

CS 430 Computer Architecture

Problem Set 1

Date assigned: Wednesday, September 3, 2008

Date due: Wednesday, September 10, 2008

Points: 45

1) (10 pts) Consider the IAS instruction set. We will define a redundant instruction as one that could be eliminated from the instruction set and replaced by some combination of instructions from the remaining instruction set. By this definition of redundancy are the instructions LSH and RSH redundant or not? If they are, show why they are and explain why these instructions exist if they are redundant. If they are not, explain why they are not.

2) (5 pts) Using only the axioms and laws of Boolean algebra, show that the following law is true. At each step you can only apply one axiom/law. At each step, state the single axiom/law being applied.

$$X + X'Y = X + Y$$

3) (10 pts) Construct the operation XOR using only NOR gates (Hint: With a two-level POS, simply substitute NOR gates at each level). Also, when giving the NOR gate representation, you need to make an inverter out of a two-input NOR gate depending on your solution. Draw the logic diagram using Digital Works 95, (<http://www.spsu.edu/cs/faculty/bbrown/circuits/howto.html>), and paste it in your Word document.

4) (5 pts) The table below shows the binary-coded-decimal (BCD) representation of the digits 0 through 9. Write a Boolean expression (in simplified SOP form) that expresses an invalid code. Show all work for full credit including your simplification method.

digit	A	B	C	D	
0	0	0	0	0	
1	0	0	0	1	
2	0	0	1	0	
3	0	0	1	1	
4	0	1	0	0	
5	0	1	0	1	
6	0	1	1	0	
7	0	1	1	1	
8	1	0	0	0	
9	1	0	0	1	
	1	0	1	0	<- Invalid codes begin here
	1	0	1	1	
	1	1	0	0	
	1	1	0	1	
	1	1	1	0	
	1	1	1	1	

5) (15 pts) Using Digital Works 95, construct a digital circuit equivalent to your solution from question 4) and then implement your circuit using Digital Works 95. Your circuit is to have four interactive inputs and two outputs. One output is labeled Valid and goes red if the code is valid. The other output labeled Invalid and goes red if the code is invalid. Save your circuit in the CS430 Drop Box as your PUNetCircuit.dwm (for me that is khoj0332Circuit.dwm) and paste a copy of your circuit solution into your Word solution.

Note1: This assignment should be submitted electronically using GoogleDocs. Create a Google document called (01PUNet) and share that document with me. You must not edit the document after the due date and time or it will be considered late. You will not submit a hard copy for this assignment.

Note2: I don't mind you talking about particular problem at a very high level (not a specific solution level) and even lending resources of where more information can be found. Further, all of your solutions are to be original and in your own words. If you have any questions, let me know.

Note3: Please make sure your problem sets are typed, and answered in order.