

## **CSC 314 - Assignment 6 – Due Nov 2nd – Tuesday**

**Name:** \_\_\_\_\_

**Fill in the final answers in the boxes. Please do not write any of your calculations and working areas in Pages 1 and 2. Keep all the calculations from page 3 onwards. Answers not written in the boxes will not be considered for grading. Use this file as your submission format.**

### **Question 1: (15 points – 3 Points each)**

How many bits would you need to address the following memory configurations, if the memory is byte addressable and word addressable.

Configuration	Bits Required for Byte Addressable	Word Size	Bit Required for Word Addressable
128 T X 32	49	32	47
16 G X 64	37	64	34
1M X 128	24	128	20
256 G X 16	39	16	38
32 T X 64	48	64	45

### **Question 2: (5 points)**

List the 7 registers of MARIE Architecture. Briefly explain the purpose of each one of them.

Register	Purpose of the register
AC	Accumulator, A 16 bit register that holds a conditional operator or one operand of a two operand instruction.
MAR	Memory Address Register, A 12 bit register that holds the address of the instruction or the operand of the instruction.
MBC	Memory Buffer Register, A 16 bit register that holds the data after its retrieval from or before its placement in the memory.
PC	Program Counter, A 12 bit register that holds the address of the next instruction to be executed.
IR	Instruction Register, holds an instruction immediately preceding its execution.
InReg	Input Register, A 8 bit register that holds data read from an input device.
OutReg	Output Register, A 8 bit register that holds data that is ready for the output device.

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### **Question 3: (10 points)**

**Write a program in MARIE Simulator, that performs the following.**

Assume 2 variables, X, Y in two memory locations. Take 2 inputs from the user and store the values in X and Y. The program should perform a swap of values in X and Y.

After performing the swap, create 2 variables SUM and DIFF, and store the values of  $X+Y$  in sum and  $X - Y$  in DIFF. Your program should work for both positive and negative numbers.

For example (Values represented in Decimal): Input  $X = 15$ ,  $Y = 8$ . After swapping it should store  $X = 8$ ,  $Y = 15$ ,  $X + Y = 23$ ,  $X - Y = (-7)$

```
ORG 100
INPUT
STORE X
INPUT
STORE Y
LOAD X
STORE TEMP
LOAD Y
STORE X
LOAD TEMP
STORE Y
/Performed Swap now starting sum
and diff
CLEAR
LOAD X
ADD Y
STORE SUM
LOAD X
SUBT Y
STORE DIFF
HALT
X, DEC 06
Y, DEC 09
TEMP, DEC 00
SUM, DEC 00
DIFF, DEC 00
```

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Input Value	F a c t o r i a l o u t p u t i n H E X F o r m a t
4	
5	
6	
7	
8	
9	
10	

### Question 4: (20 points)

Write a program in MARIE Simulator, that performs the following.

Take an input value from the user and output its factorial.

Factorial for 1 = 1, 2 = 2 X 1 = 2, 3 = 3 X 2 X 1 = 6 and so on.

Fill in the sheet for the output values shown in HEX.

Did you find any discrepancies in the output for any input? If so please state the reason why?

Yes One discrepancy I found was that the MARIE Simulator cannot do factorial calculations over 7 because it ends up having an OverFlow error. This is because MARIE has a 16 bit Arithmetic Logic Unit(ALU) which means the biggest possible number that can be stored is 32,768 which is equivalent to

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( $2^{16}$ )/2 because it is in 2's complement the bits can represent negative numbers and has a minimum of -32,767 which has a range of  $2^{16}$ , hence why the 16 bit ALU cannot cover numbers bigger than 32,768..

```
ORG 100
INPUT
STORE X
LOAD X
SUBT ONE
STORE Y
STORE TEMP
MYLOOP, LOAD ANS
ADD X
STORE ANS
LOAD Y
SUBT ONE
STORE Y
SKIPCOND 400
JUMP MYLOOP
LOAD ANS
STORE X
CLEAR
STORE ANS
LOAD TEMP
SUBT ONE
STORE TEMP
STORE Y
SKIPCOND 400
JUMP MYLOOP
LOAD X
STORE ANS
OUTPUT
HALT
X, DEC 00
Y, DEC 00
ANS, DEC 00
ONE, DEC 01
TEMP, DEC 00
```

'

**Space for calculations**