CSC 103 • HOW COMPUTERS WORK HOMEWORK 1: REFLECTION & SIMPLE CIRCUITS DUE 1:00 PM ON FRIDAY, 17 SEPTEMBER 2010 PLEASE SUBMIT YOUR WORK ELECTRONICALLY VIA MOODLE

Part One: Reflection

The textbook (TMCM) introduces the concept of *structured complexity* as a tool for understanding the workings of a computer.

In practice, complex data can be managed because it can be viewed as being made up of simpler "chunks," which are combined together in some reasonably straightforward way to give the whole... Although the overall structure is very complex, it is comprehensible because the chunking that occurs on each level is manageable. [TMCM, p. 12]

Although the immediate discussion concerns the organization of data within a computer, the notion of structured complexity proves useful in understanding many other aspects of computers as well. Indeed, the intuition that we can understand a concept at some chosen level of detail by treating components as units and ignoring their internal operations is broadly applicable to many aspects of life.

Expand on this theme by picking a suitably complex system **not related to computers** with which you are familiar. For example, you may pick a physical system, such as an organism or a jet aircraft, or an organizational system, such as a government, or something else. In one to two written pages, explain how your chosen system exhibits structured complexity. You should give a description of components at three different levels of the structure hierarchy. In your discussion, make clear how the details apparent at the lower levels are hidden when thinking at a higher level. Do you think this is an effective way of way of dealing with complex phenomena? Why or why not? Do you see other types of problems where this sort of thinking might be helpful?

This reflection will be graded on the following points:

- Clear writing style and clear organization of your thoughts
 - o You must have an introduction
 - o You must have a point or objective to your essay
 - o You must have a conclusion
 - o The reflection should move clearly from one thought to the next
- Creativity and interesting thoughts, comments, reflections

Part Two: Simple Circuits

Following the examples from class, please give the requested alternative representations of the circuits below. To submit a circuit diagram electronically, you can either build it in the circuit simulator (see http://maven.smith.edu/~nhowe/103/labs/simcir.html) and take a screenshot, or else draw it by hand and scan your diagram.

A. Create both a truth table and mathematical formula for the circuit illustrated below.



B. Suppose you want a circuit that will implement a "majority vote" concept for three input wires. One of your friends suggests the formula $(A \bullet B)+(B \bullet C)+(A \bullet C)$. Another friend insists that it should be $(A \bullet (B+C))+(C \bullet (A+B))$ instead.

To figure out which friend is correct, develop a truth table for each formula. Show your work by including columns for all the intermediate values. (You should have one column for each set of parentheses, plus the final result.) What do you conclude from this exercise, both about your friends' advice and circuit design in general?

C. Suppose you want to build a circuit that implements the concept "exactly one out of three." Start by writing down a truth table for this concept. Then give a circuit diagram and its mathematical notation.

[Note: This one is challenging, because going from a concept to a circuit requires creativity and/or experimentation. You may find it easier to write down the formula before the truth table. If you cannot solve this problem completely, show your work for as much as you can do. If you do come up with an answer, try to make it as simple as possible.]