Programming Lab 1A

16-Bit Calculator

Topics: Introduction to the programming environment

Prerequisite Reading: Chapter 1 & Appendix B
Revised: December 10, 2021

Objective: The purpose of this lab is merely to get acquainted with the workspace environment, how to compile the main program (`Lab1A-Main.c`), assemble the assembly language file (`Lab1A-Calculator.s`) that contains functions called by the main program, link them together with the run-time library (`library.a`) to create an the executable image file (`output.bin`), and transfer it to the single-board computer. You are **not** expected to write any code – just to become familiar with the tools.

Assignment:

1. Click on the first (top) yellow link above to view the software installation instructions. Follow the directions to install the workspace. If you are using your own personal computer, download and install the compiler and (if your computer is running Microsoft Windows) GNU make and GNU grep for Windows

2. Download the files `Lab1A-Main.c` and `Lab1A-Calculator.s` and store them in the `src` directory of your workspace folder. Use the following instructions to build and test the Lab 1A sample program:

3. **Windows Only:** Double-click on the file named `setup.bat` that is located in your workspace folder. This will open a command line window with the root of the workspace folder as the current directory.

4. **Linux and OS X Only:** Open a terminal window and change the current directory to the root of the workspace directory.

5. Enter the command "`make`". This will run the compiler, the assembler and the linker, producing the final program in a file named `output.bin`. The make program uses a text file named "makefile" that describes how to compile, assemble, and link the program components together. It is designed to compile any C source code files, and assemble any assembly language source code files, that it finds in the `src` directory. Doing so will produce corresponding object files in the `obj` directory. The make program will then link these object files with the run-time library (`library.a`) to produce the executable image file (`output.bin`); these are both located in the root of the workspace directory.

6. Connect the single board computer to the desktop computer using a mini-USB cable. A window will open as if you had inserted a USB thumb drive. Into that window, copy the file `output.bin` from the root directory of your workspace to the window that just opened. The board will automatically load and execute your program.

7. If everything proceeds normally, you should see the 16-bit calculator on the display of the board shown at right. Use the touch screen to enter numbers, change the radix (number base), or do simple arithmetic operations. The arithmetic operations are implemented in the assembly language file; everything else is implemented in the main program.