[Software Development]

Linux ToolSet (part A)

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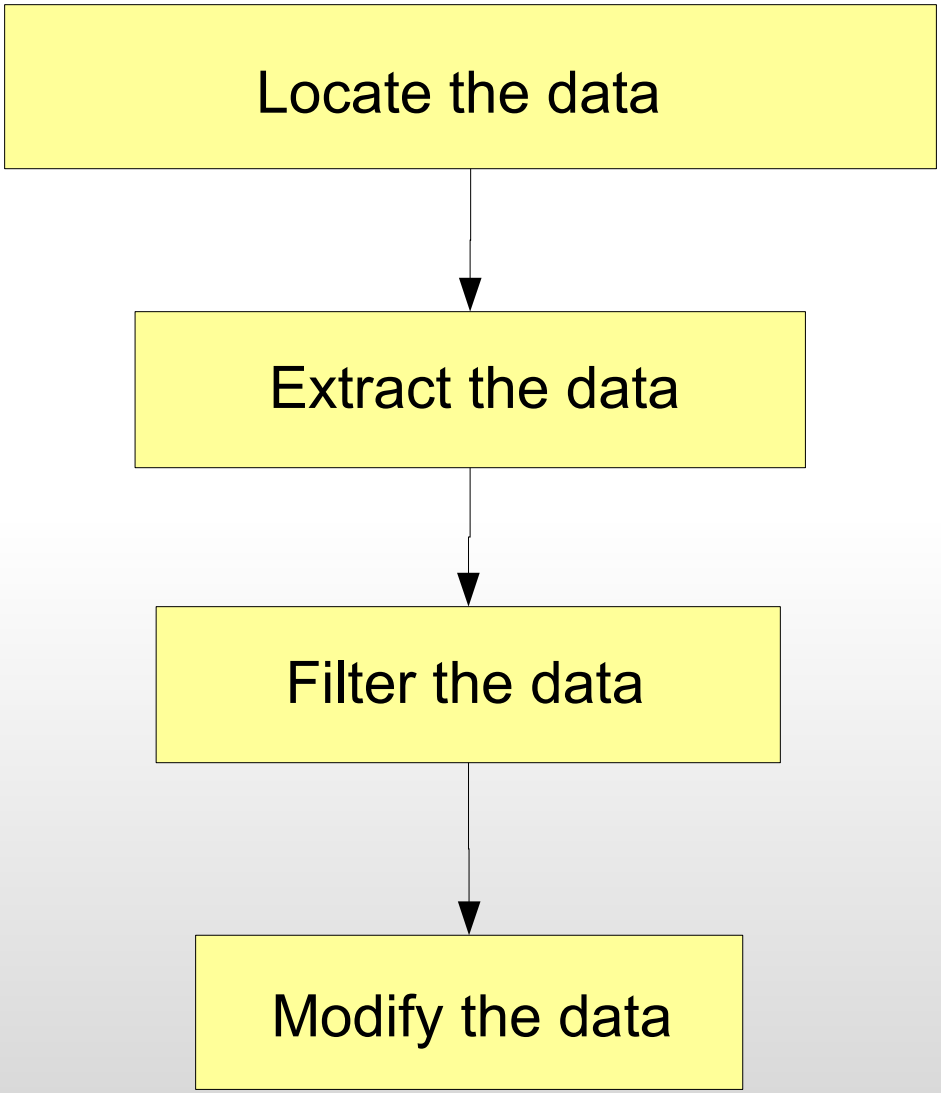
If Unix can Do It, You Shouldn't

- As a general rule:

> *Don't implement your own code unless you have a solid reason why common tools won't solve the problem*

- Modern Linux distributions are capable of performing a lot of tasks
- Most of the hard problems have already been solved (by very smart people) for you...
  - … you just need to know where to look
  - … and choose the right tool for your job

Different Tools for Different Jobs



Getting Help

- Any Linux distribution comes with thousands of files in `/usr/bin`
  - Knowing each command is difficult
  - Knowing each option of each command is practically impossible
- The most useful skill is to know where to look for help
  - Google knows all the answers
    (if you know how to pose the right questions)
  - `help` – documentation for the shell builtin commands
  - `cmd --help` – most of the programs give you some help if you ask

The Manual

- Unix man pages were introduced in 1971 to have an online documentation of all the system commands
- The pages are organized in 8 sections:

1. general commands
2. system calls
3. C functions
4. special files
5. file formats
6. games
7. misc
8. admin commands

```
CAL(1)                    BSD General Commands Manual                CAL(1)

NAME
     cal, ncal - displays a calendar and the date of easter

SYNOPSIS
     cal [-3jmy] [[month] year]
     ncal [-jJpwy] [-s country_code] [[month] year]
     ncal [-Jeo] [year]

DESCRIPTION
     The cal utility displays a simple calendar in traditional format and
     ncal offers an alternative layout, more options and the date of easter
```

Other forms of Help

- `info` – access the Info pages
  - Official documentation of the GNU project
  - Simple hypertext
- `apropos` – searches for keywords in the header lines of all the manpages

```
balzarot:~> apropos calendar
cal (1)              - displays a calendar and the date of easter
calendar (1)         - reminder service
gcal (1)             - a program for calculating and printing calendars.
gcalcli (1)          - Google Calendar Command Line Interface
konsolekalendar (1)  - Command line interface to KDE calendars
ncal (1)             - displays a calendar and the date of easter
```

Builtins

- Some commands (`kill`, `echo`) have two versions: a builtin and an external tool
- **`type [-t] [-a] name`**
  tells you how `name` would be interpreted if used as a command
  - alias
  - keyword (i.e., a shell reserved word)
  - function (i.e., a shell function)
  - builtin
  - file
- If it's not a builtin, `which` tells you what command is executed

```
balzarot:~> which ls
/bin/ls

balzarot:~> type -a ls
ls is aliased to `ls --color -FX -rt'
ls is /bin/ls
```

Builtins

- Directory management:
  `cd`, `pwd`, `pushd`, `popd`
- Shell management:
  `history`, `enable`, `alias`, `export`
- Getting help:
  `help`, `type`
- Printing messages:
  `echo`, `printf`
- Job control:
  `fg`, `bg`, `jobs`, `kill`

Job Control

- Job control refers to the ability to selectively stop (suspend) the execution of processes and continue (resume) their execution at a later point
- When a shell run a program, it usually waits until it terminates before returning control to the user (i.e., accepting another command)
  - If a command ends with a "`&`" it is instead executed in background
- Useful commands:
  - `jobs` – list the status of the jobs
  - `ps` – list all the system processes
  - `bg` – move a job to background
  - `fg` – move a job to foreground
  - `kill` – send a signal to a process or a job
    (9 is kill, check the manpage for the other ones)
  - `CRTL-z` – suspend the current job

Finding Files

find path [options] [test] [action]

- Looks for files starting from the directory `path` and performs the `action` for each file that matches `test`
- Options:

  `-maxdepth n` – descend no more than n directory levels
- Tests (specify what you are looking for):
  - Time values: `amin, atime, cmin, ctime, mmin, mtime`
  - File owner: `group, user`
  - File name: `name, iname, wholename`
  - Other file characteristics: `perm, size, type`
  - A `+` in front of a number means greater than, a `-` lesser than

Finding Files

- Actions specify what to do when you find the files
  - By default, it prints the relative file path (`-print`)
  - Execute a command: **`-exec`**
    - `{}` is a placeholder for the name of the file
    - The command must be terminated by \;
  - Print the file: `-print, -printf, -ls, -print0`

- Combining together multiple expressions:
  - Two or more tests are implicitly in AND
  - Combining more expressions in OR:
    - `\( expr1 -o expr2 \)`
    - `expr` can be just a test or a sequence of a test and an action

Examples

```
# Find files bigger than 10 megabytes
balzarot> find . -size +10M

# Find files modified in the last 30 minutes
balzarot> find . -mmin -30

# Find ps and pdf files
balzarot> find . \( -iname "*.pdf" -o -iname "*.ps" \) -print

# Find temporary files older than a week and print name and size
balzarot> find ~/tmp /tmp /var/tmp -mtime +7 -printf "%f %s\n"

# Change permissions of all the .h files
balzarot> find . -name "*.h" -exec chmod ug+r {} \;


# Remove all the tmp file in the home
balzarot> find ~ -name "*.tmp" -type f -print | xargs /bin/rm -f

# Better version (works also with filename containing spaces)
balzarot> find ~ -name "*.tmp" -type f -print0 | xargs -0 /bin/rm -f
```

Locating Files

locate [options] pattern

- Locate search for files matching a given pattern in a system database
  - The database is created (and updated) by calling `updatedb`
  - By default, locate looks for "`*pattern*`"
- Options:
  - `-e` check if the file still exists
  - `-i` case insensitive
  - `-0` separate entries with null bytes (for xargs)

View the File Content

- `cat` – print (concatenate) one or more files
- If the output must be read by a human and it is too long, it can be run through a pager
  - `more` – shows the output one page at the time
  - `less` – shows the output allowing the user to freely more up and down
- Head or Tail
  - `head -n x` : shows the first x lines
  - `tail -n x` : shows the last x lines
  - `tail -f` : shows the last 10 lines and keep printing the new data as the file grows
- If the input is binary, `hexdump -C` will do the job

Info about the File Content

- `wc` prints some useful statistics about a text stream
  - `wc -l` : print the number of lines
  - `wc -c` : print the number of bytes
  - `wc -w` : print the number of words
  - `wc -L` : print the length of the longest line

- `extract` extracts and prints the file metadata
  - The metadata depends on the file type
    - For mp3, it extracts the ID3 tags
    - For photos, it extracts the EXIF tags
    - For MS Word Documents, it extracts authors, last modification...
    - ....

Working with Other File Formats

- Many tools exist to convert other file formats to plain text
  - `html2text` – convert html to text
  - `pdftotext` – convert pdf to text
  - `ps2ascii` – convert postscript to text
  - `antiword` – convert Microsoft Word documents to text
  - `unrtf` – convert rtf to text

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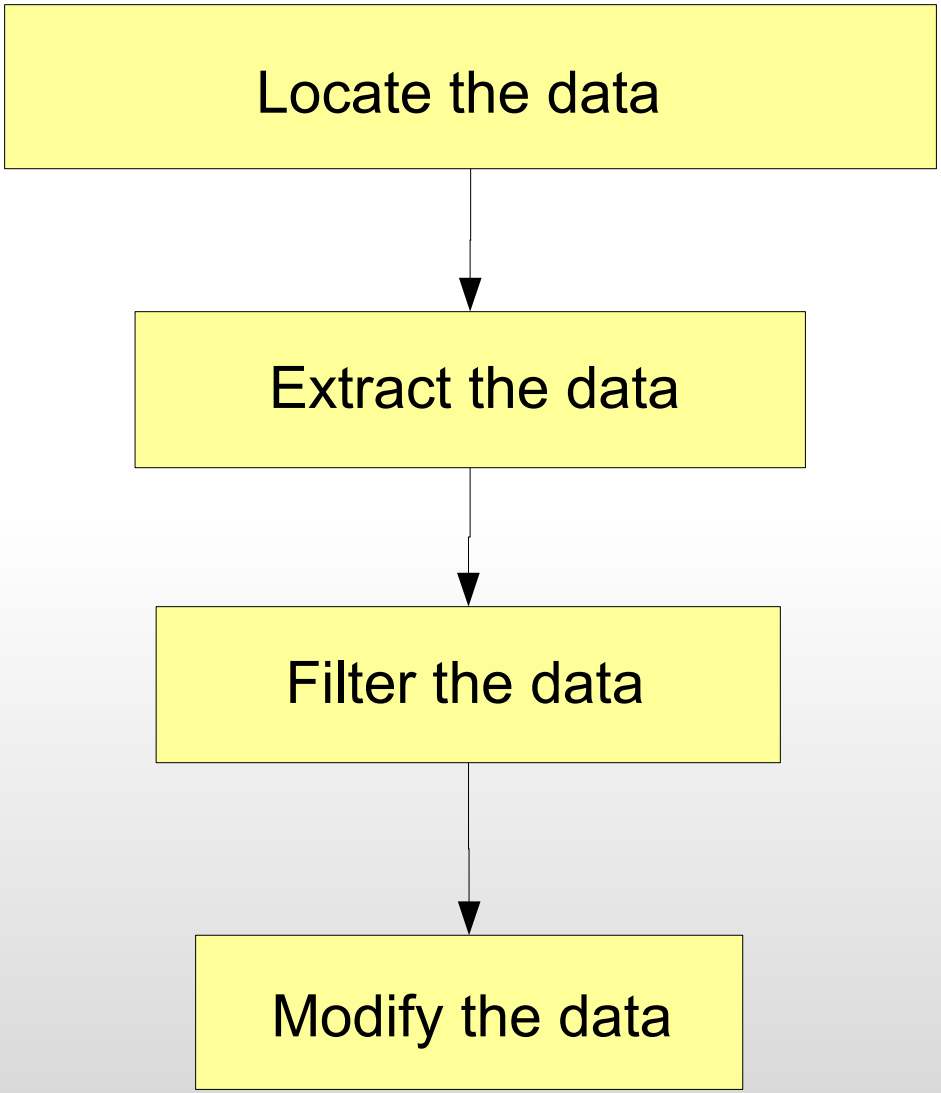


Searching for Text

grep [options] pattern [file list]

- GREP (Global Regular Expression and Print) allows to search (or filter) a file for known patterns
  - One of the most useful (and used) command line tools
    - ..to check which file contains a certain info
    - ..to filter out the lines you are not interested
- By default, it prints the lines that match the pattern
  - Comes in three flavors
    - `grep` – the original
    - `egrep` – the extended version (matches extended regex)
    - `fgrep` – the fixed version: matches a list of strings (no regex)

Searching for Text

- Options:

  `-n` : show the line number

  `-i` : ignore case

  `-v` : display the lines that do NOT match

  `-H` : show the file name too

  `--color` : emphasize the match

  `-x` : try to match the entire line

  `-B n (-A n)` : prints also the n lines before (after) the match

  `-o` : prints only the matching string (not the full line)

- In order to use `grep` you need to understand regular expressions (regex)
  - Regex are used in many Unix commands and languages (but sometimes with a slightly different syntax)

RegExp 101

- Regular expressions are a powerful language to express patterns
- Characters matching
  - `[]` any characters between the brackets
  - `[^]` any character excluding the ones between the brackets
  - `.` any character (except the end of line)
- Repetition operators
  - `?` zero or one time (extended regex only)
  - `*` zero or more times
  - `+` one or more times (extended regex only)
  - `{n}` exactly n times
  - `{n,}` n or more times
  - `{n1,n2}` between n1 and n2 times

RegExp 101

- Anchors
  - `^` beginning of the line
  - `$` end of the line

- Grouping (extended regex only)
  - `(pattern)` group together pattern
  - `\k` back-reference to the k-th pattern
  - `pattern1 | pattern2` one or the other

- Note: there is no way to put two patterns in AND
  - Either you pipe two grep commands, or you merge the patterns in one

Examples

```
# Which header file defines the function setDistance
balzarot> grep setDistance *.h

# Which lines contains Linux or Unix
balzarot> egrep -in "(Linux)|(Unix)" file.txt

# Working on some crosswords?
balzarot> grep -i "^c..a.r..$" /etc/dictionaries-common/words

# Dictionary's word without the apostrophe
balzarot> grep -v "'" /etc/dictionaries-common/words

# Four digit years
balzarot> grep -o “[12][[:digit:]]\{3\}”

# Match IP addresses
balzarot> egrep '(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\.(25[0-5]|
2[0-4][0-9]|[01]?[0-9][0-9]?)\.(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-
9]?)\.(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)' file.txt
```

Sorting

- `sort` sorts the input alphabetically (and prints it to `sdout`)
  - **`-r`** reverse order
  - **`-n`** sort numerically

- `uniq` discards repeated consecutive lines
  - **`-c`** prefix the lines with the number of occurrences
  - **`-d`** print the duplicated lines, not the ones that appears only once
  - **`-u`** only prints the unique lines

A

Green
Red
Yellow
Blue

B

Blue
White
Red

---

sort A B

Blue
Blue
Green
Red
Red
Yellow
White

A

Green
Red
Yellow
Blue

B

Blue
White
Red

sort A B

Blue
Blue
Green
Red
Red
Yellow
White

sort A A B

Blue
Blue
Blue
Green
Green
Red
Red
Red
Yellow
Yellow
White

A

Green
Red
Yellow
Blue

B

Blue
White
Red

sort A B	sort A A B	sort A B B
Blue	Blue	Blue
Blue	Blue	Blue
Green	Blue	Blue
Red	Green	Green
Red	Green	Red
Yellow	Red	Red
White	Red	Red
	Red	Yellow
	Yellow	White
	Yellow	White
	White	

Set Operations

- `sort` and `uniq` are simple tools, but they can be combined together to accomplish powerful tasks

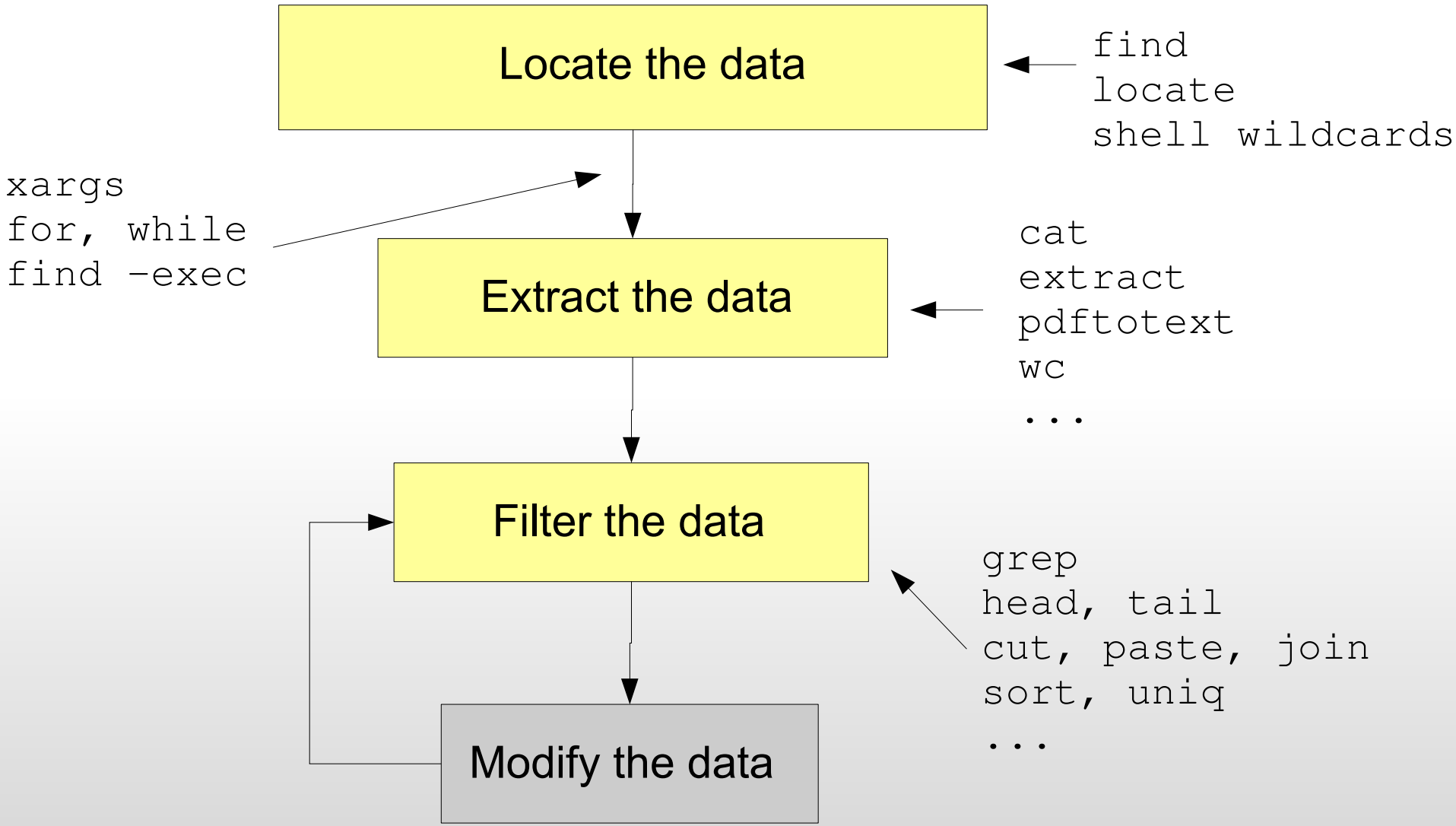
SetA and SetB (intersection)	`sort setA setB | uniq -d`
SetA or SetB (union)	`sort setA setB | uniq`
SetA but not in SetB (complement)	`sort setA setB setB | uniq -u`
SetB but not in SetA (complement)	`sort setA setA setB | uniq -u`
SetA or SetB but not in both (xor)	`sort set1 set2 | uniq -u`

Cut & Paste

- `cut` selects only certain columns of a text
  - `-d c` use c as field delimiter
  - `-f x` select only the field x
    - `-f x1-x2` select from field x1 to x2
    - `-f x1-` select from field x1 to the end of the line
  - `--complement` complement the selection

- `paste` add the content of one file as last column of another (put them side to side)
- `join` is like `paste`, but merge the files only when the first field is the same
  - `-1 x` for the first file, use field x
  - `-2 x` for the second file, use the field x

Different Tools for Different Jobs



Let's Practice....