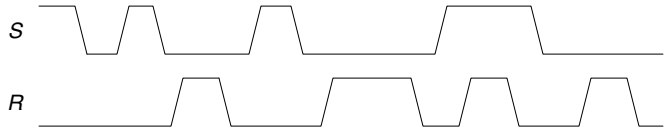
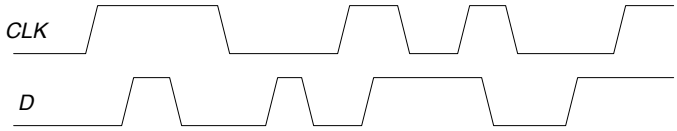
CSE 260M - Homework 3

Always show all work for full credit.

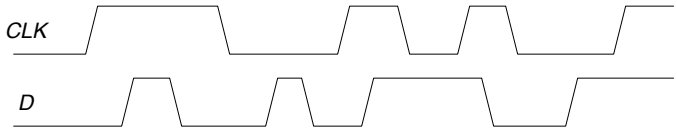
1. Given the input waveforms shown below, sketch the output, Q, of an SR latch.



2. Given the input waveforms shown below, sketch the output, Q, of a D latch.

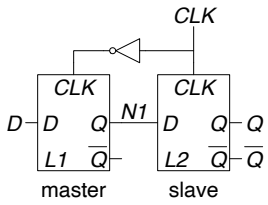


3. Given the input waveforms shown below (same as used in the last problem), sketch the output, Q, of a ***D flip-flop***.



4. In your own words:
   a. Explain the difference in behavior between a synchronously resettable vs asynchronously resettable flip-flop.
   b. Try to provide an example where one may be preferred over the other (describe the example, which may be preferred, and why)

5. For the flip-flop shown below (Figure 3.8 of the text), *how would the behavior* change if the inverter's location were to be changed such that the clock was directly fed to the master and inverted to the slave D flip-flop? (That is, the figure below behaves as described in class/lecture. How would it behave if modified so the inverter's location was moved)



6. How many bits of memory are required to design a state machine that must count from 0-19?

7. You have been enlisted to design a soda machine dispenser for your department lounge. Sodas are partially subsidized by the student chapter of the IEEE, so they cost only 25 cents. The machine accepts nickels, dimes, and quarters. When enough coins have been inserted, it dispenses the soda and returns any necessary change. Design an FSM controller for the soda machine.

The FSM inputs are *Nickel*, *Dime*, and *Quarter*, indicating which coin was inserted. Assume that exactly one coin is inserted on each cycle. The outputs are *Dispense*, *ReturnNickel*, *ReturnDime*, and *ReturnTwoDimes*. When the FSM reaches 25 cents, it asserts *Dispense* and the necessary *Return* outputs required to deliver the appropriate change. Then, it should be ready to start accepting coins for another soda.

a. Draw the state transition diagrams that identify the states and any input and outputs to the system
b. Create a truth table that relates the inputs (including present states of flip-flops, Q0, Q1, etc.) to the next states and outputs of the system
c. Derive the functional expressions that relate the inputs to the next states and outputs
d. Build the state machine in JLS (will be a separate Gradescope submission for the JLS file)
e. Simulate the state machine to insure that it works properly