ASTR4004/ASTR8004 Astronomical Computing Lecture 00

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Prerequisites

1 Computing environment and shell

1. Before we can get started with Astronomical Computing, we need a computer with certain programs installed. The most important such program is the 'shell'. We will be using the Bourne Again Shell (Bash) in this course. First of all, you will need a computer with a shell program installed. This is always the case for Unix/Linux and Mac operating systems. Windows also provides a command line tool, but you will have to install a Unix-type shell. For Windows users I recommend to install 'cygwin', because it provides all the more advanced functionality of a Unix shell, including X11 forwarding (we'll get to what that is). For Mac users, I recommend to install 'iTerm'.

2. Now make sure you have Bash installed on your computer. Open a terminal program (e.g., 'cygwin' on Windows or 'iTerm' on the Mac) and type:
   ```
   > echo $SHELL
   ```
   This should give you as output something like `/bin/bash`. The last part of the path is the file `bash`, which is the Bash program that starts a Bash shell.

3. Bash is a shell program designed to listen to your commands, do what you tell it to, as well as to browse and modify files and directories on your computer. Bash is a text-based program, so it may seem limiting at first, but we will see that it is very powerful and provides you with full control over advanced tasks, such as scripting (non-interactive Bash mode) or connecting to other computers in the network.

4. Now make yourself familiar with the most basic functions of Bash. I recommend to go through the Bash guide (http://guide.bash.academy) or a similar online tutorial on Bash.

2 Package managers

1. Bash comes with a set of basic commands and some important standard programs will already be installed on your system. However, some other useful programs may not yet be installed, so we have to find a way to add them to your system.

2. In order to install additional programs, it is best to use so called 'package managers'. For Mac users, I recommend to install 'macports' (https://www.macports.org), which is a good package manager. Simply go to https://www.macports.org/install.php and follow the instructions to install macports. You will need to install Xcode and do a couple of further steps explained there.

3. For Linux users, lets assume you already know what you are doing :) ...and for Windows users the situation is basically hopeless :o ...oh well, you can install additional programs with the 'cygwin' package manager.

4. Now you can install additional programs with your package manager.

3   Window manager

If you are using a Mac, you will also need to install XQuartz from https://www.xquartz.org.

Note for Windows 10 users: if you are a Windows 10 user, you install Bash (https://itsfoss.com/install-bash-on-windows/) and you have to install the Xming X Server for Windows. You might also have to set `export DISPLAY=localhost:0.0` in your SHELL environment (e.g., add that to your `.bashrc`).

Also note that if you use the Bash on Windows 10, there are some issues with file permissions, i.e., new files are usually given read/write/exec permissions not only for the user, but also for the group and everyone else. This can cause problems when configuring secure shell (in the following lectures) to connect to other computers/servers. You can fix the file permissions by hand (using `chmod go-rwx [file]`) in that case.

4   Other required/useful programs

1. First you need an editor, a program to open, modify, save and close files. I recommend to install 'emacs'. Using macports on the Mac (see previous section), you would do:
   `> sudo port install emacs`
   This will install emacs. You can start emacs from the shell, simply by typing `emacs`. You can exit with Ctrl-X-Ctrl-C. Have a look at the emacs manual to learn about basic commands to control emacs (such as open/close/save files, and exit, ...there is a lot more that can be done with emacs, but we will only use the most basic functions here).

2. Two other useful programs that we will need for some of the later lectures are 'rsync' and 'gnuplot'. The first one is a program to copy/synchronise files on your and other computers and the second one is a plotting package. If they are not yet installed, please install them with your package manager. See if they are installed by typing:
   `> rsync`
   which should bring up a list of command line options for rsync and
   `> gnuplot`
   which should start gnuplot. You can exit gnuplot by typing `gnuplot> exit`.

3. You can install more programs as required. For example to search for a program by name, in macports, you can type:
   `> sudo port search [name_of_program]`
   to see if that program is available for installation.

4. A note on X11 (so you can use windows and graphics on your own as well as on remote computers), the simplest is to install gnuplot
   `> sudo port install gnuplot`
   which comes with the required xorg libraries.

If you need more information, please ask me and/or use the power of searching the internet to find some answers. But do not necessarily trust either of those :)

CAUTION: be careful with copying-and-pasting code or shell commands from this PDF document into the shell or into another document (e.g., a script opened in an editor). You may not be getting what you are seeing on the screen, for example, depending on the exact editor, shell, and PDF viewer, the special characters '(', ')', ' ' ', '%' can all cause problems when doing copy-paste operations. This is because of potential differences in character encodings between the PDF document and the shell or script editor.

In general, you can use `man [command]` *to bring up the manual page of a program/command to learn about possible command-line options for shell program(s), or search the internet for answers/solutions; especially if you get unexpected errors or warnings. Usually, someone else with a similar or the same configuration of your computer/script/shell/code will have encountered a similar problem/issue and you primarily have to learn how to search for the right answer on the internet.*