Cpr E 281 LAB 09
ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Lab 9 Answer Sheet

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Submission Instructions:

Prelab:
1. **Complete the prelab**
2. **Submit this report with the prelab completed to Canvas before your lab starts**

Lab:
1. **Complete the lab according to the instructions**
2. **Take screenshots of your ModelSim waveform (note: to receive points your NetID has to be present in the screenshot) and insert them into this document.**
3. **Include screenshots of any related block design files or Verilog files in the report**
4. **Complete this report and reupload it to Canvas**

PRELAB:

Refer to Chapter 5 in your textbook and the lab instructions to complete your pre-lab. Please read all the material and complete the circuit diagrams before you come to the lab.

Q1. Draw the circuit diagram for the SR Latch using NOR Gates for **Section 2.0** in the space below.
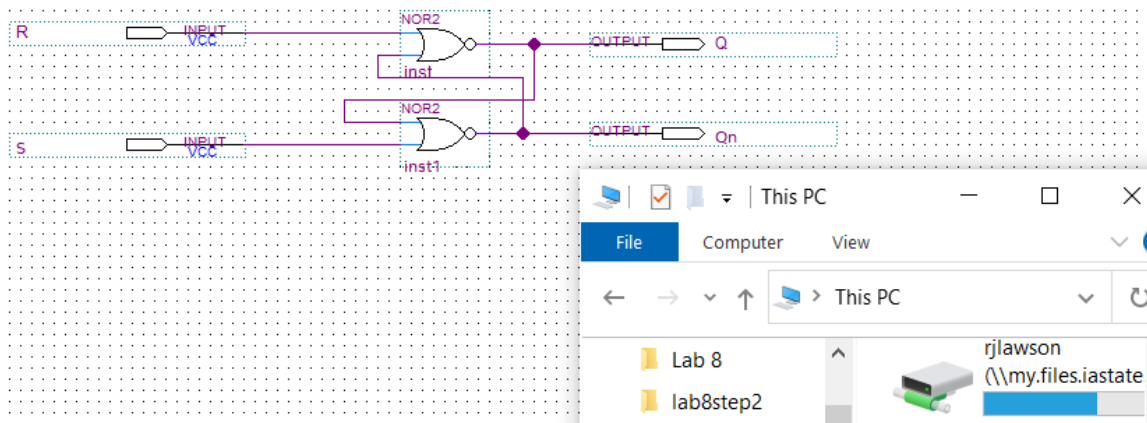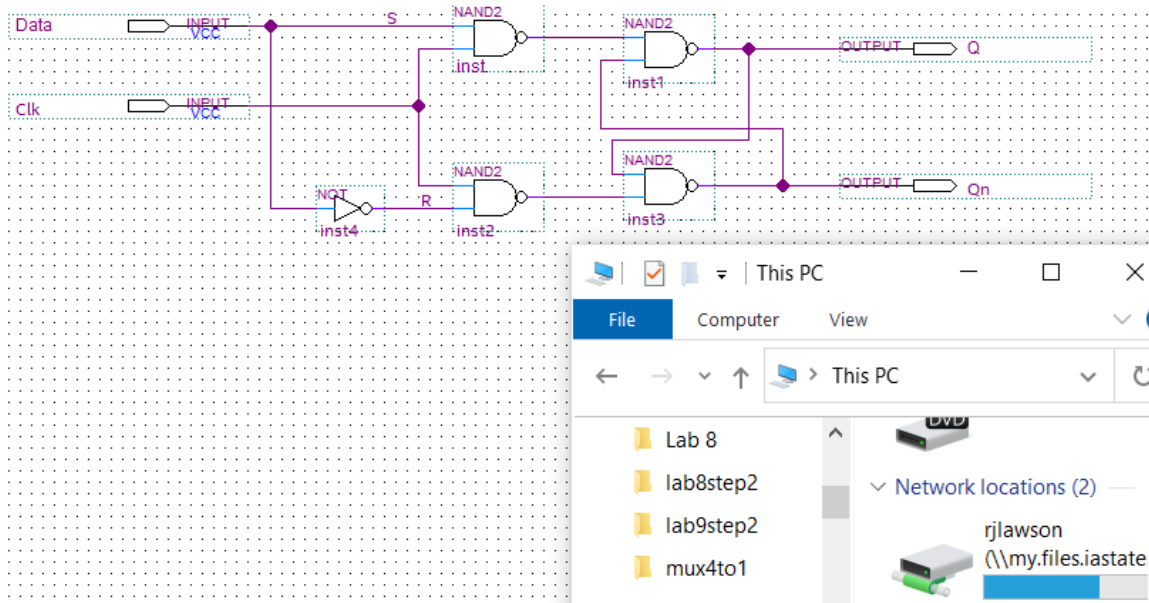

Q2. Draw the circuit diagram for the $\overline{\text{SR}}$ Latch using NAND Gates for **Section 2.0** in the space below.
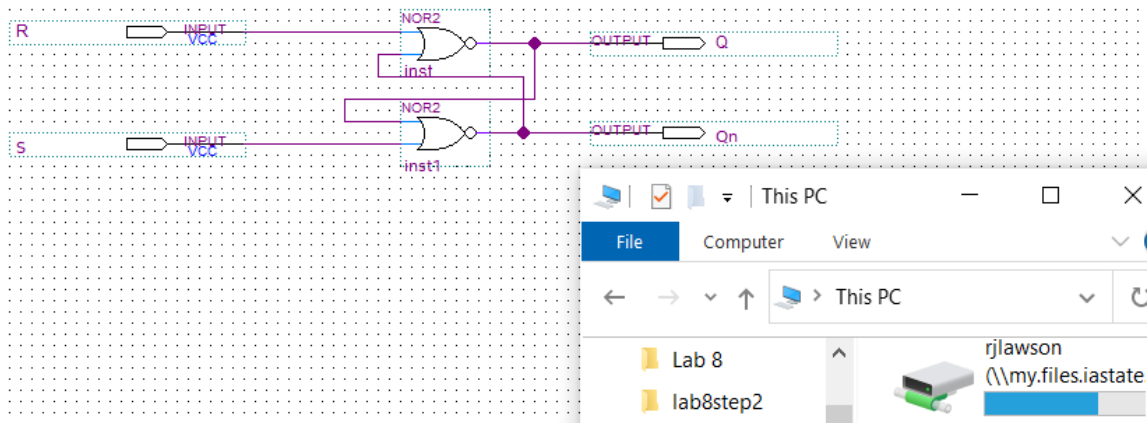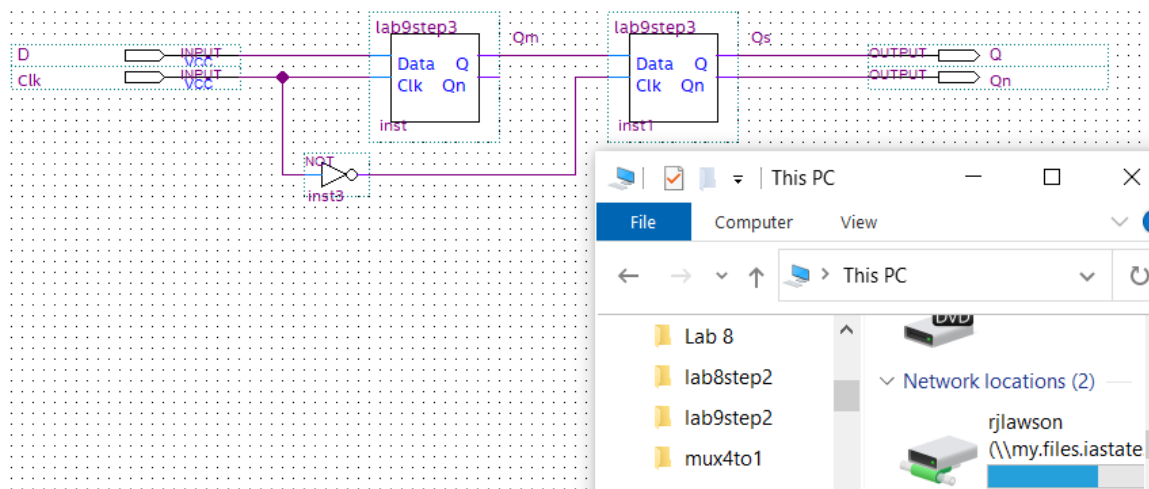
Q3. Draw the circuit diagram for the D Latch using NAND Gates and a NOT gate for **Section 3.0** in the space below.

Q4. Draw the circuit diagram for the Master-Slave D Flip-Flop for **Section 4.0** using the D latches you built in the previous step in the space below. The flip-flop should be triggered by the negative edge of the clock.

3

Q5. Draw the circuit diagram for the Positive-Edge-Triggered D Flip-Flop using NAND gates for **Section 4.0** in the space below.
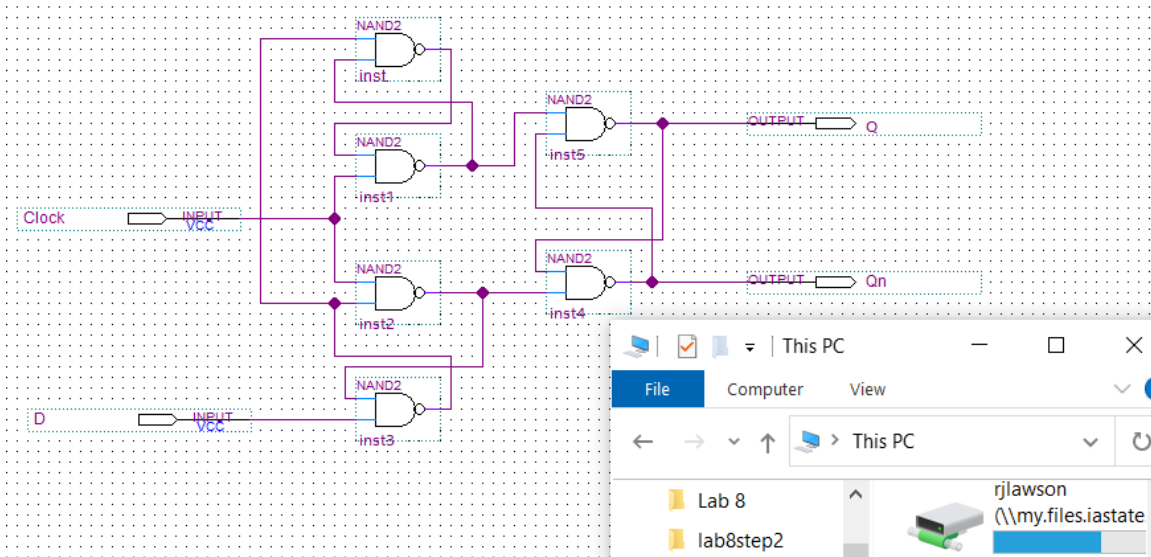
LAB:

2.0 Complete the characteristic table for both versions of the SR latch. Do both versions function properly as a latch?

SR NOR Latch		
S	R	Action
0	0	*Keep State*
0	1	*Q =*
1	0	*Q =*
1	1	*Restricted Combination*

$\overline{\text{SR}}$ NAND Latch		
S	R	Action
0	0	
0	1	*Q =*
1	0	*Q =*
1	1	

NOR Screenshots:
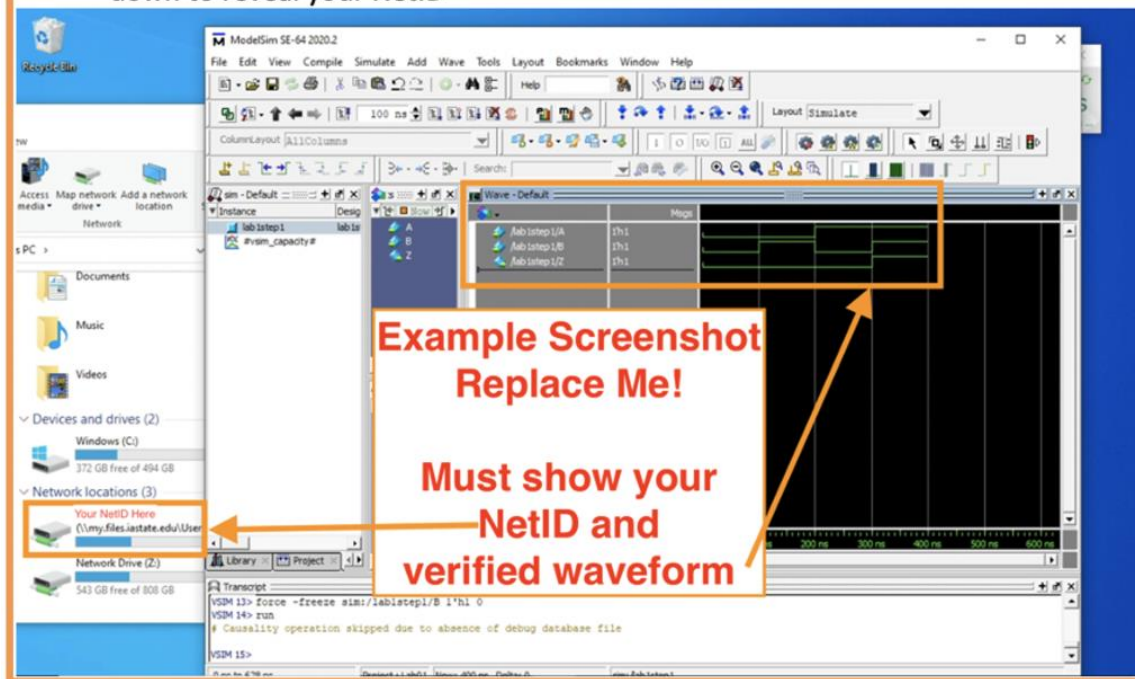<<<Insert a screenshot of your SR NOR latch here>>>

4

<<< Insert a screenshot of your waveform for your SR NOR latch here>>>

To get full points, replace this screenshot with your results

- To find your NetID, open the start menu and search for "This PC". Then scroll down to reveal your NetID
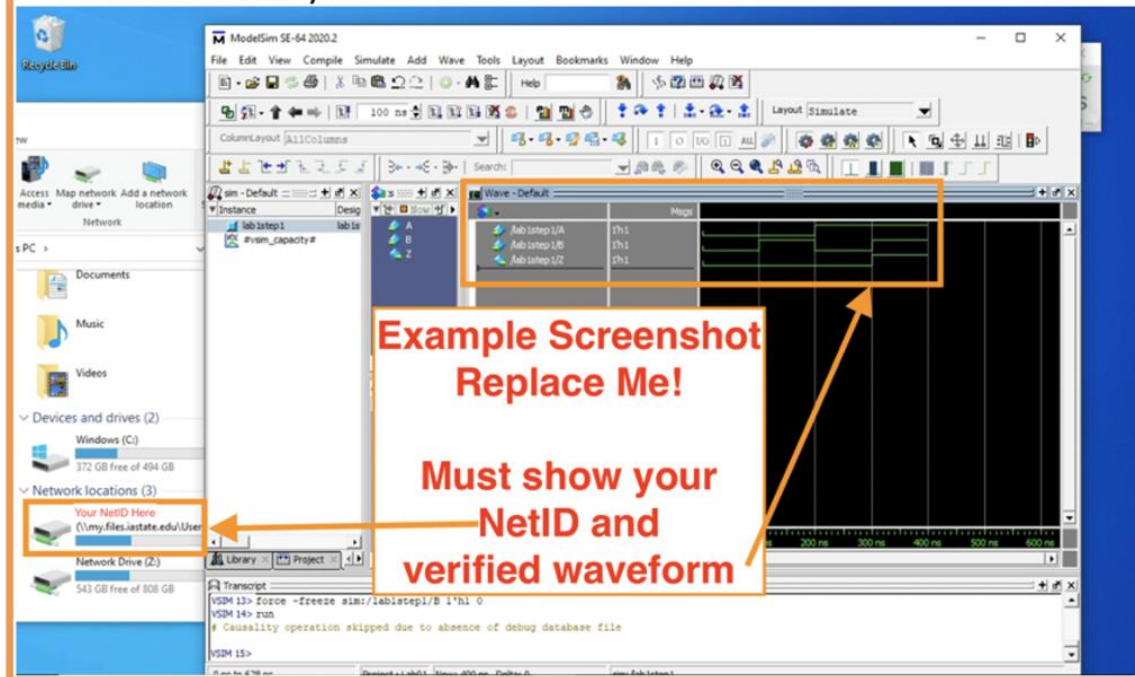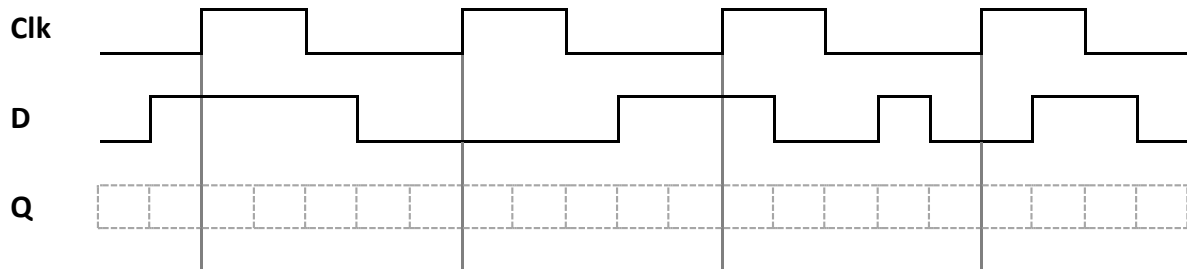
Example Screenshot Replace Me!

Must show your NetID and verified waveform

NAND screenshots:

<<<Insert a screenshot of your SR NAND latch here>>>

<<< Insert a screenshot of your waveform for your SR NAND latch here>>>

3.0 Complete the timing diagram below for your Gated D Latch. What is the difference between this gated latch and the previous basic latches?

Clk

D

Q

D Latch Screenshots:
<<<Insert a screenshot of your D latch here>>>

<<< Insert a screenshot of your waveform for your D latch here>>>

4.0 Complete the timing diagram below for your <u>Negative</u>-Edge-Triggered D Flip-Flop.
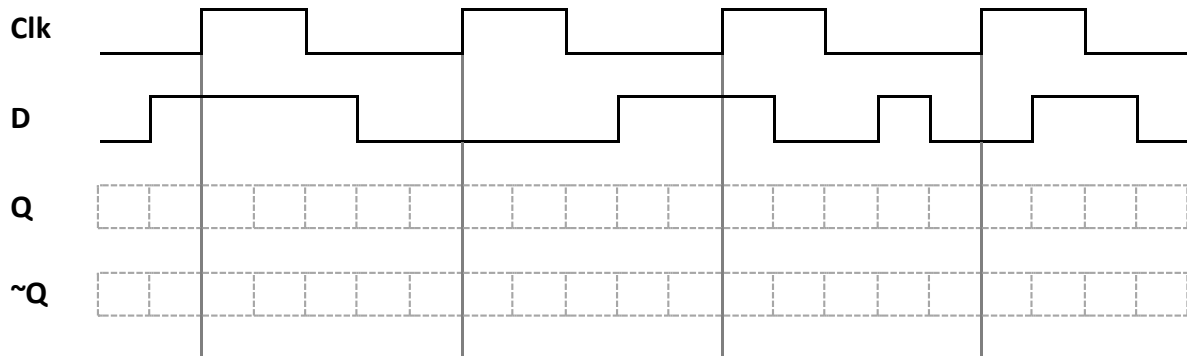
Negative Edge D Flip-Flop Screenshots:
<<<Insert a screenshot of your Neg. Edge DFF here>>>

<<< Insert a screenshot of your Neg. Edge DFF waveform here>>>

Complete the timing diagram below for your <u>Positive</u>-Edge-Triggered D Flip-Flop.

Positive Edge D Flip-Flop Screenshots:
<<<Insert a screenshot of your Pos. Edge DFF here>>>

<<< Insert a screenshot of your Pos. Edge DFF waveform here>>>