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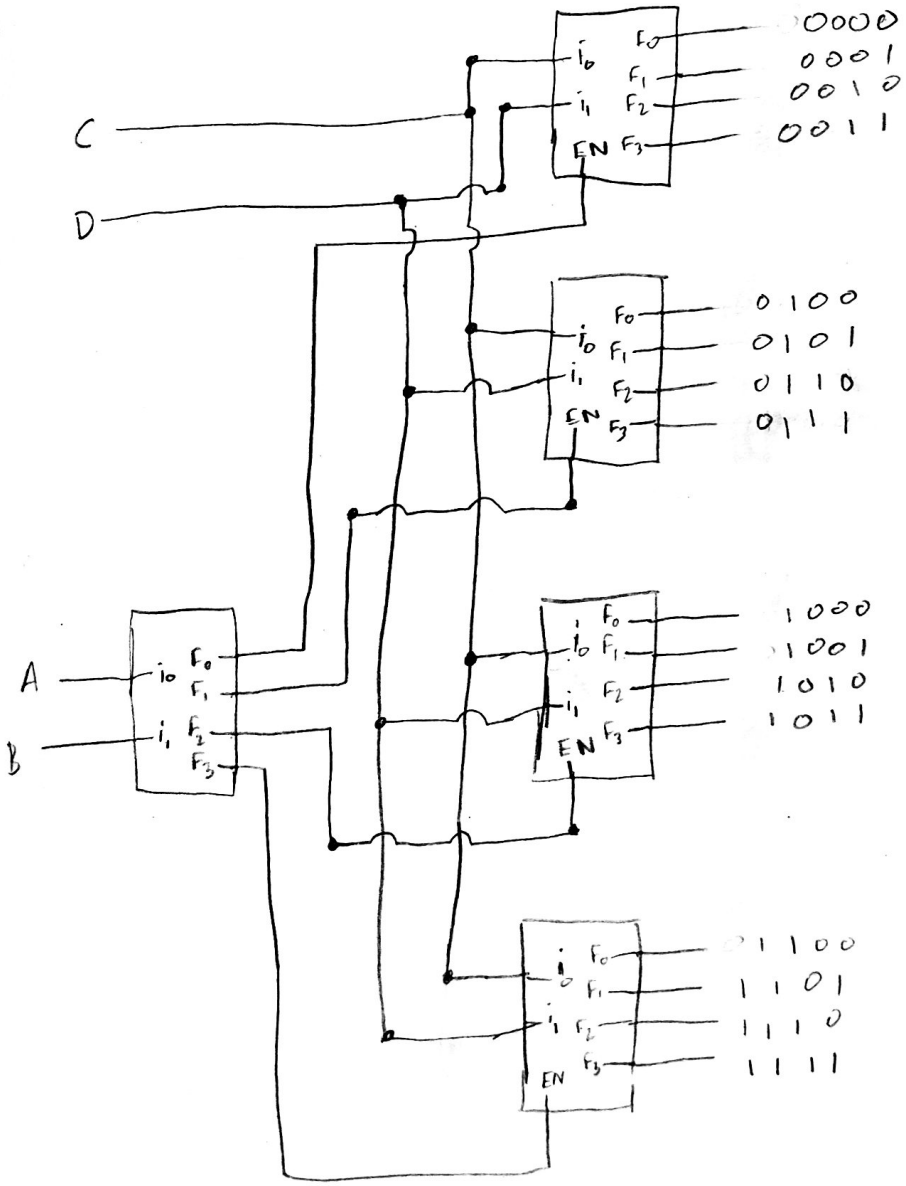
CS 362 : Computer Design (Fall 2018)

Homework 3 : Decoders, Muxes, Memory, Finite State Machines (100 points)
Due Date : 10/11/2018

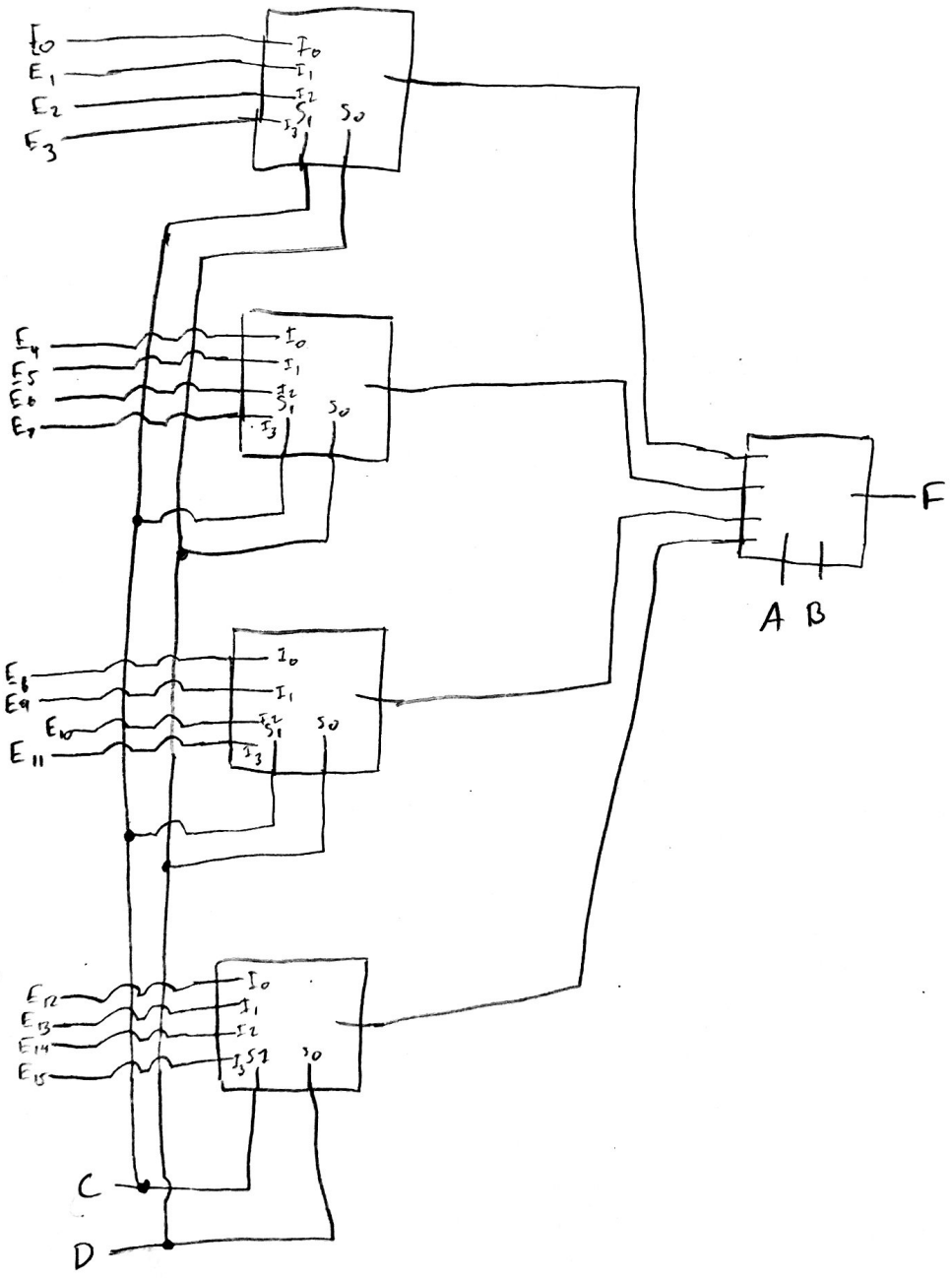
Problem 1 (10 Points):

Build a 4-to-16 decoder using 2-to-4 decoders. Be sure to label all the inputs and outputs of the devices used as well as the inputs and outputs of the overall design.



Problem 2 (10 Points):

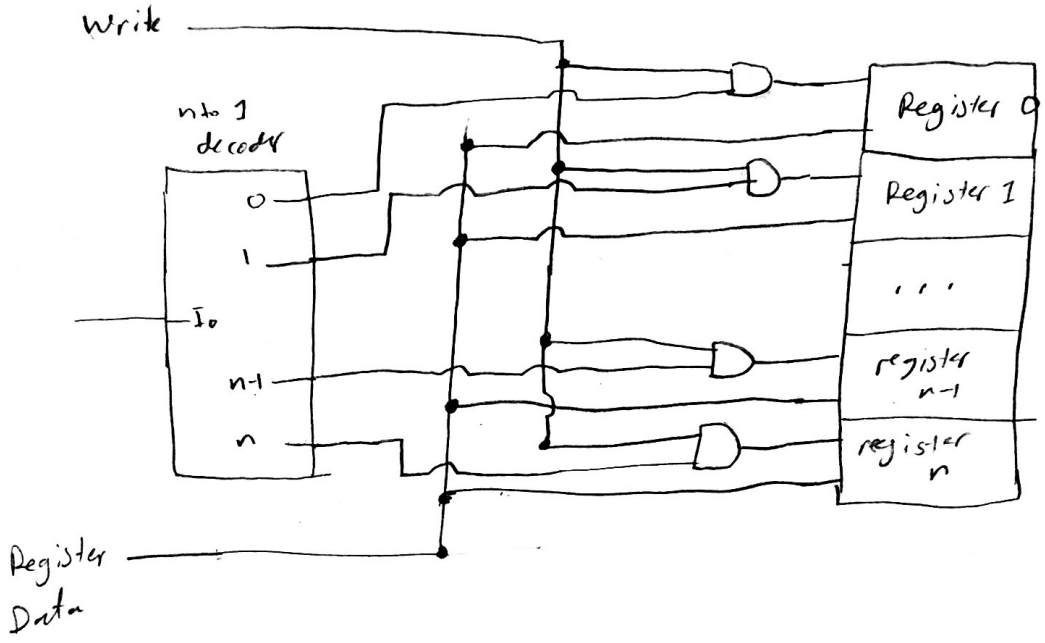
Build a 4-bit 16:1 Multiplexer using 2-bit 4:1 Multiplexers. Be sure to label all the inputs and outputs of the devices used as well as the inputs and outputs of the overall design.



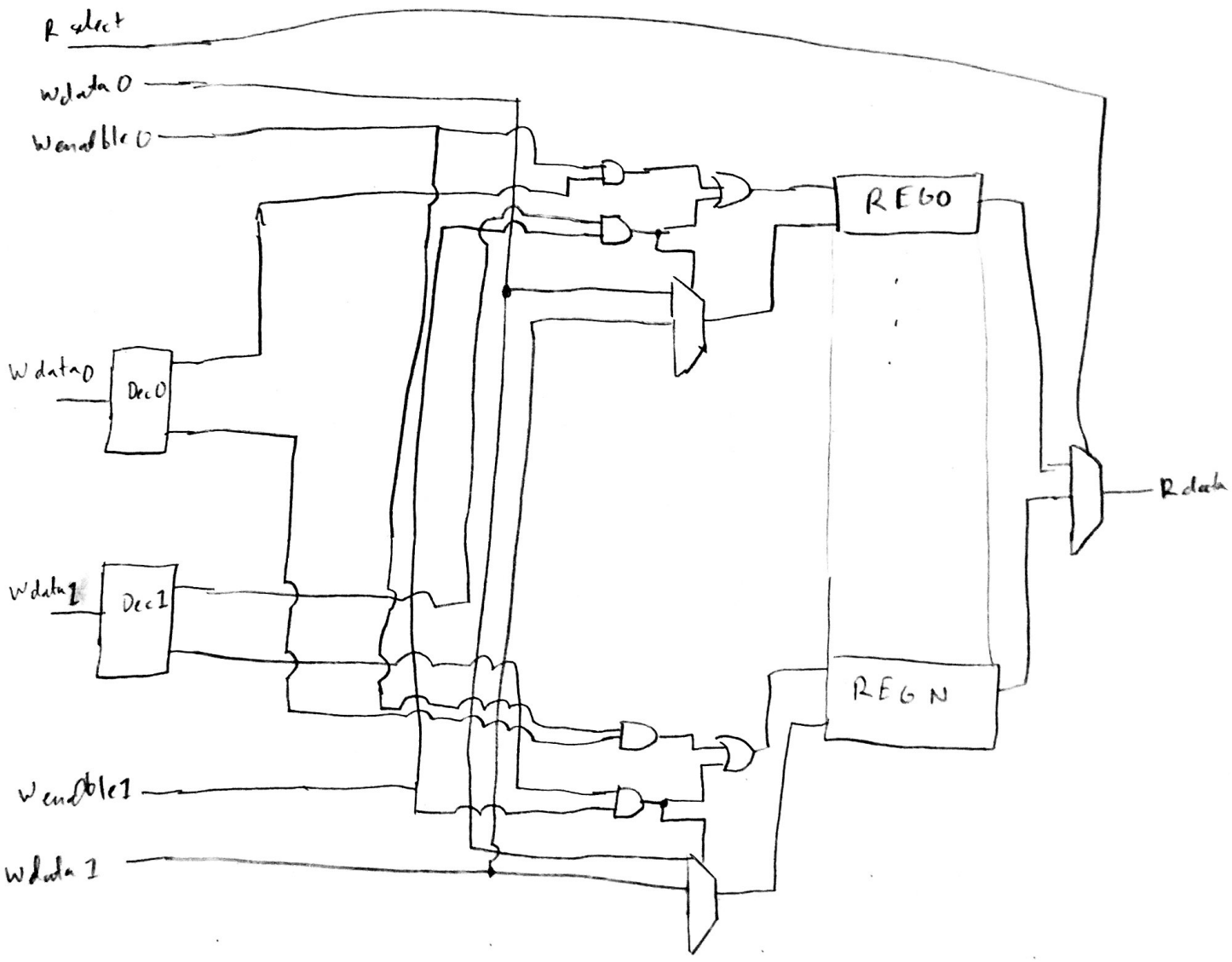
Problem 3 (10 Points):

We showed a design for writing a single register value to the register file.

a) If we wanted to have the ability to write a single value to 2 (or more) registers in the register file, how would the design shown in class have to change? (5 Points)

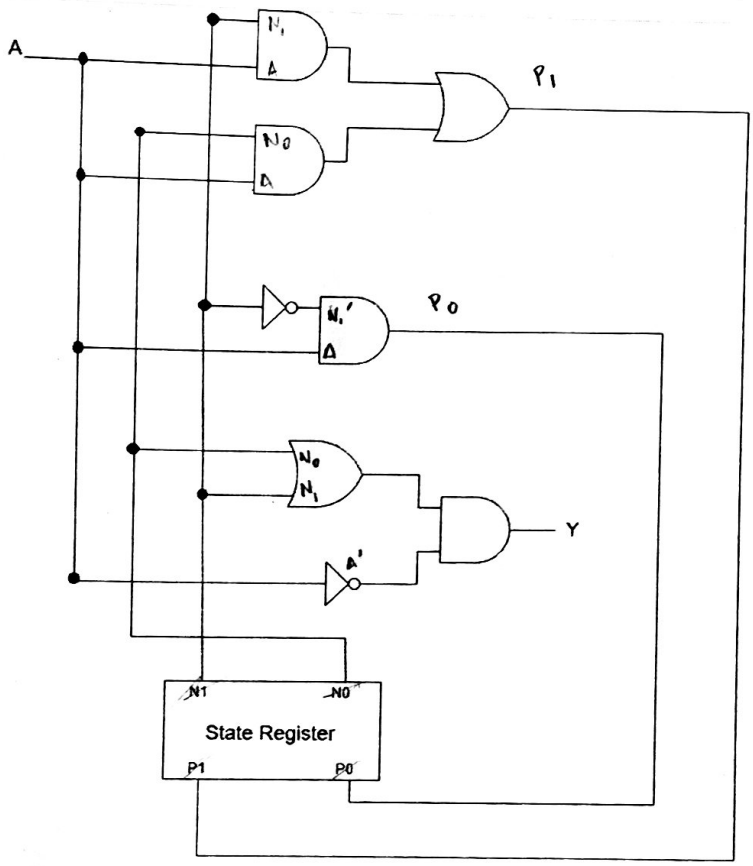


b) If we wanted to have the ability to write two different values to two different registers in the register file, how would the design shown in class have to change? (5 Points)

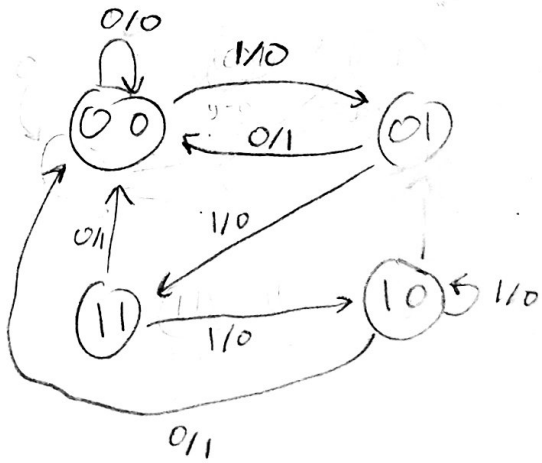


Problem 4 (25 Points):

Give the truth table for the following circuit, and the FSM that this circuit represents.

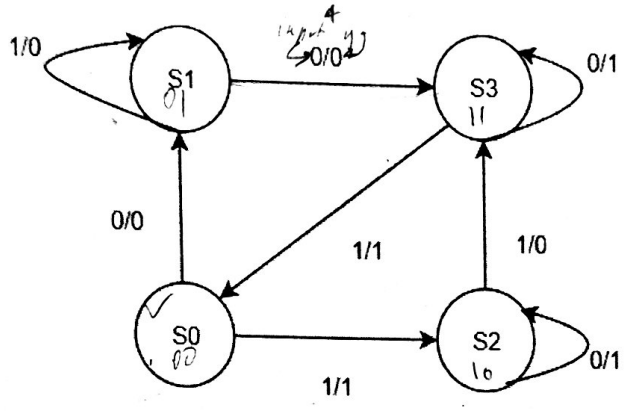


P_1	P_0	A	n_1	n_0	Y
0	0	0	0	0	0
0	0	1	0	1	0
0	1	0	0	0	1
0	1	1	1	1	0
1	0	0	0	0	1
1	0	1	1	0	0
1	1	0	0	0	1
1	1	1	1	0	0



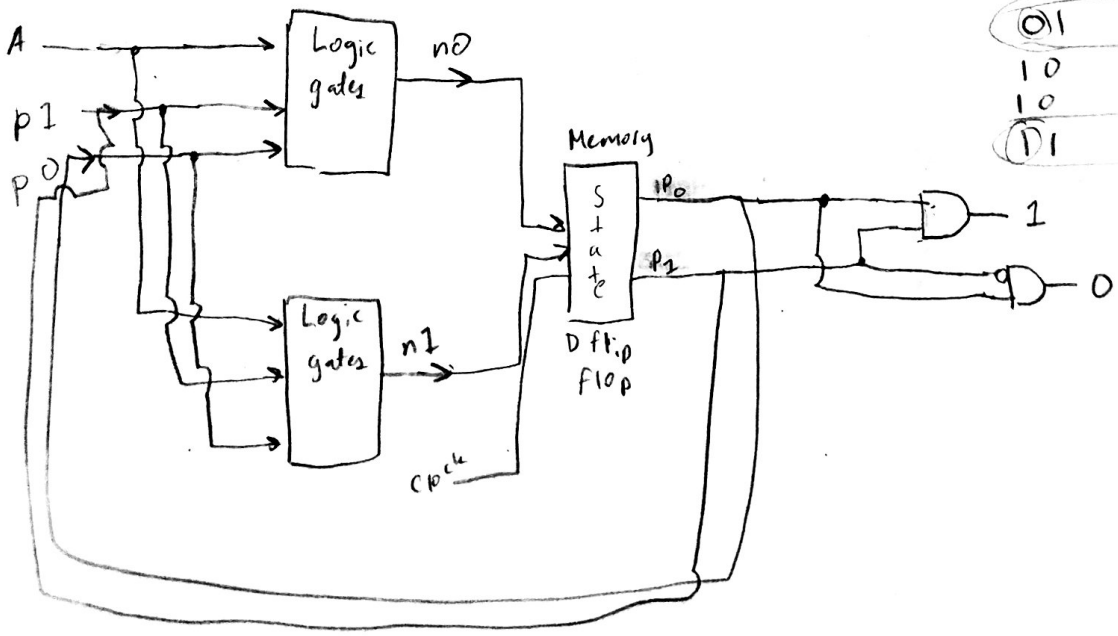
Problem 5 (20 Points):

Given the following Finite State Machine, give the truth table. Use X as the label for the input and Y for the output label. Then, design a circuit with equivalent behavior. Use D-Flip Flops for memory and a one hot encoding design for the state register. You can also use decoders, encoders, and multiplexors.



p_1	p_0	A	n_1	n_0	Y
0	0	0	0	1	0
0	0	1	1	0	1
0	1	0	1	1	0
0	1	1	0	1	0
1	0	0	1	0	1
1	0	1	1	1	0
1	1	0	1	1	1
1	1	1	0	0	1

p_1	p_0	Y
0	0	0
0	0	1
0	1	0
0	1	0
1	0	1
1	0	1
1	1	1

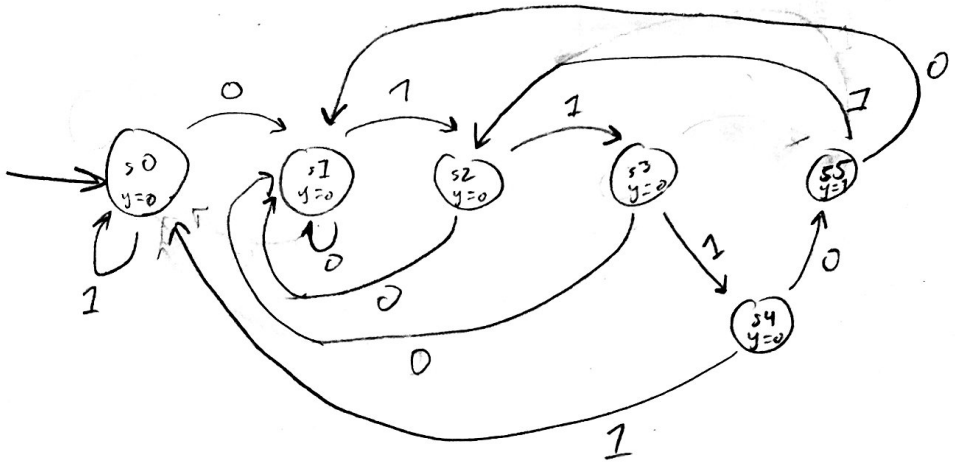


Problem 6 (25 Points):

Suppose we have a machine that takes in an infinite stream of bits, one bit at a time. On every input, the machine will output '0', unless the machine has seen the pattern '01110' in the last five inputs, where it will instead output '1'. Below is an example of this behavior.

Input: 01110011101110011100 0...
Output: 0000100000100010000100...

a.) Design an FSM that exhibits the behavior described above. (10 Points)



S0 = 0 0 0 0 0 1
S1 = 0 0 0 0 1 0
S2 = 0 0 0 1 0 0
S3 = 0 0 1 0 0 0
S4 = 0 1 0 0 0 0
S5 = 1 0 0 0 0 0

I	P0	A	Y
0		0	0
0		1	0
1		0	
1		1	
0		0	
0		1	
1		0	
1		1	