IN1006 Systems Architecture (PRD1 A 2022/23)

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Grade	10.00 out of 10.00 (100%)

Question 1

Correct

Mark 1.00 out of 1.00

Which MARIE instruction is being carried out by the microoperations that follow?

$MAR \leftarrow X$
$MBR \leftarrow M[MAR]$
$AC \leftarrow AC + MBR$

Select one:

- a. Add X ✔
- b. Load X
- c. Jump X
- d. Don't know/No answer
- e. Store X

The correct answer is: Add X

Question 2

Correct

Mark 1.00 out of 1.00

Consider the following MARIE program. What is the outcome of the program?

```
            Load X
            Store Sum
LoopC,      Skipcond 800
            Jump LoopEnd
Loop,       Subt Y
            Store W
            Add Sum
            Store Sum
            Load W
            Jump LoopC
LoopEnd,    Halt
X,          Dec 4
Y,          Dec 1
Sum,        Dec 0
W,          Dec 0
```

Select one:

- a. The program will output the values 4, 3, 2, 1 and 0 before ending.
- b. The program will halt immediately after reaching the Skipcond instruction for the first time.
- c. The program will compute the expression 4+2+0 before ending.
- d. The program will compute the sum 4+3+2+1+0 before ending.
- e. The program will compute the sum 4+3+2+1+0 and store it in Sum before ending. ✔

This program executes a "Loop" using the Skipcond instruction. In this case, the condition in Skipcond is set to 10 and so IR[11-10] is 10. Thus, if AC>0 then PC will become PC+1 and the execution will continue from "Loop" . Otherwise, the execution will continue from "LoopEnd". Initially (after the execution of the first two statements) the AC will be 4 (>0) and the value 4 will be stored in Sum. Thus the instruction at the position "Loop" will be executed subtracting 1 from AC, adding its value to Sum and storing the updated value to Sum (this will make the value of Sum equal to 7, i.e., 4+3). Then the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 3 so the evaluation of Skipcond will make the program continue from "Loop" again, this time subtracting 1 first from AC and then adding its value (i.e., 2) to Sum. This will continue until AC becomes 0, at which point the program execution will jump to "LoopEnd" and will be halted. Thus, the program will find the sum of values 4+3+2+1+0 and store it in the memory position Sum before halting.

The correct answer is: The program will compute the sum 4+3+2+1+0 and store it in Sum before ending.

Question 3

Correct

Mark 1.00 out of 1.00

What is the difference when executing instructions `ADD x` and `ADDI x` ?

Select one:

- a. There is no difference between the two instructions if x is the current value of MBR
- b. ADD x loads the value of MBR to AC; ADDI x adds the value of IR to AC.
- c. ADD x loads the value at address x to the AC; ADDI x loads the value x to the AC
- d. ADD x adds the value at address x to the AC; ADDI x adds the value found in the location addressed by the value in location x to the AC ✔
- e. ADD x loads the value of PC to the AC; ADDI loads the value found at x to the MBR and adds the value of MBR to the AC

ADD x adds the value of the memory word with address x to the AC, whereas ADDI x adds the value of the memory word whose address is the value of the memory word with address x to the AC.

The correct answer is: ADD x adds the value at address x to the AC; ADDI x adds the value found in the location addressed by the value in location x to the AC

Question 4

Correct

Mark 1.00 out of 1.00

Consider the following MARIE program. What is the outcome of the program?

```
            Clear
            Add X
            Store Sum
LoopC,      Skipcond 800
            Jump LoopEnd
Loop,       Output
            Subt Y
            Jump LoopC
LoopEnd,    Halt
X,          Dec 10
Y,          Dec 4
Sum,        Dec 0
```

Select one:

- a. The program will output the decimal numbers 10, 6 and 2 before ending. ✔
- b. The program will compute the expression 10+6+2 (i.e., 18) before ending.
- c. The program will output the decimal numbers 10, 8, 6, 4, 2 and 0 before ending.
- d. The program will compute the expression 10, 8, 6, 4 and 2 before ending.
- e. The program will output 4 for three consecutive times before ending.

This program executes a "Loop" using the Skipcond instruction. In this case, the condition in Skipcond is set to 10 and so IR[11-10] is 10. Thus, if AC>0 then PC will become PC+1 and the execution will continue from "Loop" . Otherwise, the execution will continue from "LoopEnd". Initially (after the execution of the first two statements) the AC will be 10 (>0) and thus the instruction at the position "Loop" will be executed outputing 10 (i.e., the current value of AC). Then 4 will be subtracted from AC and the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 6 so the evaluation of Skipcond will make the program continue from "Loop" again, this time outputing 6 first and then subtracting 4 from it. This will continue until AC becomes -2, at which point the program execution will jump to "LoopEnd" and will be halted. Thus, the program will output the values 10, 6, and 2 before halting.

The correct answer is: The program will output the decimal numbers 10, 6 and 2 before ending.

Question 5

Correct

Mark 1.00 out of 1.00

Which MARIE instruction is being carried out by the microoperation that follows?

$PC \leftarrow X$

Select one:

- a. Store X
- b. Don't know/No answer
- c. Jump X ✔
- d. Add X
- e. Load X

The correct answer is: Jump X

Question 6

Correct

Mark 1.00 out of 1.00

Which MARIE instruction is being carried out by the following microoperations?

$$MAR \leftarrow Y$$
$$MBR \leftarrow AC$$
$$M[MAR] \leftarrow MBR$$

Select one:

- a. STORE Y ✔ Correct
- b. Neither the above sequence nor any subsequence of it corresponds to a MARIE instruction.
- c. LOAD Y
- d. ADD Y
- e. STORE AC+MAR

Your answer is correct.

The first microoperation assigns Y to MAR. The second microoperation assigns the value of AC to MBR, and the last microoperation stores the value of MBR to the memory word with the address indicated by MAR. Hence given microoperations correspond to the MARIE instruction STORE Y.

The correct answer is: STORE Y

Question 7

Correct

Mark 1.00 out of 1.00

What is the difference when executing instructions `LOAD x` and `LOADI x` ?

Select one:

- a. LOAD x loads the value of MBR to AC; LOADI loads the value of MAR to AC.
- b. LOAD loads the value at address x to the AC; LOADI loads the value x to the AC
- c. LOAD loads the value x to the AC; LOADI loads the value found at x to the AC
- d. LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC ✔
- e. There is no difference if x is the current value of MBR

LOAD x loads the value of the memory word with address x to the AC whereas LOADI x loads the value of the memory word whose address is the value of the memory word with address x to the AC.

The correct answer is: LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC

Question 8

Correct

Mark 1.00 out of 1.00

Consider the following MARIE program. What is the outcome of the program?

```
            Clear
            Add X
LoopC,      Skipcond 800
            Jump LoopEnd
Loop,       Output
            Subt Y
            Jump LoopC
LoopEnd,    Halt
X,          Dec 5
Y,          Dec 1
```

Select one:

- a. The program will compute the expression 5 + 4 + 3 + 2 +1 (i.e., 15) before ending.
- b. The program will output the decimal numbers 5, 4, 3, 2 and 1 before ending. ✔
- c. The program will compute the expression 5 - 4 - 3 -2 -1 (i.e., - 5) before ending.
- d. The program will output the decimal numbers 5, 4, 3, 2, 1 and 0 before ending.
- e. The program will do nothing.

This program executes a "Loop" using the Skipcond instruction. In this case, the condition in Skipcond is set to 10 and so IR[11-10] is 10. Thus, if AC>0 then PC will become PC+1 and the execution will continue from "Loop" . Otherwise, the execution will continue from "LoopEnd". Initially (after the execution of the first two statements) the AC will be 5 (>0) and thus the instruction at the position "Loop" will be executed outputing 5 (i.e., the current value of AC). Then 1 will be subtracted from AC and the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 4 so the evaluation of Skipcond will make the program continue from "Loop" again, this time outputing 4 first and then subtracting 1 from it. This will continue until AC becomes 0, at which point the program execution will jump to "LoopEnd" and will be halted. Thus, the program will output the values 5, 4, 3, 2 and 1 before halting.

The correct answer is: The program will output the decimal numbers 5, 4, 3, 2 and 1 before ending.

Question 9

Correct

Mark 1.00 out of 1.00

What is the difference in operation between a LOAD x and a LOADI x instruction?

Select one:

- a. There is no difference if x is the same
- b. Don't know/No answer
- c. LOAD loads the value x to the AC; LOADI loads the value found at x to the AC
- d. The LOAD loads the value at address x to the AC; the LOADI loads the value x to the AC
- e. The LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC ✔

Your answer is correct.

The correct answer is: The LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC

Question 10

Correct

Mark 1.00 out of 1.00

Consider the following MARIE code. The code starts at address 000: the first instruction is saved at address 000.

After the execution of this code what is the value (in decimal) stored in the OutREG register?

```
If,     Load X
        Subt Y
        Skipcond 400
        Jump Else
Then,   Load X
        Add Z
        Output
        Jump Endif
Else,   Load X
        Add X
        Subt Y
        Subt Z
        Output
Endif,  Halt
X,      Dec 9
Y,      Dec 5
Z,      Dec 2
```

Select one:

- a. 8
- b. 10
- c. 11 ✔
- d. 18
- e. 7

This program executes the "If, then, else" statement using the Skipcond instruction. In this case, the condition in Skipcond is 01. So, the statement (if AC=0 then PC=PC+1) is evaluated and the "Else" part of the code is executed since AC equals to 4 after the execution of the first two instructions of the program. The program then continues to execute and the "Output" instruction outputs the value of OutREG and OutREG=AC and AC is X+X-Y-Z=11 and terminates at "Halt". So the answer is 11.

The correct answer is: 11

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