

Linux primer

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Motivation – Why do you need this?

- **Shared CBSU environment**

- Central storage: images, scripts, documents, etc.
 - Backup (automatic)
- High-Performance Computing: analysis
 - Speed (only if you know the “tricks”)

LINUX

- **Challenges/Tasks**

- “Where are my documents?”, “Where are the tools?”, “Where am I?”
- “Can I have this script/image?”
- “Why cannot I open this document?”, “File I/O error???”
- “How could I analyse 20 subjects in one go?”

- **Fun? → Efficiency**

- Programming¹

Basics

Unix Primer – Concept

- **File system**

- Names (file and commands) are case sensitive
- No file extensions
- No drive letters, root = “/”
- Directories can be network shares
 - */home, /imaging, /group, /mridata*
- home, Home, HOME?
- Well...
- “Where is drive U:?”

- **Permissions¹**

- User (owner)
- Group
- All
- “File I/O error!”
- “Am I in this group?”²

- **Path (*PATH*)**

- Current folder is not assumed (unlike Windows or MATLAB)
- “But my script is here!”

Unix Primer – Desktop, here you are!

- **Applications**
 - Accessories:
 - gedit
 - Take Screenshot
 - System Tools
 - File Browser – **nautilus**
 - System Monitor
 - Terminal
- **Places**

Unix Primer – Terminal

- **Why?**
 - Faster and more powerful than GUI
 - No window drawing (But: You can call GUIs¹)
 - More functions (N.B.: GUIs are just wrappers)
 - Scripting: higher speed and flexibility
 - Wrappers
 - Batches → Parallelisation

Unix Primer – Terminal

- **Shell**

- Encapsulated (“in a shell”) environment
 - Execute commands (maximum as long as its “parent” terminal is open¹)
 - Variables²
 - Command history!

- **Command editor**

- Command prompt
- Interactive
- Scrollable, editable, tab-completion
- Keyboard short-cuts (a bit different for CSH and BASH):
 - History: Ctrl+R
 - Break: Ctrl+C

Unix Primer – Terminal

- **Structure of commands¹:**

- Executable [Arguments(s)]
 - [-/--]Option(s)
 - Input(s)
 - Output(s)

- E.g² .:

fslview -h/--help

Usage:³

fslview [-m 3d|ortho|lightbox]

[<baseimage>] [-l lutname] [-b low,hi] [-t transparency]

[<overlay> [-l lutname] [-b low,hi] [-t transparency]] ...

fslview -m ortho,lightbox swmStructural.nii spmT_0001.nii -l "Hot" -b 3,5 -t 0.5



Unix Primer – Useful Commands

Help/Info	<i>man, -h, --help</i> <i>man -k</i> <i>pwd</i> <i>echo</i>	Help find similar or related commands present working directory display text or variable
Listing	<i>ls</i> <i>cat</i> <i>top</i> <i>id -G -n <username></i>	directory file processes list group memberships
Searching	<i>locate</i> <i>which</i>	file executable
Navigate	<i>ssh</i> <i>cd</i>	compute machine directory

Unix Primer – Useful Commands

Manipulate	<i>mkdir</i>	create directory
	<i>cp (-r)</i>	copy (directory)
	<i>mv</i>	move/rename
	<i>rm (-r)</i>	remove/delete irreversibly (directory)
	<i>chown (-R)</i>	change owner (directory)
	<i>chmod (-R)</i>	change permission (directory)
	<i>vncserver</i>	create/kill VNC session
	<i>dos2unix, unix2dos</i>	convert text file (EOL)
	<i>wget <URL></i>	download
	<i>tar -czf</i>	Compress into .tar.gz
	<i>tar -xzf</i>	Extract from .tar.gz

Unix Primer – Useful Commands

Practice

- **1. “I have it somewhere...”**
 - Does *train12linux* have a *thresholds.txt* in his/her **imaging space**?
 - Can you read it? Why?
 - Can you write it? Why?
- **2. “Lets collaborate!”**
 - Op. 1.: Get a copy → Edit → Copy back
 - Can you do it? Why?
 - Op. 2.: Make it accessible
 - Parallel editing?

Advanced

Unix Primer – Make your life easier!

- **File browser - nautilus**

- Create Bookmarks
- Once a browser, always a browser

- **Symbolic links**

- References to folders/files
- Create: `ln -s <original> <link>`
- Delete: `rm <link>`, `unlink <link>`

1. Search `pathdef.m`
2. Copy it to the top of your imaging space
3. Create a link called `link_to_pathdef.m`
4. Delete (new) `pathdef.m`
5. Open `link_to_pathdef.m` (`cat`, `gedit`)

- **Aliases:**

- Short-cuts to command/script/program
- Define: `alias` (with no arguments, lists existing aliases)
- Un-define: `unalias`
- E.g.:
 - `alias vnc 'vncserver :99 -geometry 1280x920'`
 - `alias matlab_my 'cd ~/Documents/MATLAB;/hpc-software/matlab/r2013a/bin/matlab'`

Unix Primer – Command-line

- **(Re)direction**
 - “|”: pipe output to another command; e.g.: *ls /bin | more*
 - “>” and “>>”: redirect output to a file
 - e.g. > *ls /bin > binlist*
 - “2>”: redirect error (useful in scripts)
 - 2>: redirect error to a file; e.g. > *ls /bin /junk 2> errors*
 - 2>&1: redirect error to the output; e.g. > *ls /bin /junk > binlist 2>&1*
- They can be combined into “mini-program”:¹
 - Practice!

Unix Primer – Command-line

- **Beginner:** “What is the maximum T-value in *spmT_0001.nii*?”

- Save result into *maxval.txt*
- Use *fsfstats* and *awk* '{print \$2}' !

```
fsfstats spmT_0001 -R | awk '{print $2}' >> maxval.txt
```

- **Intermediate:** “What TR has been used for *dicom.dcm*?”

- Use *mri_probedicom*, *grep* and *awk* '{print \$3}' !

```
mri_probedicom --i dicom.dcm | grep TR | awk '{print $3}'
```

- **Advanced:** What sequence has been used for *dicom.dcm*?

- Use *mri_probedicom*, *grep*, *awk* '{print \$2}' and *sed* 's/+AF8//g'!

```
mri_probedicom --i dicom.dcm | grep tProtocolName | awk '{print $3}' | sed 's/+AF8//g'
```

Unix Primer – Useful Commands (toolkit)

<i>grep <filename></i>	Print lines with pattern fit
<i>grep -c ptrn <filename></i>	Print number of lines with pattern fit
<i>awk '{print \$2}' <filename></i>	Print second entry only (of each line)
<i>sed 's/ptrn1/ptrn2/' <filename></i>	Print content with ptrn1 replaced with ptrn2 (first instance only)
<i>sed 's/ptrn1/ptrn2/g' <filename></i>	Print content with ptrn1 replaced with ptrn2 (globally)
<i>printf "format" inpt</i>	Formatted print (~ MATLAB)
<i>echo "statement" bc</i>	Calculator
<i>seq n</i>	Sequence of integer up to n (useful for loops)

Unix Primer –Scripts

- **Definition:**
 - Collection of commands (in a structured way)
- **Login scripts**
 - `/home/<username>/system.cshrc` - CBSU-specific general `.cshrc`
 - `/home/<username>/login` - on login
 - `/home/<username>/cshrc` - on opening a shell
 - Add your script storage folder to the PATH
 - Store aliases
 - Configure FSL, FreeSurfer

Scripting

Unix Primer – Scripts

E.g.: (.bashrc)

```
export PS1='\u@\h:\w\> '
```

```
alias matlab_2013a='/hpc-software/matlab/r2013a/bin/matlab'
```

```
alias imagej='cd /home/ta02/Programs/ImageJ;./run'
```

```
if [ -d ${HOME}/bin ]; then
```

```
    export PATH=${HOME}/bin:${PATH}
```

```
    for i in ${HOME}/bin/*; do
```

```
        if [ -d $i ]; then
```

```
            export PATH=${i}:${PATH}
```

```
        fi
```

```
    done
```

```
    . ${HOME}/bin/defaults.sh >> /dev/null
```

```
fi
```

```
fsl_setup_noecho
```

```
freesurfer_setup_noecho
```

```
if [ -d ${HOME}/matlab ]; then rm -r ${HOME}/matlab; fi
```

```
# setup environmental variable
```

```
# define alias
```

```
# define alias
```

```
# start condition
```

```
# setup environmental variable
```

```
# start finite loop (based on a list)
```

```
# start condition
```

```
# setup environmental variable
```

```
# end condition
```

```
# end loop
```

```
# source a script discarding its output
```

```
# end condition
```

```
# launch a script (already in the PATH)
```

```
# launch a script (already in the PATH)
```

```
# one-line condition block
```

Unix Primer – Scripts

- **Scripting “Languages”**
 - Any interpreter:
 - shells – */bin/sh, /bin/bash, /bin/tcsh, etc*
 - interpreted languages - *perl, python, etc*
- **Syntax**
 - Depends on the scripting language or shell used

Unix Primer – Scripts

- **Execution**
 - command line
 - execute with interpreter and script file
 - e.g. *bash test.sh, perl test.pl, python test.py, etc*
 - uses “parent” shell’s environment
 - embedded
 - interpreter in the first line of the header, with #! (use the full path!)
 - e.g. *#!/bin/bash, #!/usr/bin/perl*
 - must have execute permission on the file
 - execute with script file alone
 - e.g. *test.sh, test.pl, test.py, etc.*

Further Information

- **Linux:**
 - Basics:
 - <http://imaging.mrc-cbu.cam.ac.uk/methods/unixsurvivalguide>
 - <http://www.ee.surrey.ac.uk/Teaching/Unix>
 - Scripting:
 - <http://tldp.org/LDP> (both Beginner and Advanced)