = Z - 1;

| Hex Address | Label | Instruction |
| --- | --- | --- |
| 100 | Start (If), | LOAD X |
| 101 |  | SUBT One |
| 102 |  | SUBT Y |
| 103 |  | SKIPCOND 000 |
| 104 |  | JUMP Else1 |
| 105 | Then1 | LOAD Y |
| 106 |  | SUBT One |
| 107 |  | STORE Y |
| 108 |  | JUMP Endif |
| 109 | Else1 | LOAD X |
| 10A |  | SUBT Z |
| 10B |  | SKIPCOND 400 |
| 10C |  | JUMP Then2 |
| 10D | Else2 | LOAD Z |
| 10E |  | SUBT One |
| 10F |  | STORE Z |
| 110 |  | JUMP Endif |
| 111 | Then2 | LOAD Y |
| 112 |  | ADD One |
| 113 |  | STORE Y |
| 114 |  | JUMP Endif |
| 115 | Endif | HALT |
| 116 | ONE | HEX 0001 |
| 117 | X | Can be any numerical value |
| 118 | Y | Can be any numerical value |
| 119 | Z | Can be any numerical value |

1. Write the following code segment in MARIE’s assembly language:

Sum = 0;

for X = 1 to 10 do

Sum = Sum + 2 \* X;

| Hex Address | Label | Instruction |
| --- | --- | --- |
| 100 | Start | LOAD Sum |
| 101 |  | ADD X |
| 102 |  | ADD X |
| 103 |  | STORE Sum |
| 104 |  | LOAD X |
| 105 |  | ADD One |
| 106 |  | STORE X |
| 107 |  | LOAD 10 |
| 108 |  | SUBT X |
| 109 |  | SKIPCOND 000 |
| 10A |  | JUMP Start |
| 10B |  | HALT |
| 10C | Sum | HEX 0000 |
| 10D | One | HEX 0001 |
| 10E | Ten | HEX 000A |
| 10F | X | HEX 0001 |