Lab #2 Familiarity with LogicWorks and Schematics

Start during lab and finish on your own time.

In the lab room, you don't need to install LogicWorks. However, if you wish to install on your own PC to work outside of class, see the online instructions:
http://www.usna.edu/Users/cs/lmcdowel/courses/ic220/logicworks/

Requirements for Logic Works Circuits:
   1) All inputs must be labeled and have switches (or hex keyboards) attached.
   2) All outputs must be labeled and have probes attached.
   3) The circuits must work.
   4) The files you submit must exactly match the printouts you turn in.
It is highly recommended that you label and probe/switch your signals first, rather than at the end, to facilitate testing.

Be sure to save your files on your X drive, not on the local computer, or else you may lose your work.

0. Complete the LogicWorks Tutorial.
   See http://www.usna.edu/Users/cs/lmcdowel/courses/ic220/logicworks/

1. Using LogicWorks, implement and test a circuit for the following:

$$y = (\overline{W} \bullet X + W \bullet \overline{X}) \bullet Y$$

You must use binary switches for inputs W, X, and Y.

Suggested method:
   Select your components and add them to the schematic
   Add switches for I/O
   Add wires to connect the devices
   Label wires from the inputs (you don't have to label intermediate wires)
   Add probes for outputs and label the outputs.
   Test your circuit
Label the circuit and the page in accordance with the specifications in the tutorial. Then print the circuit.

Name your file as follows: Lab2-Part1-section-lastname.cct. Example: Lab2-Part1-2001-smith.cct. You will submit this file later, together with part 2.

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2. (When you are ready, **start a new file** – do not include this in your previous file). You wish to compare two 2-bit numbers and decide if the first is less than the second.
Inputs: W (high order bit of number #1), X (low order bit of number #1),
         Y (high order bit of number #2), Z (low order bit of number #2),
Output: LessThan – true if $WX_2 < YZ_2$.

Example #1: W=1, X=0,   Y=0, Z=1 → 10 is not less than 01, so LessThan is 0.
Example #2: W=0, X=1,   Y=0, Z=1 → 01 is not less than 01, so LessThan is 0.
Example #3: W=0, X=1,   Y=1, Z=1 → 01 is less than 11, so LessThan is 1.

Required steps:
1. Draw a truth table for this function.
2. Minimize the function using a K-map
3. Implement and test the circuit using Logic Works.

Use 4 binary switches, one for each of W, X, Y, and Z. Be sure to test your circuit using all possible inputs.

Label the circuit and the page in accordance with the specifications in the tutorial. Then print the circuit. Name your file as follows: Lab2-Part2-section-lastname.cct. Example: Lab2-Part2-2001-smith.cct.

Deliverables:
1. Coversheet (10 pts)
2. Save files from part 1 and part 2 in a new "Lab2" folder under "IC220" in your X drive. Be sure to read circuit requirements at top of page 1.(20 pts)
3. Print-out of your working circuit for part 1 (20 pts)
4. Truth table for part 2 (10 pts)
5. K-Map and simplified equations for part 2 (20 pts)
6. Print-out of your working circuit for part 2**(with inputs WX=01, YZ=10)** (20 pts)

Extra Credit (up to 10 pts)
Option 1: Expand your circuit for Part 2 so that it also computes two additional signals: Equal and GreaterThan, defined in the obvious ways. You can include this in your file for Part 2.
Option 2: Improve your computation for LessThan so that it can compare 3-bit or 4-bit numbers. It's not required that your circuit be minimal. You can explore other LogicWorks components to try and find easy ways to do this, but the most credit will be earned for solutions just using basic gates. Turn this is in as a separate file: Lab2-Extra-section-name.cct.