

CSC258 Computer Organization 2008 winter Assignment 3 due Mon.Apr.7 at 5pm in BA2220

1[35] Write a program in CSC258 assembly language to implement a calculator. The operations are addition, subtraction, multiplication, and division. Division by zero produces the answer E. Here is an example.

1.+1.=2.
1.2-.3=.9
-4.5/-0.=E

The input is a sequence of lines followed by the escape character. Each input line is a number followed by an operation followed by a number followed by the equal sign. The output echoes the input with the answer catenated to the end of each line. Each number is an optional minus sign followed by zero or more digits followed by a decimal point and zero or more digits. The total number of digits in a number is at most 4. (A decimal point all by itself is the number zero.) An operation is one of +, -, *, /. The input does not include spaces, tabs, or newline characters.

You must hand in the program and commentary and a sample output on paper in the box in BA2220. You must also submit your program electronically, either by using the submit command on cdf, or by using www.cdf.utoronto.ca/students and click on csc258 and then on submissions. The assignment name is A3Q1 and the file must be named calc.ax. The deadline 2008 Apr.7 at 5pm is firm; submissions are not accepted after that. (Suggestion: for safety, submit something well in advance, but keep working and resubmit.) The program should be lightly but judiciously commented, and the first line should say your name and student number. The paper commentary on the design should be less than one page.

There is a routine called printint on the website. It is not directly of use to you because it is for integers, and your calculator is not limited to integers. But it may be of use as a model.

Suggestion: write the program in the language of your choice, and then translate to assembly language. You can assemble and run your program using ax.c from the course web site and from cdf. You can compile and run ax on any computer, but you should make a final test on cdf because that's where it will be marked.

For 75% credit, you can build an integer calculator (no decimal points). Say clearly in your commentary that you have done so.

- 2 Write a microprogram (sequence of register transfers) for the CSC258 computer that implements each of the following instructions. Describe any special details or changes to the basic computer that are needed to add these instructions to the machine. Do not make any changes to the machine that are not needed.
- (a)[5] BCT *m* (Branch-on-CounT is an IBM mainframe instruction) The content of the accumulator (viewed as a 2's complement number) is decremented by 1. If the result is non-negative, control is transferred to location *m*. (The E bit may change.)
- (b)[5] EXE *m* (EXEcute) Execute the instruction in memory location *m*. This is not a branch to location *m* because the instruction executed after this one is the instruction located after this EXE instruction (unless the instruction in memory location *m* happens to be a branch).