Lab 4 for COMP 2280

Dates: March 18 and March 20, 2020

Total: 15 points

Resources

Sample programs Stack Example 1, Stack Example 2 and Recursion Example are found in the course web pages.

Question 1 (7 points)

Using the sample programs as guides write an LC-3 assembly language program that implements the recursion f(x) = f(x-1) + x when x > 0 and f(0) = 0. Store the value of f(x) in a word of memory labeled **result**.

You must save R7 on the stack to support nested subroutine calls and recursion.

Load the initial value of x from memory as is done for n in recurse_sum.asm.

Expected values of f(x) for some given values of x:

x	f(x)
0	0
1	1
2	3
3	6
4	10 (A_{16})
5	15 (F_{16})
20	210 ($D2_{16}$)

Make sure your program gives the correct result for x = 20.

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Question 2 (8 points)

Write a complete LC-3 assembly language program that implements a Finite State Machine (FSM) for the transition table given below.

Input	Current State			Next State			Output
X	**State**	**S_1**	**S_0**	**State**	**S_1^+**	**S_0^+**	**Y**
0	A	0	0	A	0	0	0
0	B	0	1	A	0	0	0
0	C	1	0	B	0	1	0
0	D	1	1	C	1	0	1
1	A	0	0	B	0	1	0
1	B	0	1	C	1	0	0
1	C	1	0	D	1	1	0
1	D	1	1	D	1	1	1

Use a jump table to implement a *switch* statement. There is a one to one correspondence between the four cases of the *switch* statement and the four states of the FSM.

Sample output from the program follows.

```
>> 0/0 0/0 0/0 1/0 1/0 1/1 1/1 0/0 0/0 0/0 0/0 1/0 1/0
1/1 0/0 1/1 0/0 1/1 0/0

Programmed by Stew Dent
End of processing.
```

>> is the prompt and is followed by the values for X and Y in the form X/Y, where X is the input and Y is the output.

Valid input is either a 0 or a 1. If any other character is entered terminate the program.

The output is a function of the current state. Assume A is the initial state.
To implement a FSM, where the output is a function of the current state, do not display any value for Y (the output) the first time the initial input is entered. Display only the current input followed by a slash. After that for any state display the output, a space, the current input and a slash in that order.

Before terminating the program check the current state, if it is D (state 3) display a 1 otherwise display a 0.