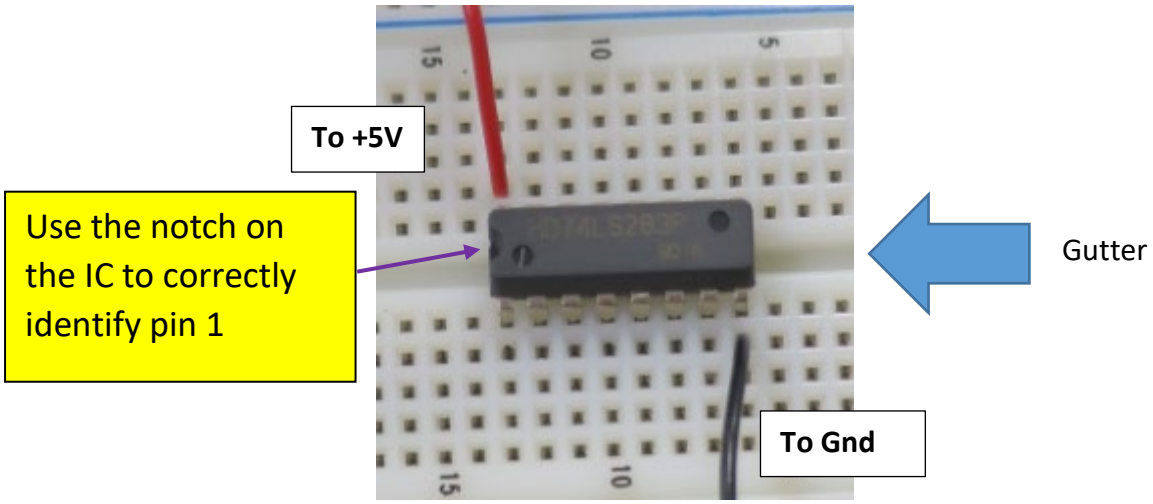
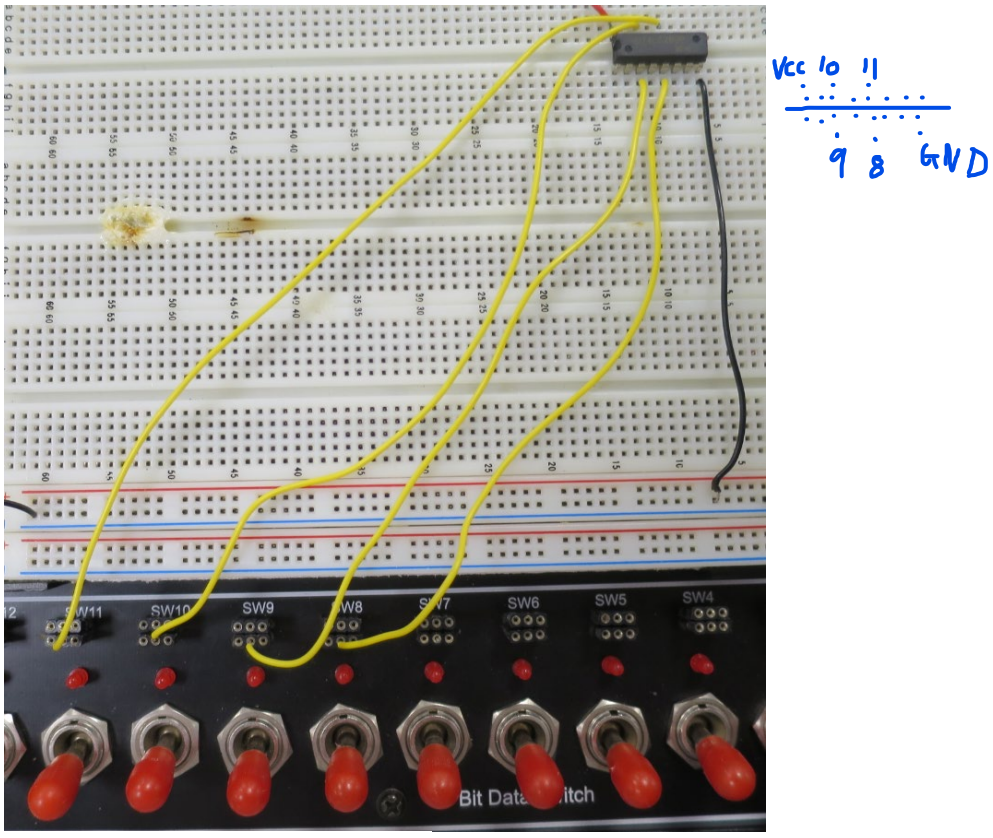
SC1005 Lab experiment 2 circuit connection guide

Different colour wires (they are the same functionally) are usually used to make circuit connections easier to trace. Students are encouraged to follow the wire colours suggested in this guide so that it is easier to trace the logic signals as well as to troubleshoot in the event the connected circuit does not function as expected.

1. Mount the IC 74LS283 (4-bit adder) firmly on the breadboard across the gutter and connect its Vcc (pin 16, **red** wire) and Gnd (pin 8, **black** wire) to 5V and 0V respectively.



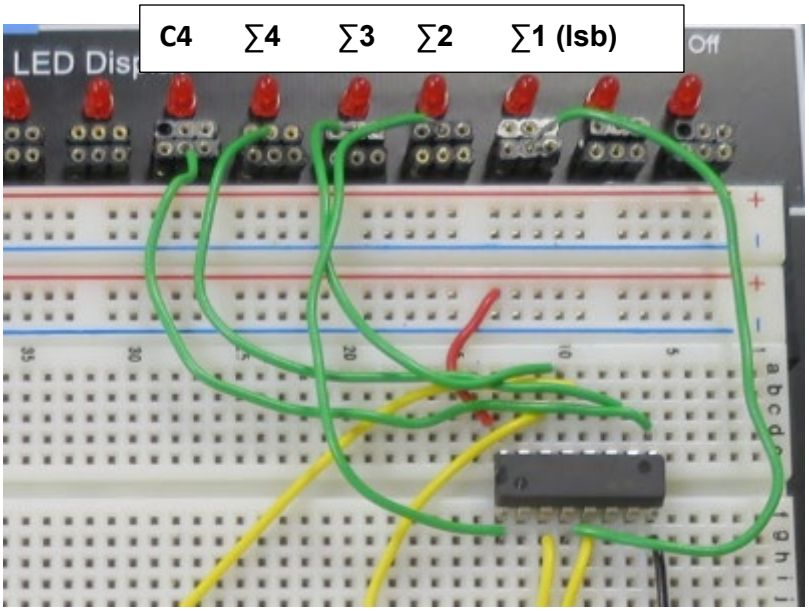
2. Connect the **input** pins A4 (msb), A3, A2, A1(lsb) to a toggle switch each (yellow wires).

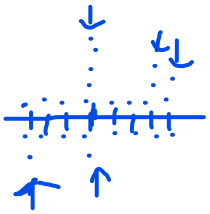


Inputs: **A4** **A3** **A2** **A1**

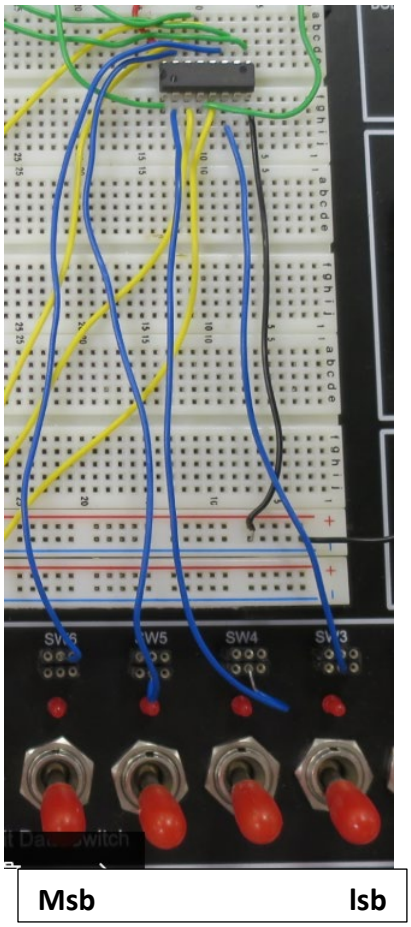
(Msb) **(lsb)**

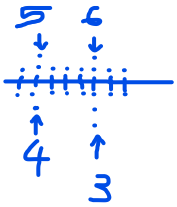
3. Connect the **output** pins C4, ∑4 (msb), ∑3, ∑2, ∑1 (lsb) to an LED each (**green** wires).



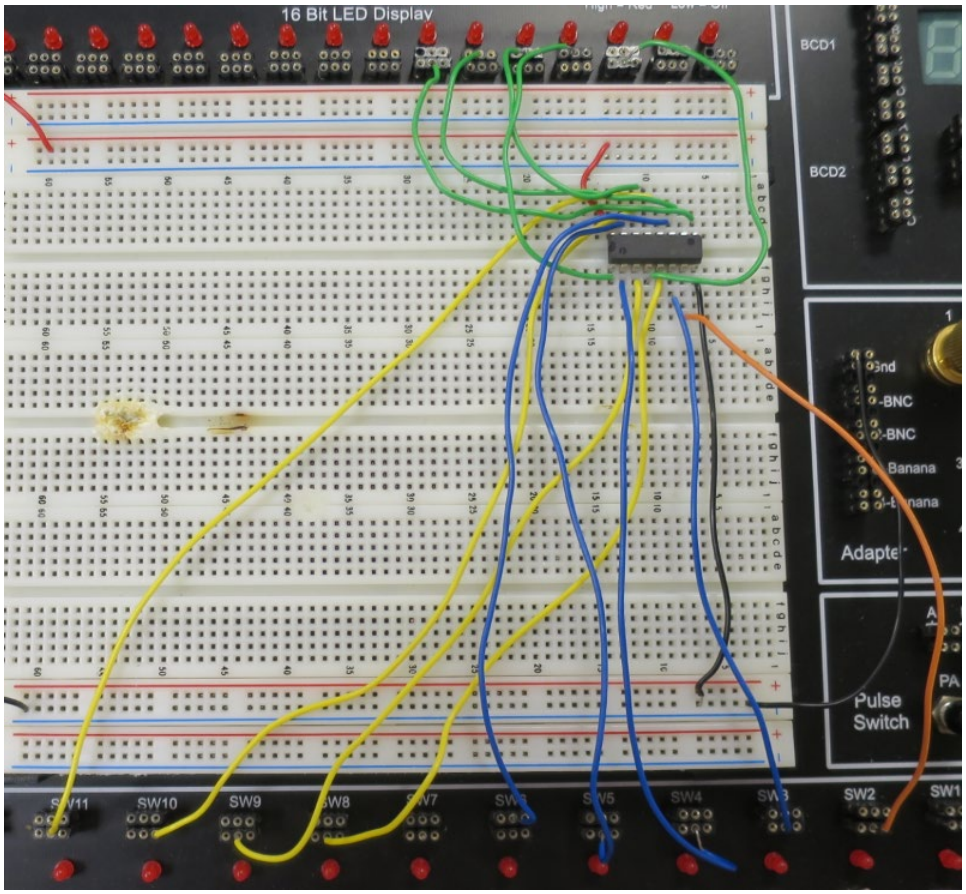


4. Connect the **input** pins B4 (msb), B3, B2, B1 (lsb) to a toggle switch each (**blue** wires).



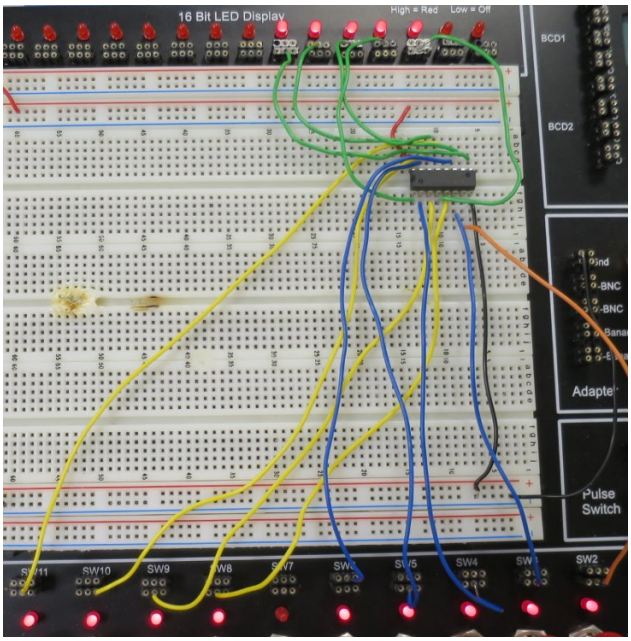


5. Connect C0 (Carry input) to a toggle switch (orange wire).



6. Power up the circuit and test it out for arithmetic addition. This figure shows the largest addition result that can be produced by the 4-bit adder.

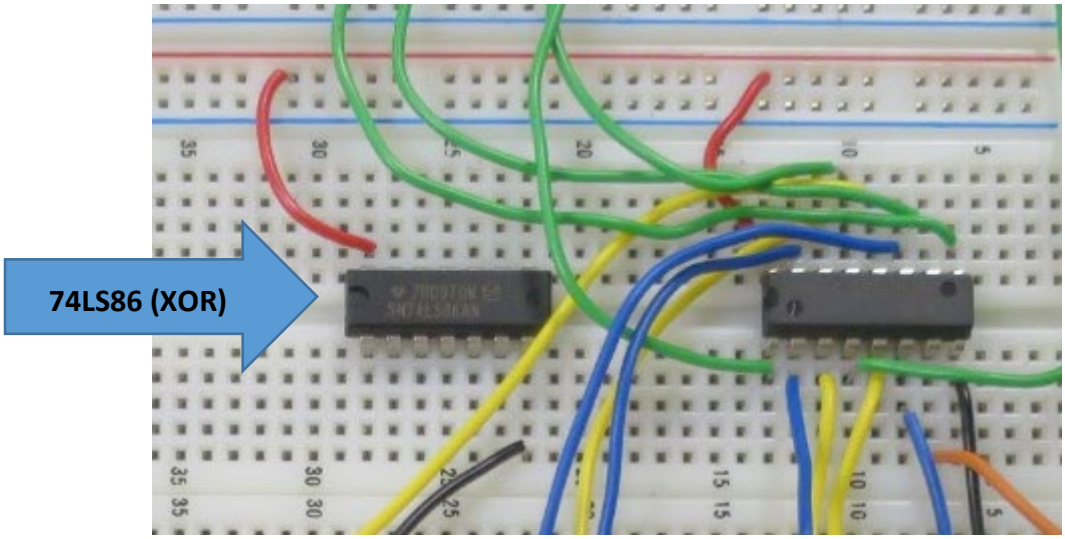
Outputs: C4 ∑4 ∑3 ∑2 ∑1



Inputs: A4 A3 A2 A1 B4 B3 B2 B1 C0

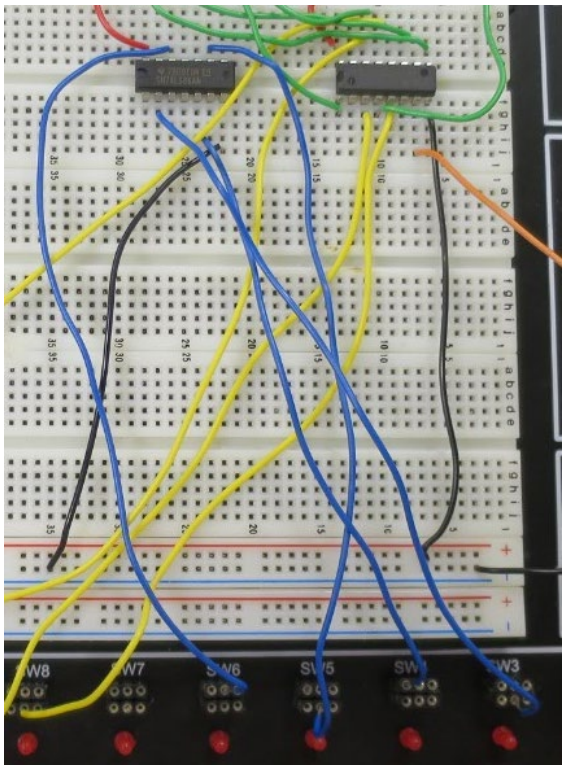
$$\begin{array}{r} 1 \\ 1\ 1\ 1\ 1 \\ +\ 1\ 1\ 1\ 1 \\ \hline =\ 1\ 1\ 1\ 1\ 1 \end{array}$$

7. Power off the circuit board. Mount the 74LS86 (quad-XOR) IC and connect its Vcc and Gnd pins to 5V (**red** wire) and 0V (**black** wire) respectively.



8. Disconnect the toggle switches from B4, B3, B2, B1 of the 74LS283 (4-bit adder) and connect them to the 74LS86 (quad-XOR) instead (i.e. the lower end of each **blue** wire remains connected to the toggle switch, but the upper end is connected to the 74LS86 instead of the 74LS283).

Change this end of each blue wire

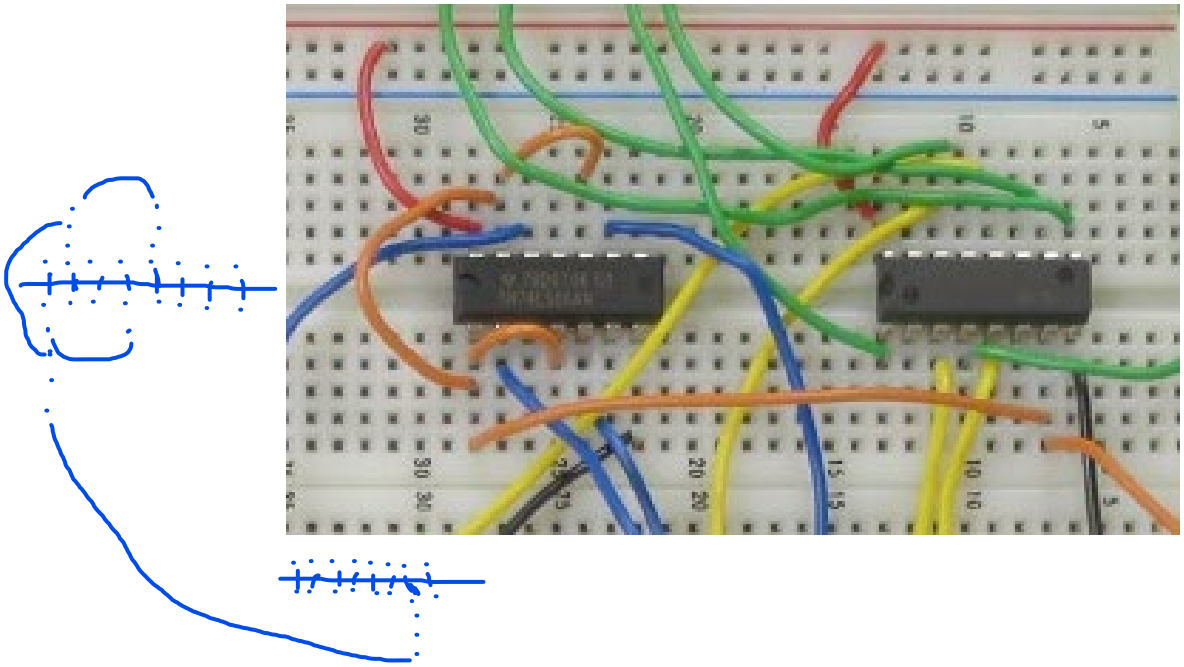


See blue

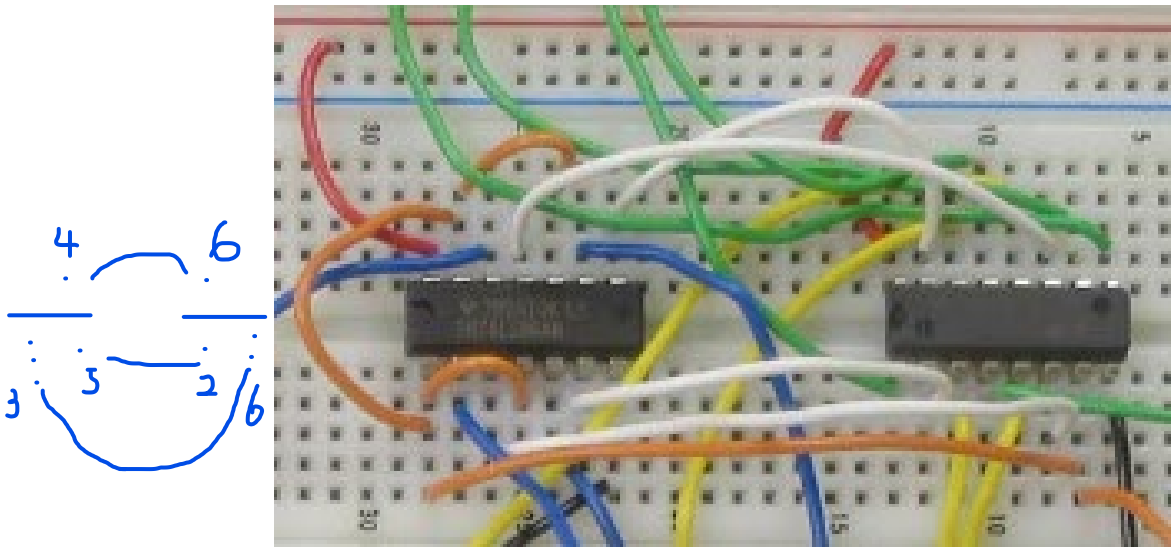
No change to this end of each blue wire

Msb **lsb**

9. Connect the four remaining inputs of the 74LS86 (quad-XOR) to C0 (carry input) of the 74LS283 (4-bit adder) (orange wires).



10. Connect the four outputs of the 74LS86 (quad-XOR) to the B4, B3, B2 and B1 inputs of the 74LS283 (4-bit adder). Make sure the order of the bits (msb to lsb) is correct (white wires).

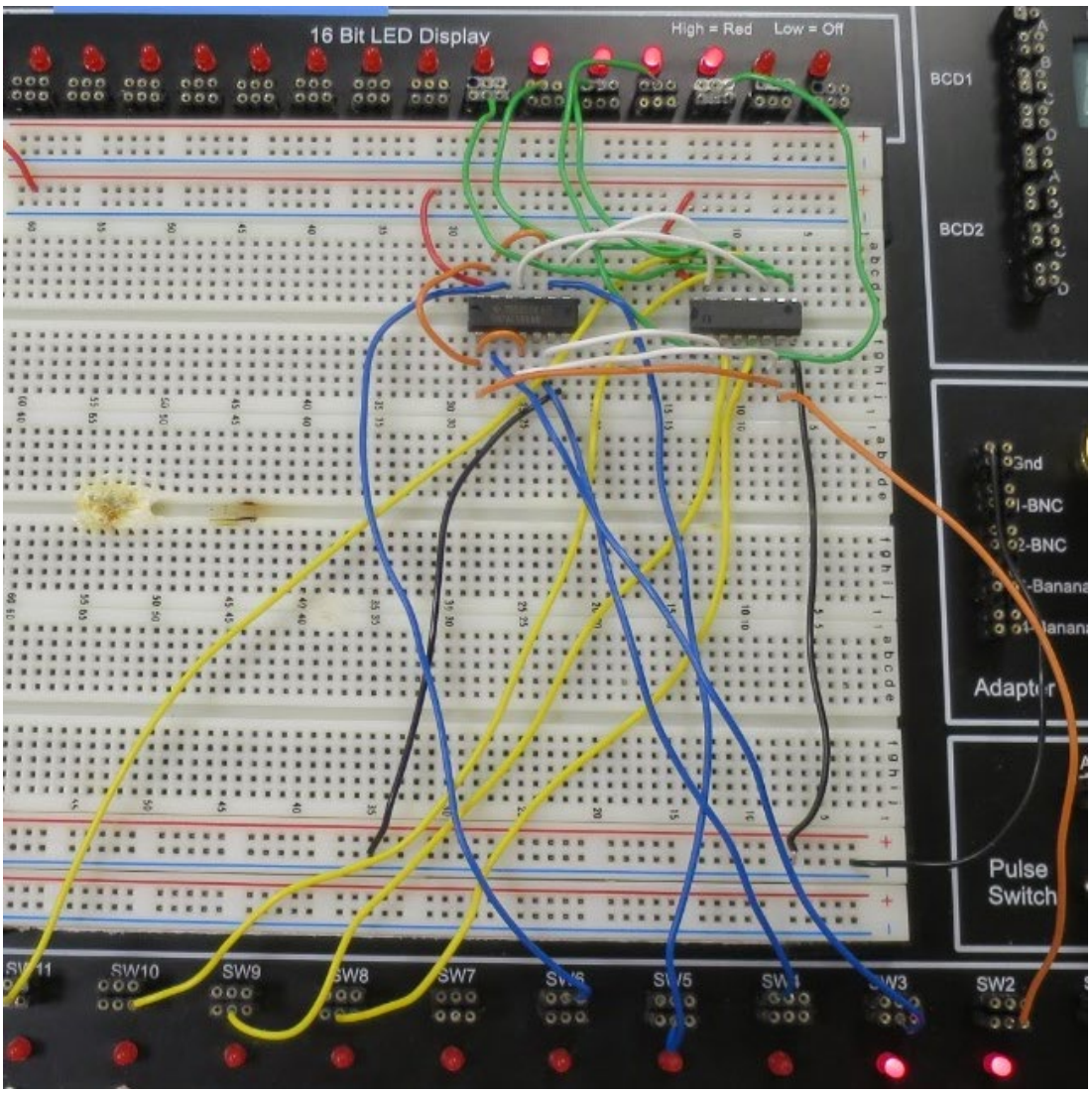


DO NOT simply follow the picture above.

Make sure you have a circuit connection diagram (including pin numbers) so that you know what is connected to each pin.

11. Power up the circuit and test it out for arithmetic addition and subtraction. This figure shows the binary result of x – y (x=0000, y=0001).

Outputs: C4 ∑4 ∑3 ∑2 ∑1



Inputs: x3 x2 x1 x0 y3 y2 y1 y0 Add/Sub

Example:

	0 0 0 0	(0 0 0 0)	
	1 1 1 0	(Invert 0001)	2's complement of 0001
+	1	(Cin = 1)	
	1 1 1 1	(-1)	

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