Union College
ECE318/CSC318
Assignment 6
Due Date: March 5th

Note: submit both the code and the simulation output for each problem requiring simulation.

Problem 1 Design an 8-bit dedicated datapath for the following algorithm and write the control words for it. Use only one adder-subtractor unit for all of the addition and subtraction operations. Label clearly all of the control and status signals

```
W=0
X=0
Y=0
INPUT Z
WHILE (Z /= 0) {
        W = W – 2
        IF (Z is an odd number) THEN
                X = X + 2
        ELSE
                Y = Y + 1
        END IF
        Z = Z - 1
}
```

Problem 2 A digital system has an 8-bit input, X, and an 11-bit output, Z, which is computed from X by the equation:

$Z = 2X + 4(X-1) + 2(X-2)$

NOTE: (X-1) is the 8-bit value of X of the PREVIOUS CLOCK CYCLE. (X-2) is the 8-bit value of X of TWO CLOCK CYCLES AGO. A new X input is applied at every clock cycle, and after 2 clock cycles, a new Z output is generated every clock cycle.

a. If the X input sequence is the simple incrementing sequence shown below, give the Z output for each of the first 10 clock cycles. We assume the initial values of X-1 and X-2 are 0, and the first two are done for you.

clock cycle	X(binary)	Z(decimal)
1	00000001	2 + 0 + 0 = 2
2	00000010	4 + 4 + 0 = 8
3	00000011	
4	00000100	
5	00000101	
6	00000110	
7	00000111	
8	00001000	
9	00001001	
10	00001010	

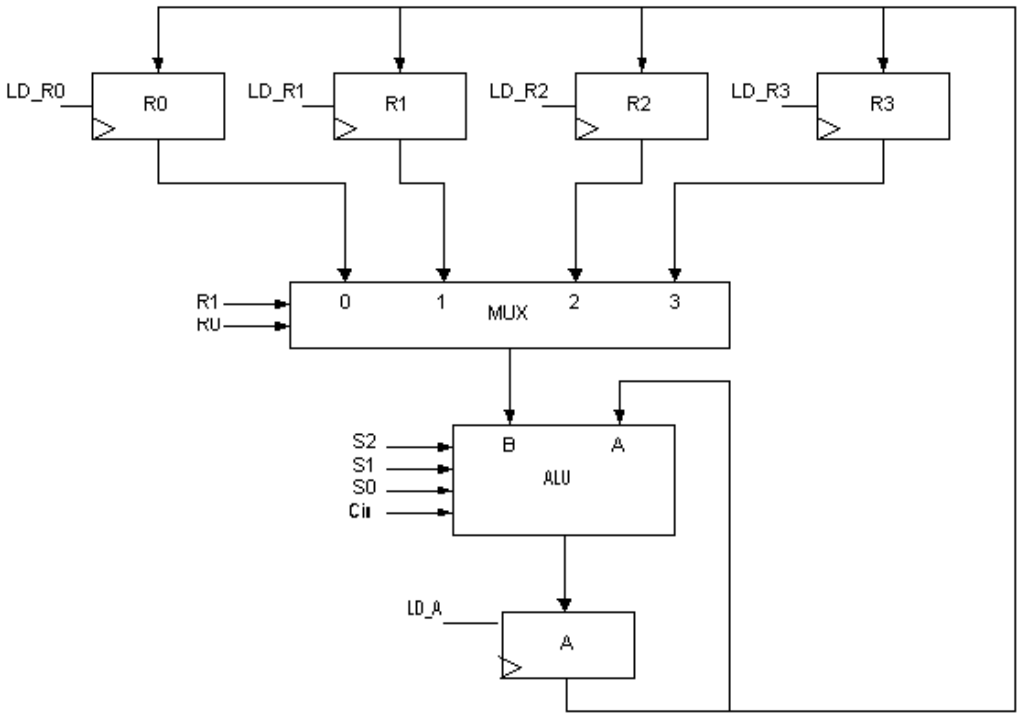
This circuit can be implemented with only a datapath, there is no controller required.

b. Draw a block diagram of the datapath. Clearly label both the ports of the components and the signals between components.

Problem 3. Come up with a control unit for assignment 5 problem problem 7.

Problem 4 The following datapath can implement operations on the 8-bit A register and the four registers R0 - R3 (also 8 bits) and store the results back to the R0-R3 registers. The ALU has output F that is defined based on the select inputs as follows:

S2	S1	S0	ALU OUTPUT F
0	0	0	F = A + B + Cin
0	0	1	F = A + B' + Cin
0	1	0	F = A
0	1	1	F = 0
1	0	0	F = A OR B
1	0	1	F = A AND B
1	1	0	F = A'
1	1	1	F = A XOR B



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(a) Give the values of the control signals for each state, S0-S4, that would be needed to implement the following sequence of operations on this datapath. State S0 is done for you.

Sequence of operations	Control signals
S0: A <---- 0	S2,S1,S0 = 011, LD_A = 1, LD_R0-LD_R3 = 0, R1,R0, Cin = X
S1: A <---- A + R3	
S2: R0 <---- A	
S3: A <---- A XOR R1	
S4: A <---- A - R2	

(b) For initial values: R0=F2, R1=CA, R2=03, R3=88, find the final value of A after this sequence of states is executed.

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