

Set-up of a Fortran-90 programming environment on Microsoft Windows

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1 Short discussion

As mentioned during the lecture, the main components needed for the development of Fortran applications are:

- *Text Editor*: This is where you type your program, make changes to it and save it on disk (not forgetting to use the `.f90` extension). The file containing your program (for example, `intLogisticEq.f90`) is also called *source code*.
- *Compiler and Linker*: These are two programs (which are often simply named *compiler*) which take the source code and ultimately transform it into an executable program. The programs encountered in this course can be run either from the *Command prompt* or, to make things easier, from the *Scintilla* editor. This is different from the way you usually run Windows applications (clicking on icons). The process is not difficult, but you just have to get used to it. We will describe the second method in more detail at the end of Section 2.2.

A Fortran program can do a lot of things, but it is not so easy to directly produce visual representations (plots, animations) of your simulation from within Fortran. This is why it is useful to install 3 more additional software packages which help with plotting and visualizing your results:

- *GnuPlot* is a well-known program for plotting datafiles (such as those produced by Fortran-programs). In addition to instant display of data plots, it also has the capability of exporting your plot into the high-quality `.ps` or `.eps`-formats, which look nice at any resolution.
- *Ghostscript* is a package for manipulating `.ps/.eps`-files, which can be used from the Windows terminal. However, most of the time you will not work with these programs directly, but through the visual interface provided by *GsView* (see next).
- *GsView* is an interface for *Ghostscript*, which allows you to inspect your plots and also to export them to the more common `.pdf`-format.

We will deal with installing all of the necessary software packages in the next section.

2 Installing the necessary software

Note: Most of the following steps assume your computer is connected to the internet so that you can download the necessary software. All of the necessary programs are open-source and free of charge.

Before installing the software as described below, it is recommended to determine first if you are running a 32-bit or a 64-bit version of Windows. You can get this information if you go to “Control Panel”, then click on “System”. You can usually safely assume that you have the 32-bit version, unless your computer is really new and/or has more than 3GB of RAM (Speicher).

To remove any confusion, we also recommend that you un-install MinGW (if you installed it in class), so that you start with a new installation.

2.1 Installing the Compiler and Linker

The *compiler* and *linker* are the essential programs for developing your own programs, since they are directly responsible for translating your Fortran programs into the internal language of the computer (binary code).

There are many commercial choices for this part, but we will concentrate on the open-source (and free) alternatives here. It is useful to know that there exists a suite of compilers (for many languages, including Fortran, C, C++ and many others) which was created by computer enthusiasts and is available for free on the internet. This is called the *GCC* (Gnu Compiler Collection). *Gfortran* is the part of this suite which is responsible for compiling *Fortran-90* programs. The linker is also included automatically, so you don’t have to worry about it.

1. Go to the website: <http://www.equation.com/servlet/equation.cmd?call=fortran>
2. Scroll down to the Section Download: **Official Release 4.3.3.**
3. Download the 32-bit or the 64-bit version, as appropriate for your computer.
4. Start the installation program.
5. On the next step, accept the license agreement.
6. Change the installation path to `C:\gcc`
7. Click *Install* and wait for the process to complete. A new entry in the Windows Start-menu will be created, containing useful links to the manuals of the compiler.
8. Click *Finish* to close the Installation program. If you get a warning from Windows about some potential installation problems, simply close the message window.
9. As some of you reported during the lecture, it may be necessary to restart the system for the compiler to show-up (some new settings created by the installer may remain ignored by Windows otherwise).

The gfortran compiler should now be installed on your system. Remember that this is a command-line application, so it does not help if you find it and click on it with your mouse. We will discuss the exact usage later. For now, you can test if everything is fine up to this point by starting a Windows terminal session (Hold the Windows-key pressed and press the **R**-key, then type `cmd` and click **Ok**). A black window will pop-up, where you can issue commands to the operating system. If you type there `gfortran -v` and then press **Enter**, you should get some messages indicating the version of the compiler. If you get an error saying that the command was not found, please check that you have completed the previous steps of the installation.

2.2 Installing the Scintilla text editor

Now that you have the compiler installed, the next step is to get a good editor for typing your programs. In principle, you could do this using `Notepad`, but this is not recommended because you would be missing many extremely useful features. One of the important features of a decent editor is “Syntax Highlighting”, which means that the editor uses different colors to distinguish different parts of your program. This makes it very easy to distinguish, for example, between the elements of the Fortran language (`IF`, `ELSE`, `CASE`, etc.) and your own variable names. This simple esthetic aspect makes program debugging much easier.

After some exploration, we recommend `Scintilla`, which is a free, open-source editor with many of the modern features a programmer would need, and is also much easier to learn compared to more “professional” alternatives such as `Vim` or `Emacs` (which can be intimidating for the unexperienced user).

1. Go to the website:
2. <http://opensource.ebswift.com/SciTEInstaller/>
3. and Click on the “SciTE 2.01 MSI Installer”-link (scroll down to the Download section).
4. On the next page, click on *Download* and save the file (`scite-win32-2.01.msi`) to a folder of your choice.
5. After the download is complete, start the installer and Click on *Next*.
6. Accept the license agreement and click on *Next*.
7. Click on *Next* again, then on *Install*. Allow the program to run if you get a dialog from the Windows operating system. Ignore any error message by simply closing the warning windows, then click on *Finish* to exit the installer.

NOTE: *Scintilla seems to have some problems with recognizing some files, so if the file you are looking for does not appear when you are using the Open menu, choose the Show all files-option as the filetype.*

You should now be able to start the “Scintilla” editor from the Start-menu. Before we use it, it is necessary to perform a last configuration to make it integrate nicely with our Fortran compiler:

Open the attached file `fortran.properties` using the Scintilla editor. Save the file using the same name in the folder where Scintilla was installed (usually `C:\Program Files\Scintilla Text Editor`). Replace the existing `fortran.properties` file.

Congratulations! You should have a working Fortran-90 environment now! You can test this by creating a new file in Scintilla where you can type the following:

```
program test
  implicit none
  write(*,*) "Fortran 90 works on Windows also!"
end program test
```

After typing the source code, save the file to a location you can remember later (maybe in a special folder on the Desktop which would hold all of your Fortran files). The name of the program can be freely chosen, but the extension `.f90` is mandatory!

Compiling In Scintilla, go to *Tools*, and select *Compile* from the menu (or press CTRL+F7 /STRG+F7 on German keyboards). This step will create the executable file corresponding to the Fortran source code you have typed. If this step is successful, it should return the message `Exit code: 0` in the Message Window that Scintilla automatically opens in the right-side of the screen.

Running Go to *Tools* and select *Go* (or press F5 on the keyboard) and you should see an encouraging message in the right-side of the screen in Scintilla.

You can now try to create your own programs now using the same steps. As long as the programs will only contain one source code file, this set-up should work fine (contact us if you need to split the code in more files).

2.3 Installing the Gnuplot graphics program

Plotting simulation results is a very effective way of transmitting the information. Normally, your Fortran-90 programs (such as the `intLogisticEq.f90`-example which was shown in class) write the results as columns of numbers in a simple text file. Using simple commands, you can tell Gnuplot to read these data-files and produce figures.

First, we will discuss in detail the installation procedure for Gnuplot and afterwards we will look at several examples. You can skip this installation if you already completed it in class.

1. Go to the website: <http://www.tatsuomatsuoka.com/gnuplot/Eng/winbin/>
2. Extract the archive (`gp45-winbin.zip`) to a folder of your choice and then move the files to a folder named `C:\Gnuplot`.
3. Create a folder named `Gnuplot` on `C:` and copy there all the files from the extracted archive.
4. Create a shortcut on the Desktop to the `wgnuplot.exe` file, which is the graphical interface to `emphGnuplot` on Windows. If you followed the previous steps, `wgnuplot.exe` should be in the `C:\Gnuplot\binary` folder.

You can now click on the shortcut and interactively test some *Gnuplot* commands, as:

```
> plot sin(x)
> splot x**2+y**2
```

In the case of first example demonstrated in class (numerical integration of the logistic equation), you can plot the data by first changing from within Gnuplot (go to *File* → *Change directory*) to the folder where the output file `LogisticEq.dat` is located (most probably, in the same folder as the source-code file), and then issuing the commands:

```
> plot 'LogisticEq.dat' using 1:2 with points title "Euler", \
      'LogisticEq.dat' using 1:3 with points title "RK4", \
      'LogisticEq.dat' using 1:4 with lines title "analytic"
```

where the backslash (`\`) is used for telling Gnuplot that the command is continued on the next line.

For the example on the numerical integration of the Lorenz system, the procedure is similar, except that we now need to use the `splot` command which needs to *use 3* columns because it creates 3-dimensional plots. Don't forget to change to the folder where (`Lorenz.dat`) is located before issuing the command:

```
> splot 'Lorenz.dat' using 2:3:4 with lines title 'Euler', \
      'Lorenz.dat' using 5:6:7 with lines title 'RK4'
```

Of course, you can change further parameters of the plots or write them directly to a PostScript-file. For more information on using Gnuplot, please consult the quick Gnuplot tutorial that was distributed.

2.4 Installing Ghostscript

As previously mentioned, Ghostscript is a system which allows you to manipulate PostScript files, and to convert them to other formats (e.g. to PDF).

1. Go to <http://pages.cs.wisc.edu/~ghost/doc/GPL/gpl864.htm> and select the 32- (`gs864w32.exe`) or 64-bit (`gs864w64.exe`) version, as appropriate for your computer. You may also have them already from the previous lecture.
2. If Windows asks for administrative privileges, allow the program to run.
3. Click on *Setup*, leave the default installation paths and proceed with the installation.

2.5 Installing GSview

1. Go to <http://pages.cs.wisc.edu/~ghost/gsview/get49.htm> and select the 32- (`gsv49w32.exe`) or 64-bit (`gsv49w64.exe`) version, as appropriate for your computer.
2. If Windows asks for administrative privileges, allow the program to run.
3. Click on *Setup*, select the language of your choice and click on *Next* two times.
4. Associate the program with PostScript files only, so that it does not change the settings of Adobe Acrobat Reader.
5. Click on *Next*, leave the default installation path and click on *Next* again.
6. Click on *Finish*, wait for the installation to complete, then click on *Exit* to close the installer.

You should now be able to open with `GSview` any PostScript file that you create using Gnuplot.