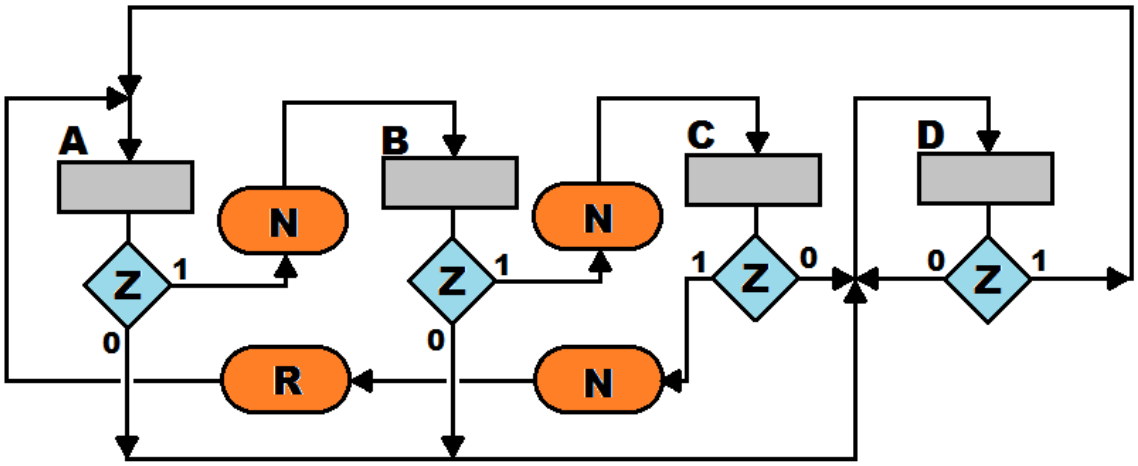
CprE 281 HW12

ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Analysis of Syn. Seq. Circuits, ASM charts/examples

Assigned Date: Thirteenth Week
Finish by Nov. 30, 2022

P1 (20 points): This problem concerns the algorithmic state machine (ASM) chart shown below:



A: What are the inputs and the outputs of this state machine?

B: Draw the state diagram that represents this state machine.

C: Make state assignments as follows: A=00, B=01, C=10, and D=11. Derive output expressions for this ASM chart using DFFs, AND gates, OR gates, and NOT gates.

D: Show that the next state expressions can be written as:

$$S_1^{new} = (\bar{Z} + S_0)\overline{(ZS_1)}, S_0^{new} = (\bar{Z} + \bar{S_0})\overline{(ZS_1)}$$

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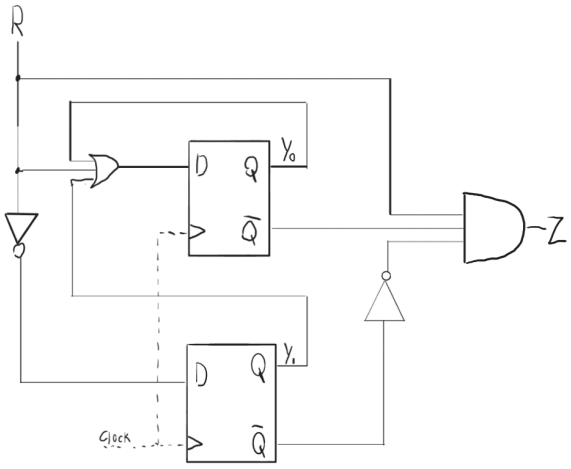
P2. (20 points): Use synchronous sequential circuit (SSC) analysis to reverse engineer the operation of the circuit shown below.



A. Is this a Mealy or Moore Machine?

B. Write expressions for Next State and Output logic

C. Write the State-Assigned Table for the circuit

D. Draw the state transition diagram

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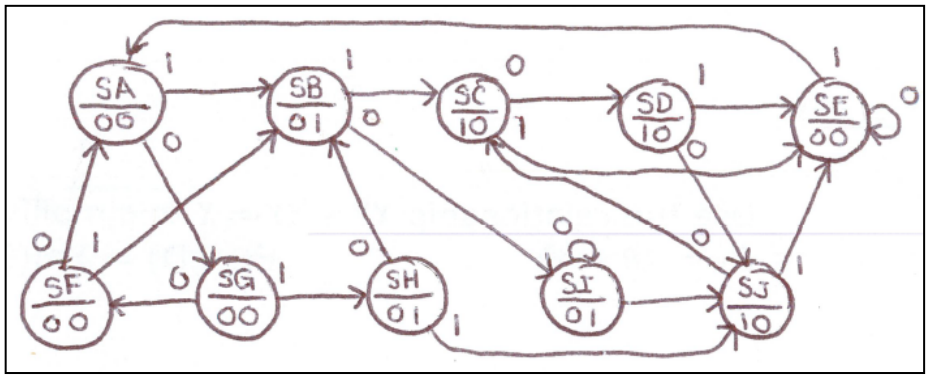
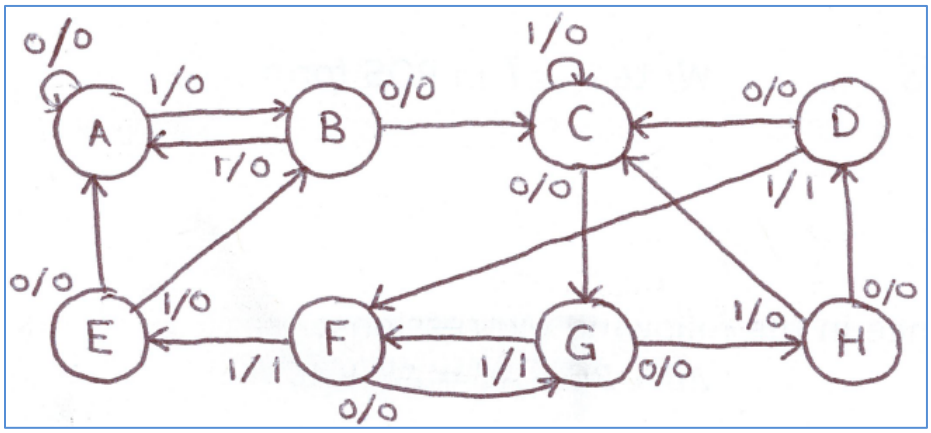
P3: (10 points): Perform state minimization on the following state diagrams:

A.



B.



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P4. (15 points) A sequential circuit has 2 rising edge triggered flip-flops (outputs A and B), two inputs (X and Y) and one output Z. One of the flip-flops is D the other is JK. The logic expressions for this circuit are:

$$\begin{aligned} D_a &= X' \cdot Y + X \cdot A \\ J_b &= X' \cdot B + X' \cdot A \\ K_b &= Y \cdot B \\ Z &= X \cdot B \end{aligned}$$

A. Sketch the circuit diagram

B. Construct the transition table

C. Construct the state diagram

P5. (25 points) Consider a counter that has a special counting sequence: 0,4,5,1,0,4,5,1, and so on. Draw this counter with minimal number of states.

A. Draw the state diagram for the counter
B. Construct the state-assigned table including the next state and output
C. Draw the circuit diagram for the counter using D flip-flops
D. Draw the circuit diagram using T flip-flops
E. Draw the circuit diagram using JK flip-flops

P6. (10 points) Consider a register machine with four registers R0, R1, R2, and R3. Write a complete register machine program (in the table format shown in the lectures) that copies the contents of register 3 into register 2 using register 1 as a temporary storage. The value of R3 at the end of the program must be the same as its value at the beginning of the program. Hint: First, you may have to clear R2 and R1 to zero them. Write a comment for each line/block of your program.