

CSSE2010/CSSE7201

Learning Lab 7

Counter Circuits

School of Information Technology and Electrical Engineering
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Today

- Counter Circuits
 - Review of Preparation Task
 - Polling questions
 - Design
 - Build and test or Simulation (Logisim)
- Don't forget preset/clear inputs on flip-flops

Peer Review of Circuit Schematics

- Check the circuit schematic
 - Naming of inputs and outputs
 - Identification of chips (U1, U2 etc) and gates within chips where applicable (:A, :B etc)
 - Identification of types of chips (74HCT00 etc.)
 - Numbering of pins (including for IO board)
 - Power supply connections
 - **Circuit functionality – will it do what was asked?**
- Check schematic guide and device pinouts on Blackboard for more detail
- Ask a tutor if necessary
- Online sessions – talk to other people in your breakout room and discuss among yourselves and make sure you have a correct design on paper

Preparation Survey: How many 74 series logic chips did your circuit schematic use?



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Which of the following best describes the behaviour of a 2-bit up/down binary counter? (U is an input)

- 0% 1. U=1: Q_1Q_0 : 00→01→10→11→00
U=0: Q_1Q_0 : 00→01→10→11→00
- 0% 2. U=1: Q_1Q_0 : 00→01→10→11→00
U=0: Q_1Q_0 : 00→11→10→01→00
- 0% 3. U=1: Q_1Q_0 : 00→11→10→01→00
U=0: Q_1Q_0 : 00→01→11→10→00
- 0% 4. U=1: Q_1Q_0 : 00→01→10→11→00
U=0: Q_1Q_0 : 00→10→11→01→00
- 0% 5. I don't know

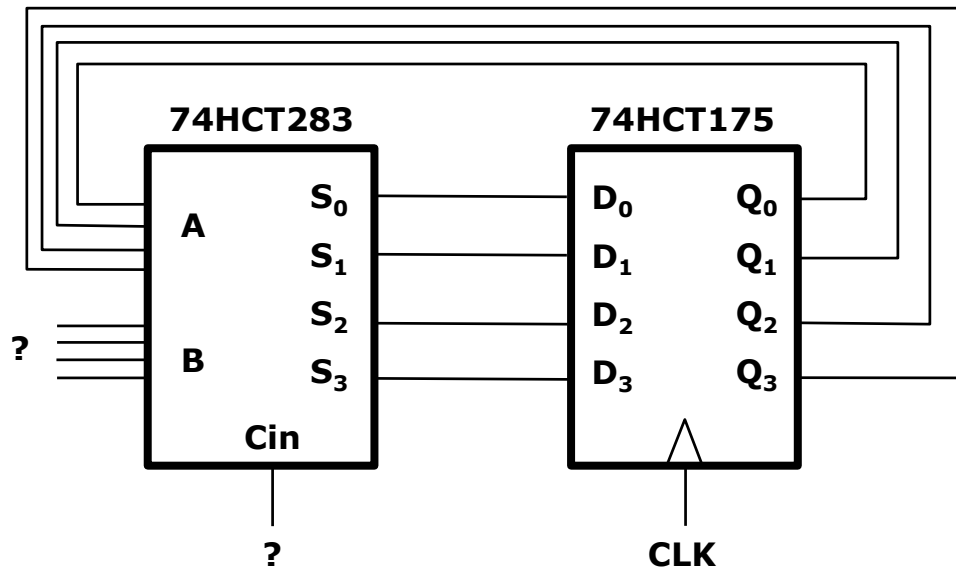
Up/Down Counter

- Complete the truth table for a 2 bit up/down binary counter
 - (U=1 counts up, U=0 counts down)
- Work out logic functions for D1 and D0 in terms of U, Q1, Q0
 - Sum of products
 - Simpler expression?

Input	Current State		Next State	
U	Q1	Q0	D1	D0
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Consider a 4-bit up/down counter built out of a 4-bit adder (e.g. 74HCT283) and 4 flip-flops (e.g. 74HCT175)

- Adder output is connected to flip-flop inputs
 - Current count (flip-flop outputs) connected to one 4-bit adder input (A)
 - What needs to be on the other 4-bit adder input (B) & Cin?
 - When counting up?
 - When counting down?
- ➔ Clicker question



If Cin is 0, what needs to be on the B input?

0%	1. Up: 1000	Down: 0001
0%	2. Up: 0001	Down: 1000
0%	3. Up: 0001	Down: 1111
0%	4. Up: 1111	Down: 0001
0%	5. Up: 0001	Down: 1110
0%	6. Up: 0001	Down: 0001

Tasks

- 4 bit up/down counter built from 4-bit adder
 - Draw the circuit in Logisim
 - Use the “Adder” component
 - Work out how splitters work for wiring
 - Simulate it & verify behaviour is as expected
 - Draw a circuit schematic diagram
 - Use button for clock, switch for up/down input
 - Have it checked by a tutor then build & test it
- Build/simulate your preparation task 3-bit counter and test it
- Draw a circuit schematic for your 2-bit up/down counter
 - Test this 2-bit up/down counter either in simulation or by building the circuit