Introduction to the Shell

Spring 2016 BZAN 583

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Contents

Office Hours

- SMC 527 D
- Open: MW 9:00-10:00am.
- Others by appointment as schedules permit.
- Additional help: Research Support (call the helpdesk, 974-9900)

The Next 3 Classes

1. Shell basics (today)
2. Shell scripting + Application
3. wrapup + git

Introduction

Today's Learning Objectives

- Gain some historical perspective.
- Become acquainted with basic interactions with the shell.
- Learn basic system monitoring.
- Discuss file manipulation.
- Introduce the standard pattern tools (`awk`/`sed`/`grep`)

On Learning

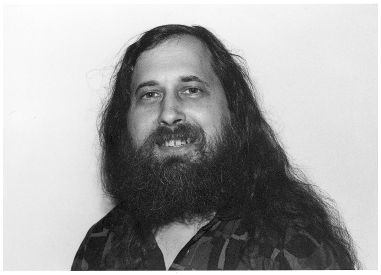
In mathematics, you don't understand things. You just get used to them.

Some Dates

- UNIX: Bell labs, 1970
- GNU: MIT, 1983
- Linux: University of Helsinki, 1991

The GNU Perspective...

I'd just like to interject for a moment. What you're refering to as Linux, is in fact, GNU/LInux, or as I've recently taken to calling it, GNU plus Linux. Linux is not an operating system unto itself, but rather another free component of a fully functioning GNU system made useful by the GNU corelibs, shell utilities and vital system components comprising a full OS as defined by POSIX.



The Confusion

- "Linux"

- Mac OS X
- FreeBSD, OpenBSD, NetBSD, . . . (“the BSD’s”)
- Solaris

It’s So Old! Why Now?

- Free (beer/speech)
- Powerful
- Multi-user by design.
- Great for servers and batch computing.
- Guess what big data needs. . .

Example Use Cases

- Servers — persistence (data consumption)
  - Grab data from a service periodically (e.g., scraping twitter)
  - Running a database
- Batch Computing — long running jobs (data analysis)
  - data mining
  - statistical modeling

Why Even Bother? I know R/Python/. . .

The Right Tool for the Job

```
du -h big.txt
## 41M  big.txt

time sort -u big.txt | wc -l
## 1048576
##
## real 0m2.472s
## user 0m6.068s
## sys  0m0.128s
```

Basics

Some Basics

- No drive letters (yay!)
- No registry (YAY!)
- *Everything* is a file.
- Multi-user design.
- `#` is a comment; text that follows is ignored*

Getting Help — `man`

- Manual — built in help
- Useful for identifying flags
- Most useful as a reference (not a teaching tool)
- `q` to exit.

Example

```
man ls
man
man man
```

Getting Help — The Internet

- search engine
- stackoverflow
- Phrases:

  - shell
  - scripting
  - bash
  - linux

Searching

- Many programs (`man`, `less`, `vim`, ...) use `/` to search.
- Example: start `man ls` and enter: `/disable`
- Find next match: `n`
- Find previous match: `N`

Permissions

- root — has access to everything
- regular user does not:
- Also group permissions (beyond scope)
- Some users have root-like access via `su` and/or `sudo`
  - In Ubuntu, `sudo su` changes to root
  - **BE CAREFUL WHEN RUNNING COMMANDS AS ROOT**

Installing Software

- If you have access to root/`sudo`: *very* easy!
- If you don't, often must build from source (can be hard!)

Example (Ubuntu)

```
tree # not installed!
sudo apt-get update
# enter your password when prompted...
sudo apt-get install tree
tree
```

Interacting with the Shell

- Tab auto-fills and/or shows options
- Tab once: complete if possible, otherwise do nothing
- Tab twice: show possibilities

Making Things Case Insensitvie

- (Linux Only!): To make your shell case-insensitive.
- Macs already do this by default.

```
if [ ! -a ~/.inputrc ]; then
  echo "\$include /etc/inputrc" > ~/.inputrc
fi

echo "set completion-ignore-case On" >> ~/.inputrc
```

Flags and Options

- Passing arguments to a function/command
- Flags: `-`
- Options: `--`
- Similar behavior, different interpretation.
- Often a command has a flag and an argument to do the same thing!
- Rough translation:
  - R: `foo(option=3, f=TRUE)`
  - Shell: `foo -f --option 3`

Why the Multiple Syntax?

- Flags are always a single character.
- Multiple charcaters interpreted as multiple flags!
- `ls -la` same as `ls -al` same as `ls -l -a`

System Monitoring

Storage Space

Command	what it does
du	Disk Usage of folder or current dir
df	File system report

Example

```
du /tmp
df
df -h
```

Processes

Command	what it does
top	Show top running processes
ps	process information
kill	Terminate a process

Example

```
top
ps 12345
kill 12345
```

Working with Files

Managing Files

Command	what it does
ls	list folder contents
cd	change directory
rm	remove file/dir
touch	create empty file
cp	copy file/dir

Example

```
ls
mkdir mydir
touch myfile
ls
rm myfile
rm mydir
rm -r mydir
```

Paths

- Separated by `/`
- Relative: `dir1/dir2`
- Absolute: `/home/user/dir1/dir2`

Command	what it does
`pwd`	Print working directory
`.`	Here
`..`	One directory up
~	Home

Dir Dots

- `.` — current working directory
- `..` — parent working directory
- `...` — **not valid**! Means nothing
- `../..` — parent of parent directory
- `../../..` — parent of parent of parent directory
- etc.

Example

```
cd ~
mkdir examples
cd ~/examples
pwd
```

Hidden Files

- Files beginning with `.` are "hidden"
- See them with `ls -a`

Example

```
ls
touch .example
ls
ls -a
rm .example
```

Interacting with Files

Command	what it does
‘head‘	see first few lines of file
‘tail‘	see last few lines of file
‘cat‘	"concatenate"

Example

```
head /etc/passwd
tail /etc/passwd
cat /etc/passwd
```

Pipes and Redirection

Pipes

- `|` (`shift`+\ on American keyboards)
- Chains together multiple commands
- Works like function composition:
  - R: `foo(bar(x))`
  - Shell: `bar x | foo`
- Flags/options rules still apply:
  - `foo(bar(x, f=TRUE), option=3)`
  - `bar x -f | foo --option 3`

Example

```
ls -l ~ | tail
ls -l ~ | tail -n 2
```

Redirection

Symbol	what it does
>	redirect (overwrite)
>>	redirect (append)

Example

```
echo "some text" > myfile
echo "some text" >> myfile
```

awk/sed/grep

awk, sed, and grep

- grep
  - Global Regular Expression Printer
  - search text for lines containing a pattern
- sed
  - Stream EDitor
  - operations on lines
- awk
  - Named after its authors (Aho, Weinberger, Kernighan)
  - operations on columns
- Useful exploratory/preprocessing tools

grep: Your New Best Friend

- Tool for searching text files with complex patterns.
- ***EXTREMELY USEFUL***
- More advanced features next time
- My 5 Most Used Commands (descending order)
  - cd
  - ls
  - git
  - vim
  - grep

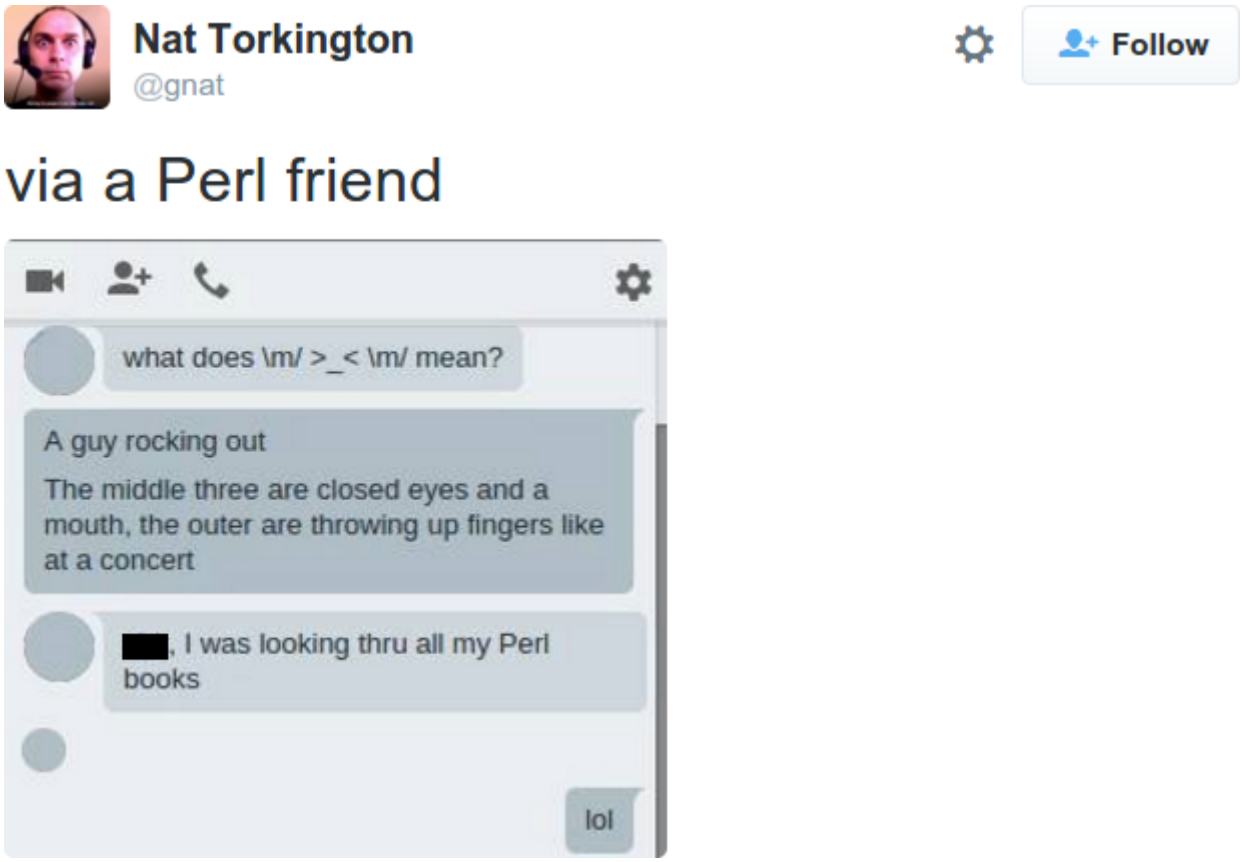
Searching? Really?

- Uses regular expressions
- Very fast
- Doesn't load files into memory!

Regular Expressions

- Concise encapsulation of patterns
- Look like the result of a cat stomping on your keyboard.
  - `/^$/d`
  - `/^$/{p;h;};/./{x;/./p;}`
- sed and grep use these
- awk is a little different...

Regular Expressions



grep: Just the Basics

- `grep pattern file`
- `grep -v anti_pattern file`
- `some_cmd | grep pattern`
- `grep pattern | grep -v anti_pattern`

Example

```
grep bash /etc/passwd
grep bash /etc/passwd | grep -v root
```

sed: Just the Basics

- Find and replace
- EXTREMELY POWERFUL
- `sed s/pattern/replacement/`
- `sed s/pattern/replacement/g`
- "Useful One-Line Scripts for sed": http://sed.sourceforge.net/sed1line.txt

Example

```
echo "dog"
echo "dog" | sed s/dog/cat/
echo "a b a c a b b" | sed s/a//g
```

Closing

Putting It All Together

- How do we use this stuff!?
- Next time!
- Great for small/medium sized data
- Sometimes acceptable for large-ish data

Homework

- On Blackboard
- Due in 1 week
- Another will be given Wednesday, also due Monday