Lab 05: Storage Units and Sequential Logic Circuits

A. Why?

Storage elements are the basic circuits that store data. Sequential logic circuits perform functions on stored data.

B. Outcomes

After this lab, you should be able to

- Trace the state change caused by modifying the inputs to a storage unit.
- Translate a state diagram for a finite state machine to an equivalent state table.

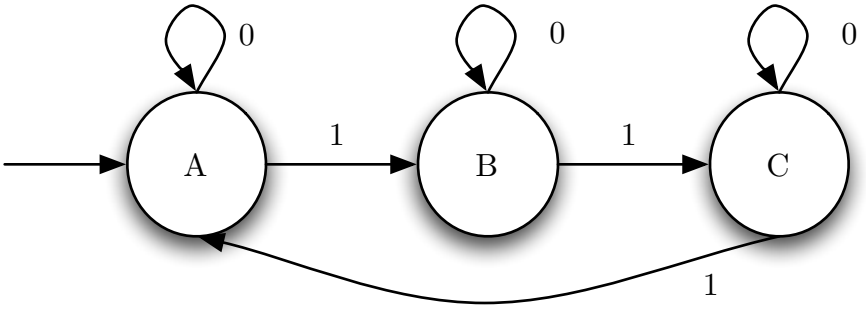
C. Discussion Questions (Not to hand in)

1. When we discussed the R-S latch in lecture, we had a table that described the changes to a and b as a function of R and S.

RS	ab	New $a = \neg(Sb)$	New $b = \neg(Ra)$
11	01	(0)	(1)
11	10	(1)	(0)
01	01	(0)	(1)
01	10	(1)	Chg to 1
01	11	Chg to 0	(1)
10	01	Chg to 1	(1)
10	10	(1)	(0)
10	11	(1)	Chg to 0
00	01	Chg to 1	(1)
00	10	(1)	Chg to 1
00	11	(1)	(1)

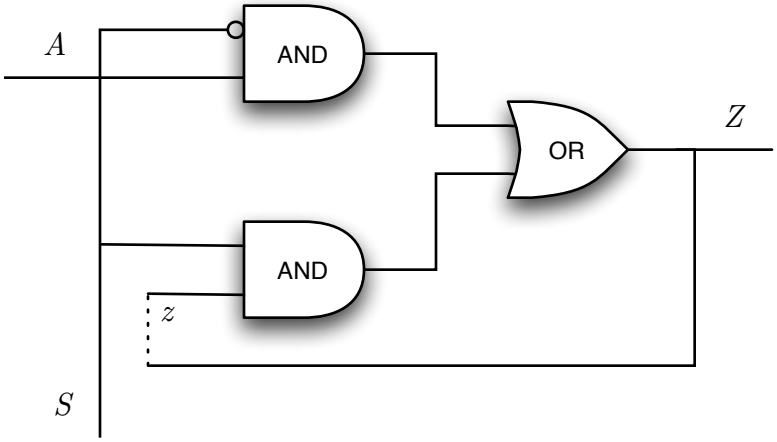
Treat this table as a state table for a finite state machine with 4 states (ab = 01, 10, 11, 00) and 4 inputs (RS = 11, 01, 10, and 00) and draw the state diagram for this machine. (It's okay to skip the state/input combinations that don't appear in the table. Let's treat 01 as the initial state. Try tracing execution of the finite state machine for various changes to RS (exclude 00 to see the legal changes; include 00 if you want an illegal change).

2. Study the state diagram below. What property must the input have so that when the machine executes, it ends in state A? State B? State C?



D. Questions

1. Study the circuit below (adapted from Problem 3.19)



(a) Suppose we break the loop from Z back to the AND gate; let z be the new name for the AND gate input. Write a 4-column truth table that describes Z as a function of A, S, and z.

(b) Now suppose we connect Z back to z. Write a 4-column truth table that gives the relationship between A, S, Z, and the new value of Z.

(c) Is this circuit logically stable for all values of A, S, and Z? Explain briefly.

(see next page)

2. Study the state table below.

State	Input	New State
EE	0	OE
EE	1	EO
EO	0	OO
EO	1	EE
OE	0	EE
OE	1	OO
OO	0	EO
OO	1	OE

(a) What sequence of states does this machine enter on input 00101? Assume "EE" is the initial state.
(b) Draw an equivalent state diagram for this machine.
(c) What do the four states indicate? (Hint: "E" stands for "even" and "O" stands for "odd".)