[Software Development]

Linux ToolSet (part B)

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find
locate
shell wildcards
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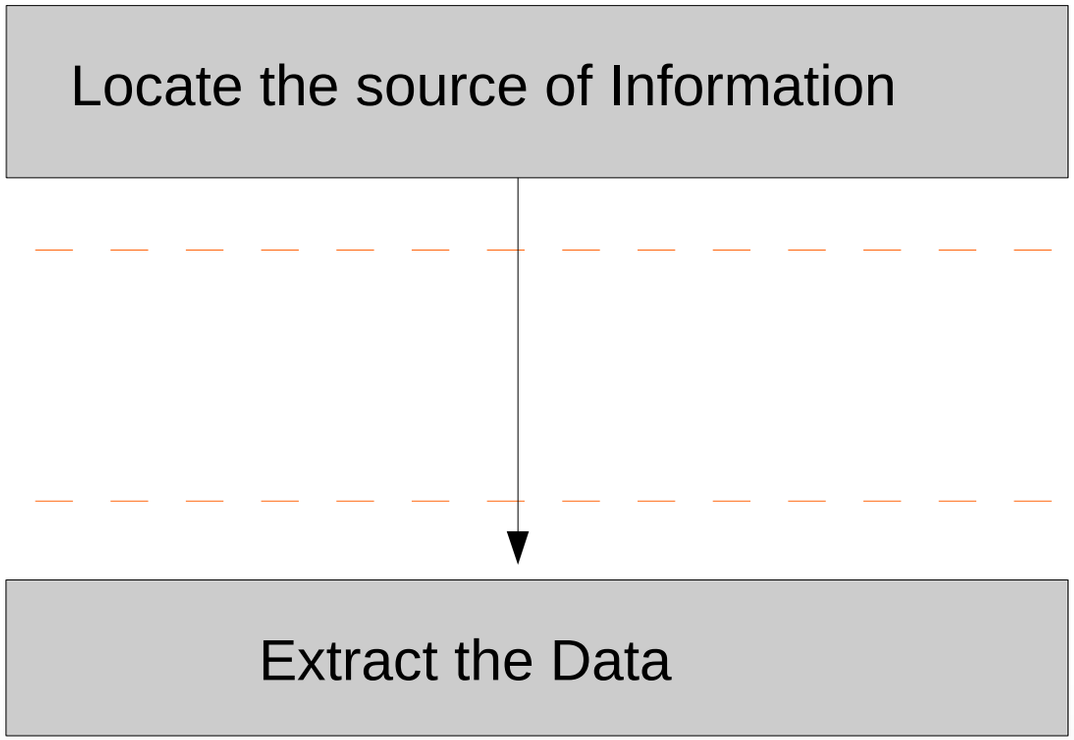


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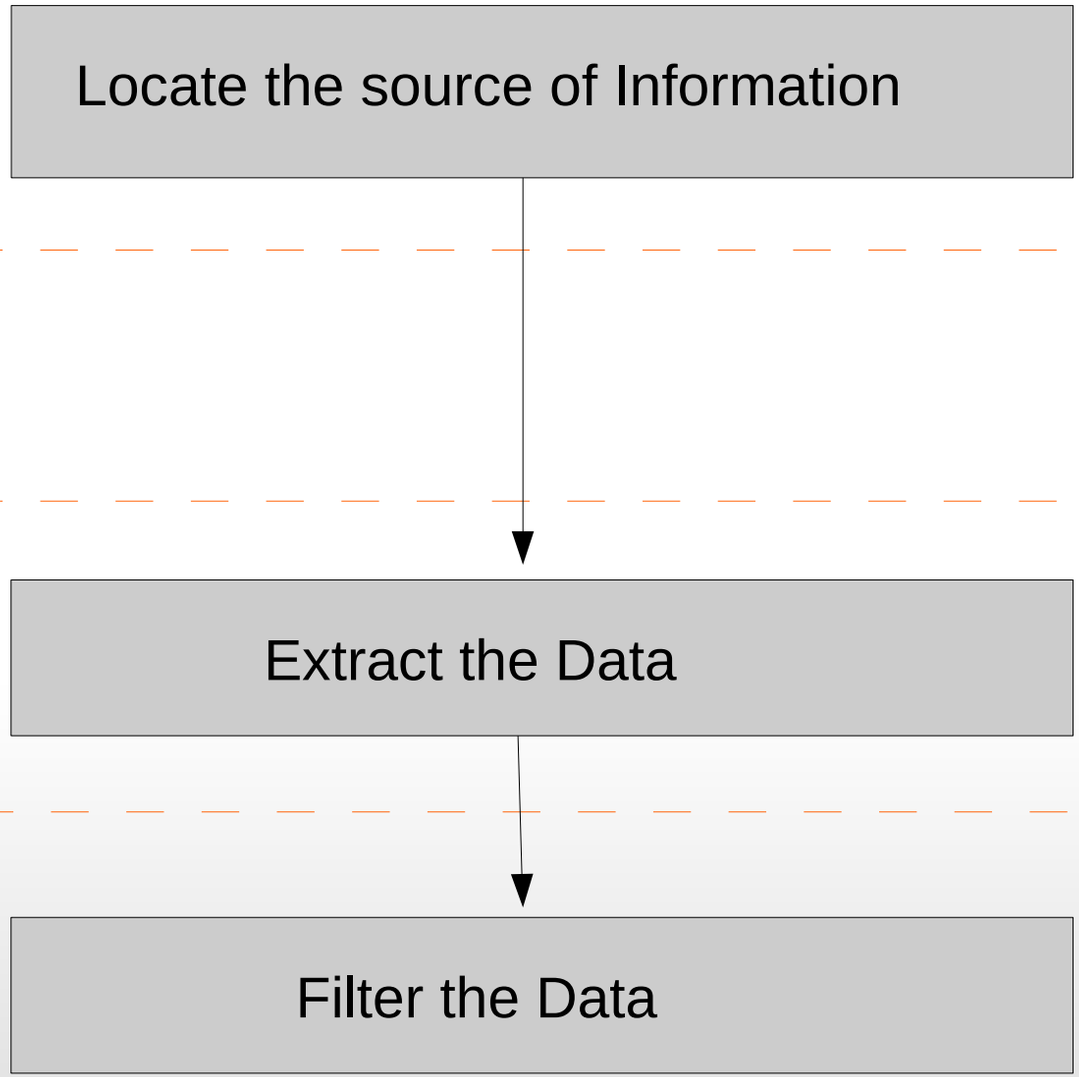


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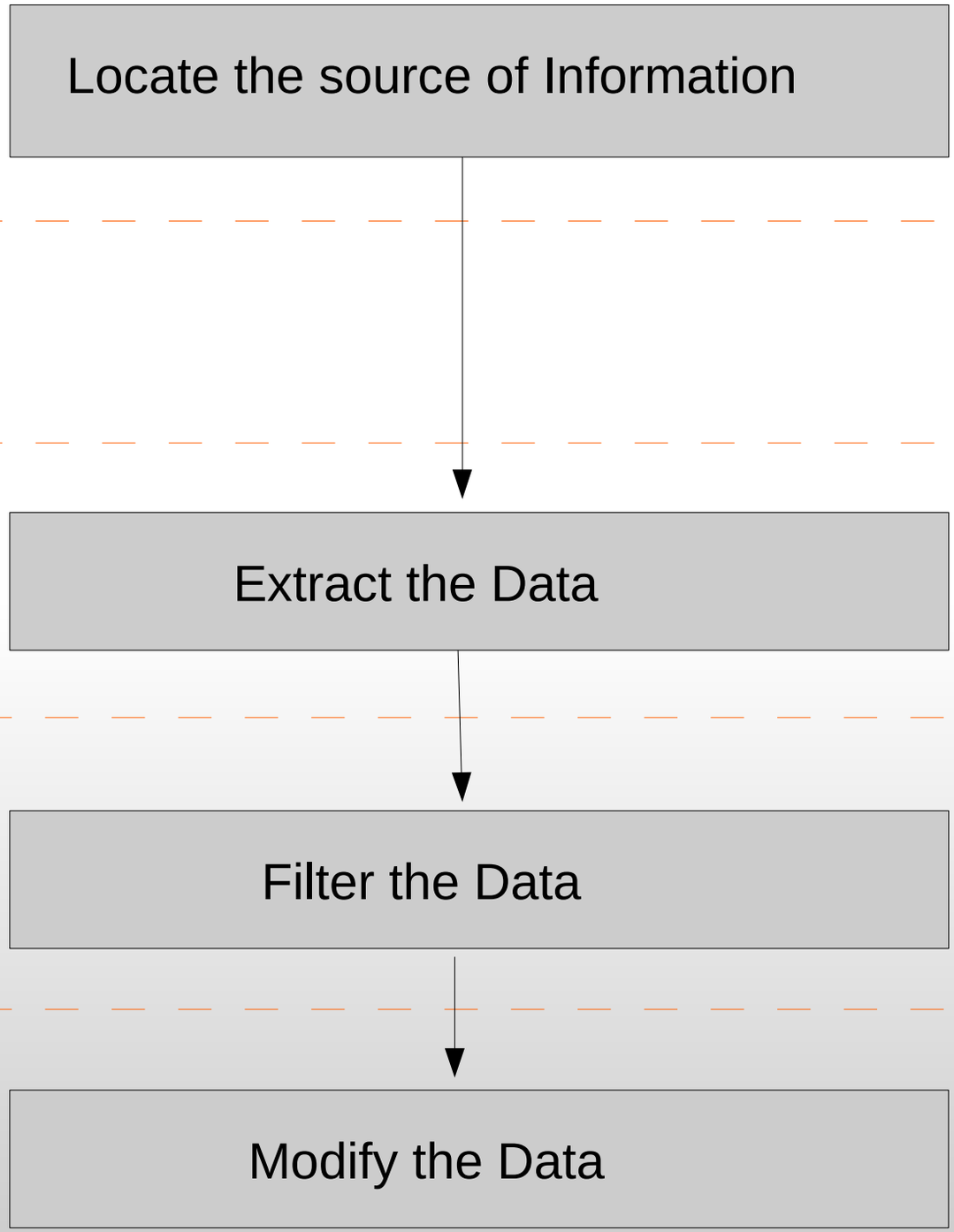


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```

Print every word in the English dictionary that contain all five vowels

```
> cat /etc/dictionaries−common/words | grep −i a | grep −i e | grep −i o | grep −i u
| grep −i i
```

You have a folder with all the pictures from your recent vacation.
Count how many of them were taken with the flash

```
> extract *.JPG | grep "flash − Yes" | wc −l
```

Print all broken symbolic links in your system

```
> find . −type l −exec file {} \; | grep "broken"
```

Remove all empty lines from a txt document

```
> cat document | grep −v '^$'
```

Print the most frequent words in a txt document

```
for word in `cat command.txt`; do echo $word; done | egrep −o "[a−zA−Z]+" | sort | u
niq −c | sort −nr | less
```

Print the most frequent words in a txt document

Can you use sort/uniq to remove stop words?


```
> find . -iname "*.txt" -exec egrep '.{81}' {} \;
```


```
> ls -l | egrep -o "^[^ ]+" | egrep 'x$'
```


```
> for f in original/*; do
   echo $f | egrep -o "[^/]+$" >> /tmp/a; done

> for f in data/*; do
   echo $f | egrep -o "[^/]+$" >> /tmp/b; done

> sort /tmp/b /tmp/b /tmp/a | uniq -u
```

Fixing the End of Line

- Unix and Unix-like systems terminate lines with a line break character (`\n` or `0x0A`)
- DOS and Windows terminate line with a sequence of two characters: carriage return (`\r` or `0x0D`) and line break
- This little difference makes text files difficult to exchange

```
In the Beginning was the Command Line^M
^M
by Neal Stephenson^M
^M
^M
 About twenty years ago Jobs and Wozniak, the founders of Apple, came up
```

- `dos2unix` and `unix2dos` commands can be used to translate the end of the line characters from one world to the other

Format

```
fmt [options] file
```

- Re-format each paragraph of a text to better fix a certain line length
  - It can break and join lines, but it preserves words
- Options
  - `-w width` – reformat each paragraph to no more than `width` characters
  - `-s` – split long lines but don't join short ones
    (useful to prevent joining lines of code)

Translate

```
tr [options] set1 [set2]
```

- Translate the characters specified in `set1` to the corresponding characters in `set2`
  - Sets of characters may be abbreviated by using ranges (`[a-z]`)
  - `set2` is automatically extended to the length of `set1` by repeating its last character as necessary

Translate

```
tr [options] set1 [set2]
```

- Options:
  - `-s` : replace each instance of a sequence of repeated characters listed in `set1` with a single instance of the character specified in `set2`
  - `-c` : complement the set of characters (substitute all the character that are NOT specified in the set)
  - `-d` : delete every instance of the characters instead of replacing it (with this option you must specify only one set of characters)

Examples

```
balzarot> echo "12345" | tr "2-4" "xyz"
```

Examples

```
balzarot> echo "12345" | tr "2-4" "xyz"
1xyz5

balzarot> echo "12345" | tr "2-4" "x"
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balzarot> echo "12345" | tr "2-4" "xyz"
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balzarot> echo "12345" | tr "2-4" "x"
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balzarot> echo "12345" | tr -s "2-4" "x"
```

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balzarot> echo "12345" | tr "2-4" "xyz"
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balzarot> echo "12345" | tr "2-4" "x"
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balzarot> echo "12345" | tr -s "2-4" "x"
1x5

balzarot> echo "12345" | tr -d "2-4"
```

Examples

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balzarot> echo "12345" | tr "2-4" "xyz"
1xyz5

balzarot> echo "12345" | tr "2-4" "x"
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balzarot> echo "12345" | tr -s "2-4" "x"
1x5

balzarot> echo "12345" | tr -d "2-4"
15



# Useful commands:

# Convert to single space
balzarot> tr -s "[[:space:]]" " "

# Convert to lowercase
balzarot> tr "A-Z" "a-z"
```

The Stream Editor

```
sed [options] “location action” [files]
```

- `sed` is one of the first Unix commands built for command line processing of text files
- It is a complex tool, but still not a full fledged programming language
  - No variables
  - No branches (only labels and GOTO)
  - … but it is still Turing-complete!
- The goal of `sed` is to perform a certain action to the specified locations
  - It is <u>line oriented</u>, so everything is repeated for each line in the input

SED

- Default behavior:
  1. Read next line
  2. Check if it matches one of the specified locations
  3. If yes, apply the corresponding action
  4. Print the line to standard output

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- Options:

  `-n` don't print the lines if not specifically instructed to

  `-e` combine together multiple expressions (location+action)

  example: `-e "2,3p" -e "7,8p"`

  `-i` edit the file in place

  `-r` use extended regex

Locations

- Locations specify to which lines an action must be applied
  - If the location is not specified, the action is executed for each line
  - If a single value is specified, the action is executed only for the line matching that value
  - If a range is specified (two locations separated by comma), the action is executed from the line matching the first location to the line matching the second location
    - The two location cannot match the same line
    - A range must always span at least two lines (unless the file terminates after the first one)

Locations

- Locations
  - `N` line number N
  - `$` last line
  - `/regex/` line matching the regular expression
  - `+N` next N lines (when used as a second value in a range)

- A location can be negated by appending an exclamation mark after it
  - `7,9!` – every line except 7, 8 and 9

Actions

- `p` – print the line (usually used in conjunction with the -n option)
- `d` – delete the line
- `q` – quit without processing the remaining lines
- `a text` – append the text after the matching line
- `i text` – insert the text before the matching line
- `c text` – change the line with text

The power of S

```
s/regex1/replacement/flag
```

- substitute whatever matches “regex1” with “replacement”
  - If no flags are specified, it only substitutes one occurrence per line
  - By adding a number N, it will only do N substitutions per line
  - By adding the `g` flag, all the occurrences will be substituted
  - The `/` characters can be uniformly replaced by any other single character (if the character also appears in the regex, it has to be escaped)

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  - The `/` characters can be uniformly replaced by any other single character (if the character also appears in the regex, it has to be escaped)
- Groups and back references
  - In the replacement, the `&` character can be used to indicate the text matched by the regex
  - In the regex, part of the pattern can be grouped between parenthesis ()
  - In the replacement, `\1`, `\2`, .. `\9` are substituted with the corresponding groups in the regex

```
sed -r '10,$ s- <a href="(.*)">(.*)</a> - \2: \1 - g'
```

```
sed -r '10,$ s- <a href="(.*)">(.*)</a> - \2: \1 - g'
```

Option
(use extended regex)

Location
(from line 10 to the end of the file)

Action
(substitute)

RegEx to substitute

Replacement

Flag
(global substitute)

Examples

Delete the second line	`sed '2d'`
Print the 10th line	`sed -n '10p'`
Comment out the 12th lines	`sed '12 s,^,//,'`
Delete all the empty lines	`sed '/^$/d'`
Print the lines longer than 80 characters	`sed -n '/.{81}/p'`
Add “Comment” after the 7th line	`sed '7a Comment'`
Delete leading whitespaces from each line	`sed 's/^[ \t]*//'`
Delete everything after the first blank line	`sed '/^$/q'`

AWK

- AWK is a programming language designed to process text files
  - First created at Bell Labs in the 1970s
  - It is an acronym of its authors' names but it is usually pronounced like the bird (i.e., auk, not hawk)
  - Beside the shell itself, AWK is the only other scripting language available in a standard Unix environment
  - It is one of the oldest tools to perform mathematical operations on files of numerical data

- `awk` is somehow similar to `sed`:

  for each record that matches a given pattern,
  it executes the corresponding action

Records and Fields

- AWK treats the input as a sequence of records
  (by default each line is a record)
- Each record is then split into a sequence of fields
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- Fields and records are specified by special variables:
  - $0 refers to the current record (line)
  - $1-$n are the single fields of the current record
    (any expression can be used instead of numbers)
  - NF is the number of fields in the current record
  - NR is the record number
  - FS and RS are the field and record separator
    (they can be a character, a word, or a regular expression)
  - OFS and ORS are the separators used in the program output

AWK Programs

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A program in AWK is composed by a sequence of rules

- Each rule specifies one pattern to search for and one action to perform when the pattern is found

```
record-pattern1 {action1}
record-pattern2 {action2}
    ...             ...
```

- In a rule, either the pattern or the action can be omitted, but not both
  - If the pattern is omitted, the action is performed for every record
  - If the action is omitted, the default action is to print all records that match the pattern

Patterns

- `BEGIN END` – special values used to specify actions to be executed at the beginning or at the end of the program (before and after the input is processed)
  - Useful to initialize variables (such as the field separator) and to print final results
- `pattern1, pattern2` – every line from the one that matches pattern1 to the one that matches pattern2
- `/regex/` – each record that matches the regular expression
- *`condition`* – each record for which the condition is true. Example:
  - `NR == 10` – at the 10th record of the input
  - `/regex1/ && /regex2/` – true if both are true
  - `$1 ~ /regex/` – true if the first field match the regex

Actions

- Each action can be a single instruction or a sequence of instructions separated by semicolon
- Control statements:
  - `if (condition) {body} else {body2}`
  - `for (initialization; condition; increment){ body }`
  - `while (condition) {body}`
  - `break and continue`
- AWK supports floating point arithmetic and automatically converts strings to numbers
- AWK supports most of the mathematical operators that you have in C (`+, -, *, /, %, ^, ++, --, +=` …)

Useful Functions

- String manipulation:
  - `length` - return the length of a string (without parameters returns the length of the current record)
  - `tolower, toupper` – convert strings to lower/upper case
  - `substr(string, start, nchar)` – extract a substring
  - `gsub(regex, replacement, string)` – regex replacement
- Output
  - `printf` – like in C
  - `print item1 item2 item3` – print the concatenation of the three items
  - `print item1, item2, item3` – print the three items separated by the output field separator (OFS)

Variables

- Modern awk implementations do not require variables to be initialized
  - Integer variables automatically initialized to `0`, strings to `""`

- Arrays are automatically created and resized
  - Arrays are "associative", meaning that the index can be any string:

    `array["txt"] = value`

    `array[50]` is equivalent to `array["50"]`
  - `index in array` – tests if the array contains the specified index
  - Array can be scanned using a special `for` loop
    - `for (variable in array) { body }`

Examples

Change the first field to “>”	`awk '{$1=”>”; print}'`
Print every line with more than 4 fields	`awk 'NF > 4'`
Right align all text on a 79-column width	`awk '{printf "%79s\n", $0}'`
Print the even-numbered lines	`awk 'NR % 2 == 0'`
Swap the first two fields	`awk '{t=$1;$1=$2;$2=t;print}'`
Add a new field at the end of each line	`awk '{$(NF+1)=”new”; print}'`
Print the sum of each field	`awk '{for(i=1;i<=NF;i=i+1)` `s+=$i; print s}'`

Working on Multiline Records

Jimmy the Weasel
100 Pleasant Drive
San Francisco, CA 12345

Big Tony
200 Incognito Ave.
Suburbia, WA 67890

```
awk 'BEGIN {RS=""; FS="\n", OFS=”,”}
          {print $1,$2,$3}'
```

Jimmy the Weasel, 100 Pleasant Drive, San Francisco, CA 12345
Big Tony, 200 Incognito Ave., Suburbia, WA 67890

Piping in AWK

- The output of the print and printf instructions can be redirected or piped to other tools

```
print $0 > "filename"

print $1 | "command"
```

- Important! AWK opens a file or a pipe only if that particular file or command has not already been written to by the program or if it has been closed since it was last written to
  - `awk '{print $1 | "sort"}'` - sort is executed once, and the outputs of all the print instructions are piped to it
  - `awk {print $1 > "file.dat"}` - the file is open (the previous content is lost) but then each line is added to it
  - `awk {print $1 > "file.dat"; close("file.dat")}` the file will contains only the output of the last print

Internet from the Command Line

- Many network- and web-related command lines tools
  - Text-based web browsers (`w3m, lynx, links`)
  - Non-interactive downloaders (`wget, curl`)
  - General input/output through sockets (`netcat`)
  - DNS query (`host, dig`)
  - Pinging, scanning, trace routing (`ping, arping, nmap, traceroute, hping3`)
  - Remote shell, secure copy (`ssh, scp`)
  - ....

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wget

- `wget` download files from the web using either HTTP, HTTPS, or the FTP protocol

```
wget [options] url
```

- It can retrieve a single document or recursively download everything that is referred to from a remote resource
- Parameters
  - `-m` – mirror the entire web site
  - `-r` – recursively download all the linked documents
  - `-l n` – specify the max recursion depth to n
  - `-nd` – don't replicate the directory structure (saves all the file in the same directory)
  - `-k` – fix all the the links in the downloaded pages to make them suitable for offline browsing

wget

- `-c` – continue the download of a partially-downloaded document
- `--spider` – don't download the pages, just check that they are there
- `-w sec` – wait sec seconds between each download
- `-U agentstring` – send agentstring as user agent
- `-A pattern` – download only files matching the pattern
- `-R pattern` – do not download files matching the pattern
- `--limit-rate nk` – limit the speed to n KB/s

- Example: download all pdf files:

```
wget -r -l1 -nd -A"*.pdf"
    http://…/softdev/material
```

CURL

- Very similar to `wget` but support more protocols:
  - FTP, FTPS, HTTP, HTTPS, SCP, SFTP, TFTP, TELNET, DICT, FILE, LDAP and LDAPS
- Curl fetches just the URLs that the user specifies
  - It does not contain any recursive downloading capability
  - It does not parse the HTML
- It supports file upload in HTTP and FTP
- It has a pretty complete cookie management

CURL

- `-s` – silent (suppress the progress meter)
- `-d data` – send the data in a POST request
- `-A useragent` – specify the given useragent
- `-F “field=@filename”` – upload a file
- `-I` – fetch only the HTTP headers
- `-c file` – write the cookies to file (in netscape format)
- `-b file` – load the cookies from file
- `-u username:password` – specify the authentication credentials

- Example: submit a POST form, pretending to be a Mozilla browser

```
curl -s -A "Mozilla/5.0 (compatible; MSIE 7.01; Windows NT
5.0)" -d 'rid=value&submit=SUBMIT'
```

URL De-Shortening with CURL

```
curl -sI http://tinyurl.com/m3q2xt
```

```
HTTP/1.1 301 Moved Permanently
Location: http://en.wikipedia.org/wiki/URL_shortening
X-tiny: cache 0.00096607208252
Content-type: text/html
Date: Wed, 20 Oct 2010 09:09:13 GMT
Server: TinyURL/1.6
```

```
sed -n 's/Location: //p'
```

The TCP/IP Swiss Army Knife

- netcat (nc) is a tool to read and write data across TCP or UDP network connections
- It can be used as a generic network client:
  - `nc host port`
  - The standard input is redirected to the remote host
  - The data received from the network is sent to the standard output
- It can be used as a generic network server:
  - `nc -l -p port`
  - It listens for inbound connections to port `port` and then forwards the data as in client mode
  - It manages only one connection and then terminates

Copying Files with NetCat

- On the sender side:

```
tar czf - dir | nc -q 10 -l 3333
```

- On the receiver side:

```
nc -w 10 remotehost 3333 | tar xzv
```

- The same can be done by having the received that listens and the sender that open the connection

Print the 10 commands you use more frequently

```
history | grep -o '\|[ ]*[^ ] +'  | grep -o '[a-zA-Z].*' | sort | uniq -c | sort -n
 history | awk '     {print $2}'
history | sed 's_|_\n 1111  _g' |awk '{print $2} ' | sort | uniq -c | sort -n
```

```
> history | sed −r 's_\|_\n 1111 _g' | sed −r 's/ [0−9]+[ \t]+([^ ]+).*/\1/' | sort | uniq −c | sort −n
```

```
count how many packages installed :
cd /var/log

cat dpkg.log | grep -i "install " | awk '{print $1}'  |uniq -c

# you can use "zcat" with "dpkg.log.*" when you're dealing with zipped logs
```

In a text file:

- Remove everything that is not an alphabetic character
- Fix duplicated words
- Print the longest word in a file

```
cat file.txt | grep '  ([a-zA-Z]+) \1 '

cat file.txt | sed -r 's/ ([a-zA-Z]+) \1 /\1/' | grep "instead instead"

cat file.txt | tr -d -c 'a-zA-Z \n' |fmt -w 1 | wc -l

cat file.txt | tr -d -c 'a-zA-Z \n' |fmt -w 1 | wc -l | awk '{print length($0), $0}' | sort -n
```

print the paragraph containing "LIVE"

```
cat file.txt | awk 'BEGIN {RS=""; FS="\n";} /LIVE/ {print $0} '
```

In a text file: Remove everything that is not an alphabetic character
> cat file | tr −d −c 'a−zA−Z '
In a text file: Fix duplicated words
> cat file | sed −r 's/ ([a−z]+) \1 / \1 /'
In a text file: Print the longest word in a fle
> cat file | fmt −w 1 | grep −o '^[A−Za−z]+' | awk '{print length($0), $0}' | sort −n

LIVE is the word you're looking for

In a C header file:

- Update the copyright year in the header `cat ar.h | sed '2s/2010/2018/'`
- Replace the comment style from /* .. */ to // `cat ar.h | sed 's_/\*(.*)\*/_//\1_'`
- Move inline comments to the previous line `cat ar.h | sed -r 's_(.*)/\*(.*)_ /*\2\n\1_ ' ls`

```
# In a C header file: Update the copyright year in the header
> cat file.h | sed '2s/2016/2018/'
# In a C header file: Replace the comment style from /* .. */ to //
> cat file.h | sed 's_/\*(.*)\*/_// \1_'
# In a C header file: Move inline comments to the previous line
cat ar.h | sed −r 's_([^/]+)(/\*.*\*/)_\2\n\1_'
```

Using “`ls -l`” print the total file size grouped by file extension

```
ls -l | grep '\.[^ ]+$' |  tr '.' ' '   | awk 'NF > 4 {total[$NF]+=$5}  END { for (ext in total){print total[ext], ext}}'
```

```
find /proc -type d -maxdepth 1 | grep '[0-9]+$' | while read path; do cat $path/status | grep "Name|Threads" | sed -r 's/^.*:[^a-zA-Z0-9]+//' ; done > output
```

```
> ls −l | grep '\.[^ ]+$' | sed −r 's/\.([^\. ]+)$/ \1/' | awk '{tot[$NF]+=$5} END {
for (ext in tot){ print ext, tot[ext]}}'
```