Primer of key Programs and Environment Setup

Part 1. Basic Unix Handling

The purpose of this part is to set up a computer account for you in the lab and practice the basic skills of file handing and editing on UNIX platform.

(1) Reboot the machine

Start the machine in linux mode by physically powering off the machine. Wait until it shows a screen with two choices (Linux or windows), use arrow keys to make sure unix is highlighted, hit   RETURN.

If it is running Windows, select "shut down" option from the "start" menu.

Choose "linux" option upon reboot.

If you are at the login screen, first click on the center button (out of 3) and select "GNOME", then username and password to login.

(2) Open a terminal (also called Command Window). Almost all your work, your commands, your plotting will be done in a terminal or multiple terminal windows.

Click on **applications** -→ **Accessories** -→ **Terminal**

   Or click the icon that looks like a computer monitor.

(3) Login to your university of Alberta account do "ls" will show that you have no files there, and do

 ls ~ygu

will show you my directories that are visible to you.

(4) Save your current **.bashrc** in ~username directory to a backup file. You may or may not have created one of these files, just in case, type the following commands:

> **cd**
> **cp .bashrc   .bashrc_original**
> **cp ~ygu/.bashrc   .**

Note, you must keep the "." as they are. The last command above means "copy the .bashrc file from Dr. Gu's directory to the current directory without name change".

(5) When the above operation is completed, **kill the current command window (this only needs to be done once after the .bashrc file).**   Then start a new command window (to allow the environmental file to take effect), then try

taup

If you get a java interface to pop up, you have successfully setup your account to run some of the key software installed for this class (you can have a look at the .bashrc file to locate the source files). If not, you may need to carefully check the above operations and see if you have missed something.

The operation involving .bashrc only needs to be performed once only for this semester.

(6) List all files in a directory that ends with ".SAC"

ls ~ygu/seismolab/lab1/*.SAC

(7) Create a directory in your home directory space called **mylabs** by
   mkdir mylabs
   (mkdir---stands or MaKe DIRectory. Some of the class exercises can be done in this directory, obviously you could create ones like "homework", "project", or whatever directories for your other tasks.

(8) Find where you are.
   pwd   (stands for "present working directory")
   (one of the hardest things is to always be aware where you are and where you put your files. Don't be stingy with the use of pwd to always be aware of where you are.)

(9) Go to the directory you made and the files you open here will be stored here as well.
   cd mylabs

(10) Make a directory called "lab1" and go there
   mkdir lab1
   cd lab1
   do a **pwd** to make sure you are here.

(11) Copy a file from a directory under my account
   cp source_file_name   destination_file_name
   Now, Copy a test SAC file from my directory to your present directory

   cp ~ygu/seismolab/lab1/test_4.seed .
   cp ~ygu/seismolab/lab1/junk.txt   newjunk.txt

   Note: The first copy uses has same name (the '.' Approach), the second copy changed the name to 'newjunk'

(12) Editing a file using EMACS, this can be done in two ways, if a simple txt file is called newjunk.txt, you can type
   xemacs newjunk.txt
   remove the line "remove me here"
   save buffer as "newjunk1.txt"

(13) Now do
   ls   (to see if you have 3 files in your directory now)
   more myjunk1.txt   (to see the content of the file)

(14) Remove myjunk.txt and myjunk1.txt
        rm myjunk.txt   myjunk1.txt

Part 2: Basic Programs for your future use
(1) Program: **finddelta**

----- This program will read the location of source (in latitude and longitude) and station (lat, lon), then it will compute the epicentral distance between the source and receiver in both arc degrees and in km. More importantly, it will tell you the azimuth and back-azimuth of the earthquake.

Theory: Use Euler angles to perform coordinate transformation (see notes).
    How to run:
            finddelta (this actually runs an executable in ~ygu/seismolab/bin/finddelta)
    Case 1, put in:
            Source lat, lon: **0.01 0.01**
            Station lat lon: **0.01   100.0**

    Case 2, put in:
            Source lat, lon: 50.0 0.01
            Station lat lon: 50.0 100.0

Why are the distances different?

(2) Program: **taup**

----- This program enables you to find the possible rays associated with a source-station distance.   You can input distance, depth of earthquake, and phases of interests, then the program tells you what time a given phase should arrive and also allows plotting the ray for you and more!

    How to run:
                taup
    > enter an epicentral distance of your interest (default=50 deg, close to 5500 km)
    > enter the earthquake depth (default = 0 km)
    > choose the Model of interests, say "PREM"
    > click 'Calculate', a table will show up with distance, depth, phase name, and
                            TIME as well as Ray parameter.
    > Now your phase of interests may not be there, this can be for 2 reasons:
            1. At this distance range, there is no such phase 2. your phase is not entered
    To enter new phase, click on "**Phases**", Add you phase name if it is not in the list,
         hit **RETURN to add, then 'close'**
        > Click "**Pierce**" on top allows you to view the piercing points of the ray within the model layers.   You get distance and depth. This actually is a rough path for the ray (distance, depth)
            > Now, Click "**Path**" on top allows you to view the ray path for each available phase.   You can toggle the phase name, and a red path will indicate the path of this specific phase. Pretty cool.

(3) Program: **rdseed**

----- This program will read file you get from IRIS and open up all the included info. You actual data seismograms can be extracted into different format using this one.

How to run:

rdseed
> Input File...:   **enter the seed file name, then hit RETURN**
> Output File (stdout): don't enter anything, hit RETURN
> Volume: RETURN
> Options: enter **d, then hit RETURN**
> Summary file: RETURN
> Station List: RETURN
> Channel List: RETURN
> Network List: RETURN
> Loc Ids: RETURN
> Output Format: RETURN
> Output poles & zeros: **enter Y, then RETURN**
> Check Reversal: **enter 3, then RETURN**
> Select Data Type: RETURN
> Start Times: RETURN
> End Times: RETURN
> Sample Buffer Length: RETURN
> Extract Responses: **enter Y, then RETURN**
> Input File...:   **type Quit**

---- Now, if you do
   ls
you will find a large number of files being extracted. The key types are:
1. **The 3 component seismograms that end with .SAC**
   ---Note sometimes you will have a lot files, possibly with different names, etc. This
   is because you requested multiple stations. In test_3.seed, many stations are requested
   with names such as PAR, SUMG, etc. The network names are IU, GE, etc, and the starting time of your requests are 2005.087 where 087 represents the Julian date (the total number of days in a given year since Jan 1 that year). The formats are
       Year . julian_day . Hour . Minutes . Sec_in_4_decimal_place
   ----Note you also have different types such as BHZ, BHN and BHE (these is a group of our interests), stands for Broadband High gain Vertical, Northsouth, Eastwest. Sometimes two seismometers of different frequency responses (say, new and old) are at the same site. You may then have LHZ, etc. This stands for the cheaper, older kind, the long period seismograph.

2. The 3 component instrument responses that begin with SAC_PZS_*

> ---These are the pole-zero files that we talked about last term. They come from the transfer functions. The zeros are on top, poles are on the denominator. These files allows us to obtain more "instrument-free" data by removing the instrument effect through deconvolution.

(4) Program: **sac**

----- This program is comprehensive Seismic Analysis Codes provided by University of Illinois.

A good site to visit

http://shadow.eas.gatech.edu/~zpeng/Teaching/Sac_Tutorial_2006/#part1_1
How to run:
   sac

   sac> **read**   your_.SAC_file
   sac> **plot**
   *after these two simple operations, you should see your seismogram with information. Note SAC graphics can be affected by your other working windows. When working with sac, you should make sure your command window does not overlap with graphics window, and in case graphics are affected, type plot again will cure it.

Useful SAC commands:
   read ----- you can actually read many files by
         read file1 file2   file3
   plot1 ----- plot all the files in one profile/window
   listhdr ----- list header information
         most important ones:
               NPTS ---- number of time samples
               DELTA ---- data sampling interval (in sec)
               IDEP ---- the type of instruments which could be
recording displacement, velocity or acceleration
               KZDATE --- GMT date
               KZTIME ---   GMT time
               STLA   ----   station latitude
               STLO   ----- station longitude

   xlim 0   500 ------ only display the data from 0 to 500 seconds

   bp corners 0.01 0.1   ------ apply a Buttersworth Bandpass filter to

remove frequencies outside $0.01-0.1$ Hz.

quit -----quit SAC.

(5) Program: ~**plotsac**

----- This program is my little code to convert a SAC file to a simple (time amp), 2-colume text file. You can use matlab to view it, etc.

How to run:
>   **plotsac**
> **> 3**
> > 0
> > SAC_file_name
> > your_output_name
> > 0

An output file will occur with your_output_name in 2 columns.

(6) Visualizing the seismogram with "xmgrace"
xmgrace is a user-friendly program designed to visualize two column file or files for simple comparisons and manipulation.

(6) Sac only tells me the station location, but no earthquake location, what can I do to find earthquake timing.
> Step 1:   Use the times of the request file to roughly know which day quake occurred
> Step 2:   Go to site   http://www.globalcmt.org/CMTsearch.html
> Enter appropriate info and identify the CMT Solution for your event. BUT,

CMT only works with quakes of 5.5 or greater in general. So you have to other things to find smaller earthquake times.