Programming your Motor-controller:

Note: I have installed the "PIC C Compiler", "MPLAB", and the chip programmer on the DELL Optiplex computer in the X50 Laboratory. This is the computer to your right as you enter room 1113 G.G. Brown, it is sitting on a table next to a Macintosh. The chip programmer is on the table just to the left of the computer monitor.

Programming in "C":

Note: The icon for the PIC C Compiler is on the desktop (upper right hand corner). The program can also be accessed through the Windows Start menu → Programs → PCW → PIC C Compiler.

Procedure:

1. Start the compiler by double clicking on the PIC C Compiler icon on the desktop or by accessing the program through the Windows Start menu.
2. Once the program is open, verify that the small window on the menu bar reads "Microchip 14 bit". If it does, fantastic, if not, use the pull down menu to set it to "Microchip 14 bit".
3. Go to File → Open
4. Locate the "Me350" folder.
5. Locate the "Example C code" folder.
6. Stored in the "Example C Code" folder is the program that currently resides on your microcontroller. The file is me350t.c
7. Open me350t.c
8. Make whatever changes you want to this file to modify the output of your motor-controller.
9. Use the **Save As** command to save your modified program to either a floppy disk or into the "Team###" folder I have established for each group inside the Me350 folder. I suggest you give your modified program a novel name so that you can easily identify it. Please be careful to make sure you use the **Save As** command. If you don't, your changes will be saved to the original me350t.c file and the students coming after you will have to spend time downloading another copy of me350t.c from Professor Dennis' website. Also, it will probably take them a considerable amount of time to figure out why the program modifications they make to me350t.c are not producing the output that they expect.
10. **After you have saved your file to your team folder or a floppy disk, close it and then reopen it. Don't ask …**
11. Once you have saved your modified program you need to compile it. Located on the menu bar is a "Compile" pull-down menu. Access that menu and compile your program (There is only one selection available in the pull-down menu and that is → Compile)
12. While your program is compiling you should see a compile window appear on the screen. This window tells you the progress of the compiling function.

13. If your program compiles successfully, there will be a "No Errors" statement at the bottom of the Compile Window. Click "Ok", minimize PIC C Compiler and proceed to the MPLAB instructions listed below.
14. If you program does not compile successfully you have an error in your code. Don't panic, the compiler will usually put the cursor on the line where your error is located. Sometimes however, the error may actually be in the line just above or just below the line where the cursor is positioned.
15. Correct your error, save your file and re-compile.

Downloading your program onto your microcontroller:

Ok, now that you have compiled your C source code you are in a position to download your code onto your microcontroller.

Note: The icon for MPLAB is on the desktop (upper right hand corner). The program can also be accessed through the Windows Start menu → Programs→ Microchip MPLAB → MPLAB.

1. Plug the PICSTART PLUS Development Programmer power cord into the nearest wall socket (This is the black power cable that has a wall transformer on one end and the other end is plugged into the programmer). Once the power cord is plugged in, the green LED on the programmer should illuminate.
2. Start MPLAB by double clicking the MPLAB icon on the desktop or access the program through the Windows Start menu.
3. Along the top of the MPLAB window are several pull down menus, the following selections will guide you through enabling the programmer, importing a hex file, and downloading the hex code onto your microcontroller.
4. PICSTART Plus → Enable Programmer (Three additional windows should appear on the screen. They are: "Program Memory Window", "Configuration Bits", and the "PICSTART Plus Device Programmer")
5. I have set the default device in the Device Programmer window to be the PIC16F84A, which is the microcontroller that your motor-control circuit is equipped with. If the device window does not say PIC16F84A, use the pull-down menu to locate and select this device.
6. PICSTART Plus → Erase program Memory (This assures that no other code is in the memory of MPLAB before you Import your HEX code)
7. When you compiled your code, the compiler actually produced about 6 different files. The only files you are interested in, are your "C" source code and the file with the .HEX file extension.
8. File → Import → Import to Memory (a small "explorer-like window labeled "Import Emulation Window" will appear)

9. Using the "Directories" side of this window, navigate to the folder where your HEX file is stored.
10. Select your HEX file and choose "OK".
11. Your code should now appear in the Program Memory Window.
12. We're almost there…don't panic now!
13. Verify that the configuration bits are set to the following values:
    - Oscillator → HS
    - Watchdog → ON
    - Power up to → OFF
    - Code Protect → OFF
14. **Note: Before proceeding, make sure you have disconnected your motor-control circuit from power.** Remove your microcontroller from the socket on your circuit board. This can be done by using the small black tweezers that I have tethered to the programmer. Grasp the chip at both ends with the tweezers and pull straight up. (If you find that you are having to exert a really large force while using the tweezers, make sure that you don't have a hold of the chip socket as well) Please do not remove the tweezers from the lab, it is the only pair I currently have.
15. Place your chip in the programmer. Remember that the end of the chip with the small hemispherical depression on it goes toward the top of programmer socket.
16. Pull the programmer socket lever to the vertical position to lock your chip into the socket.
17. Return to the MPLAB program, you are now ready to program the chip
18. In the PICSTART PLUS Device Programmer window select "Program"
19. A small window will appear that shows the progress of the programming function.
20. If the programming function completes successfully, the progress window will disappear. Additionally, in the PICSTART PLUS Device Programmer window under "Program Statistics" there will a "PASS" indication.
21. Remove your chip from the programmer and insert into the socket on your board. Remember to make sure that end of the chip with the small hemispherical depression is aligned with the end of the socket with the small hemispherical "nock out" in it. Make sure that you have all of the chip's pins aligned with the socket cavities before you apply to much downward pressure to seat the chip in the socket.
22. If you have problems downloading your code onto the chip, check that your chip is locked into the programmer and repeat these steps beginning with step 12. If you continue to have problems please contact me by email (fulcrum@umich.edu) or in person (Room 2178 G.G. Brown)

Note: When re-programming your chip you do not have to erase the chip. Simply import your new HEX file into the program memory and hit program. The chip's memory will be overwritten with the new code.