## Homework#1 for ECE 496 Introduction (Chapter 1)

Hardcopy is due in class on Tuesday, January 22

All homework must be done in a group of 2 students. Each group should turn in one hard- copy in class. If your handwriting is unreadable by typical humans, please type your homework.

1) [10 points] What is the difference between computer architecture and microarchitecture?

Would the following decisions be regarded as changes to the architecture or microarchitecture?

- Number of registers
- Clock rate
- Number of transistors in an implementation
- Support for the bgt (branch greater than) instruction
- Implementation of the ALU
- Word length (the number of bits in a word)

2) [10 points] A high level program can be translated by a compiler (and assembled) into any number of different, but functionally equivalent, machine language programs. (A simplistic and not particularly insightful example of this is that we can take the high level code C=A+B and represent it with either add C, A, B or add C, B, A.) When you compile a program, you can tell the compiler how much effort it should put into trying to create code that will run faster. If you type g++ -O0 -o myProgramUnopt myProgram.C, you'll get unoptimized code. If you type g++ -O3 -o myProgramOpt myProgram.C, you'll get highly optimized code. Please perform this experiment on the program myProgram.C located at

http://www.ee.duke.edu/~sorin/ece152/homework/myProgram.C. Compile it both with and without optimizations. *Compare the runt- imes of each and write what you observe*. (To time a program on a Unix machine, type "time myProgram", and then look at the number before the "u", as in the "0.40u" below. This number represents the time spent executing user code.)

3) [5 points] Represent the integer  $+153_{10}$  in 10-bit 2's complement.

4) [5 points] Represent the integer  $-153_{10}$  in 10-bit 2's complement.

5) [5 points] Represent "A. Swartz#13" in ASCII. Write your result in base 10. Pay careful attention to capital vs. lower-case letters as well as spaces.

```
sorin@carbon.ee.duke.edu [29] time myProgramUnopt
Finished
0.40u 0.02s 0:00.43 97.6%
```

6) [5 points] Consider the C-like code in Figure 1. What are the values of a and b after the program executes? What is the type of \*q?

7) [5 points] Research some of the architectural differences between a CPU (Central Processing Unit) and a GPU (Graphics Processing Unit). Why are CPUs more suitable for general computations and why are GPUs very suitable for graphics?

```
int a = 10;
int b = 20;
int * p = &a;
int ** q = &p;
*q = &b;
*p = 30;
```

## FIGURE 1. Code for Question 6