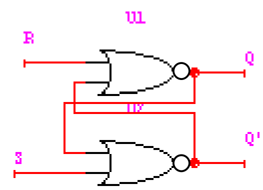
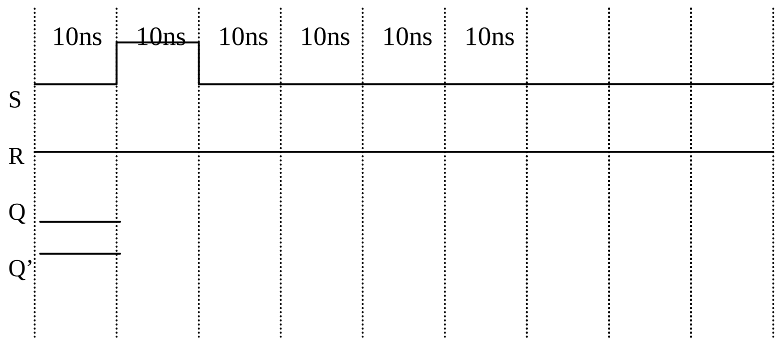
CSE370 Fall '99
Assignment 7
Distributed: 11/17/99
Due: 11/24/99

Reading: Katz 7.2-7.4 and 8.1

Another Safety Problem
Due to the passage of I695 all future roadway tunnels in the State of Washington will be limited to one lane. For this reason, we must design a safety circuit whose output is TRUE anytime there is a vehicle in the tunnel. No other vehicles are allowed to enter the tunnel when the signal is TRUE. To stay within budget constraints, you are only allowed to use one RS FlipFlop and some gates. The tunnel has a sensor at both ends. The output of the sensor is true whenever there is a vehicle passing by. For all timing diagrams below, please draw causality arrows for each signal transition.

Part A. Timing Behavior of an RS Latch
Fill in the timing diagram below. Assume all gates require have a 10ns propagation delay. Be careful!

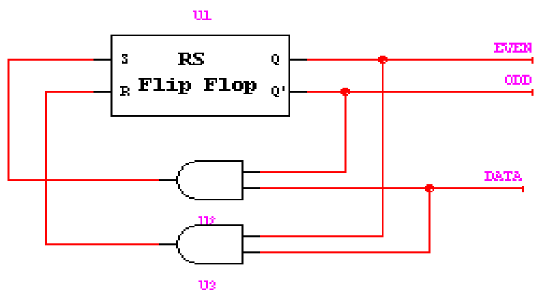


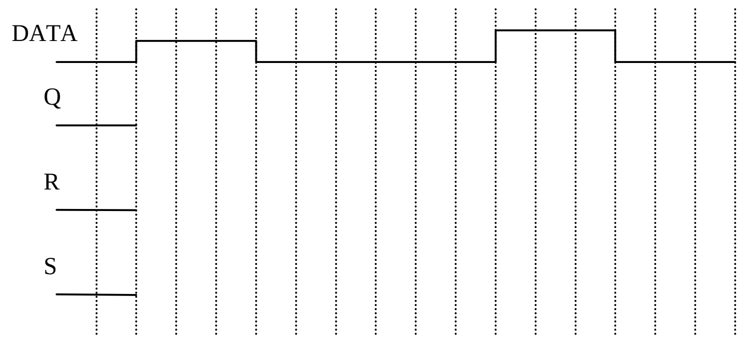


What is the minimum pulse width required on R (or S) to successfully Reset (or Set) the latch? Explain your answer.

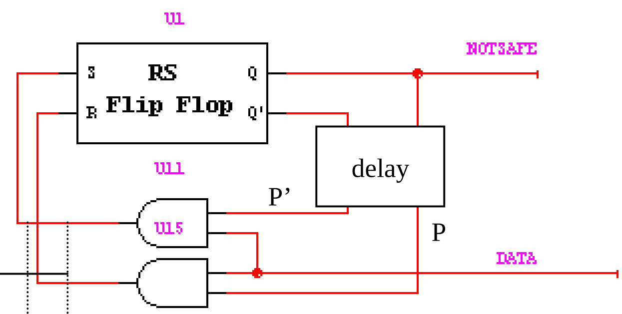
Part B. Running Parity Checker Timing Analysis

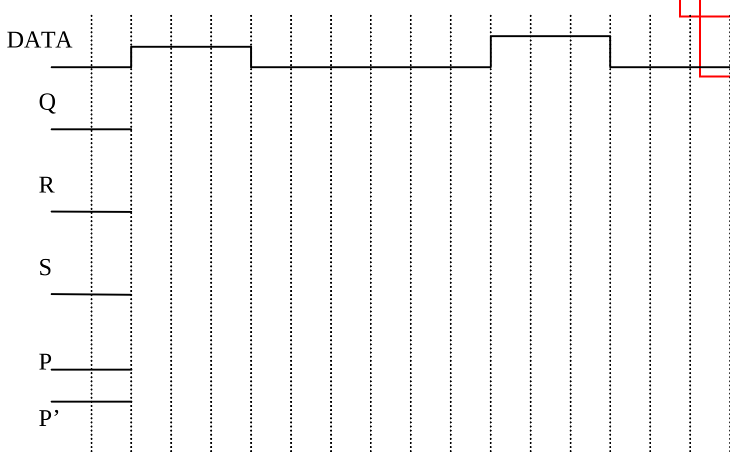
Fill in the timing diagram below for the Asynchronous Running Parity Checker from lecture. Make sure to draw all of the causality arrows.





If the maximum input pulse width is 30ns, how much delay (in ns) must be added to the circuit as shown to guarantee that there is only one state transition per input pulse? Draw a circuit that satisfies this requirement, and fill in the timing diagram.





Part C. Input Signal Processing

When a 12ft vehicle passes by a sensor at 60mph, what is the width of the pulse that is generated? Design a circuit to convert this long input pulse to a 30ns input pulse. This is basically a “glitch generator” that implements the function G(x) = 0, except that G will show a glitch when x makes a transition from 0 to 1, but not from 1 to 0. The duration of the glitch should be 30ns if the input pulse is greater than 30ns. Draw the circuit below (see lecture notes on timing behavior for suggestions).

Part D. Complete System

Using the results of Parts B and C design a circuit whose output is TRUE whenever there is a vehicle in the tunnel as shown in the diagram below. First, fill in the following table

Sensor 1	**Sensor 2**	**Q(t),P(t)**	**Q(t+), P(t+)**	**R**	**S**
No Pulse (0)	No Pulse (0)	0	0	No Pulse (0)	No Pulse (0)
No Pulse (0)	Pulse (1)	1	0	Pulse (1)	No Pulse (0)
No Pulse (0)	Pulse (1)	0	1	No Pulse (0)	Pulse (1)

Using standard logic minimization techniques, determine functions R(P,Sensor1,Sensor2) and S(P,Sensor1,Sensor2). Combining this logic with your results from Parts B and C, design a circuit whose output is true anytime there is a vehicle in the tunnel. Don’t worry about initializing the system and don’t worry about what happens if two vehicles are entering opposite ends of the tunnel at the same time. Also note that you can’t assume a vehicle entering from one direction exits in the other direction, so don’t worry about directionality.