# Introduction to Programming

## Lecture 2-3: The Unix Shell

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# Disclaimer

- Most of the material is drawn from the excellent course prepared by software carpentry
- In particular, most exercises are drawn from it (If you really want to learn something, don't look up the answers)
- Other source of inspiration is the very complete OpenClassrooms website

# What and why ?

## Unix, Shell & Bash ?

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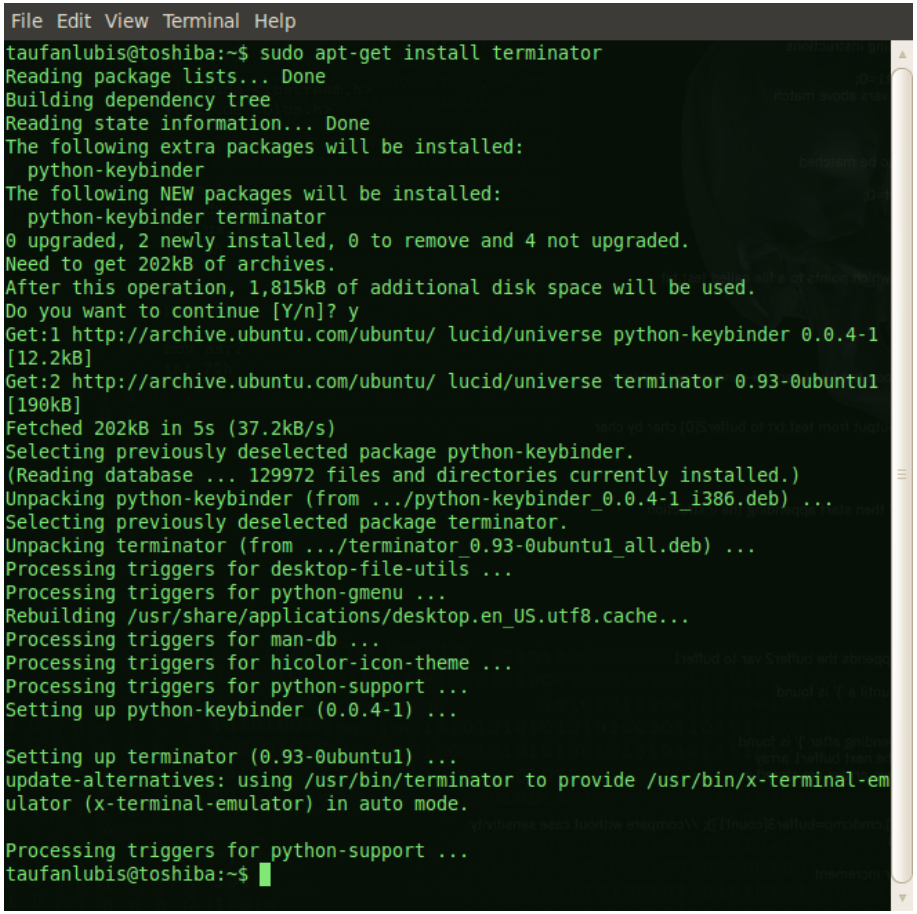
- The **Unix Shell** ($\approx$ the terminal $\approx$ the command line) : one of the first (and simplest ?) way to interact with your computer
- Why should you use it ? Despite the (high) entry cost, it is :
  - fast and efficient
  - reusable
  - sometimes necessary
  - but, more importantly...

# What and why ?

## Unix, Shell & Bash ?




- ... It makes you look smart

# What and why ?

## Unix, Shell & Bash ?

- UNIX is one of the first Operating System (1970)
- The Shell is a command (instructions) **interpreter** to interact with UNIX

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- **Bash** (Bourne Again SHell) is the most common UNIX Shell (Must watch : Revolution OS)
- Use the Unix shell from a command-line interface (CLI). The heart of the CLI : the REPL (read-evaluate-print loop)
- Why REPL : when the user types a command and then presses the Enter (or Return) key, the computer reads it, executes it, and prints its output.

# What and why ?

## Linux, Mac and Windows

- Linux and Mac OS include by default a UNIX-Shell which is Bash
- Windows OS doesn't (bad). But you can use an emulator (PuTTy, Cygwin, Mintty, Git, etc.)

OR Windows users also can install Ubuntu (one of the best Linux distribution) on their computer

# Fundamentals (I)

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- The file system : part of the OS responsible for managing files and directories
- **How to navigate in this file system ?**
  - `cd` (Change Directory) : most essential command to navigate in the file system
  - `ls` (List) : display all the files and directories inside the current working directory
  - `pwd` (Print Working Directory) : print the path of current working directory

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  - Inside that directory are several other directories, including Users (where users' personal directories are located), in green.
  - Our current working directory is stored inside /Users - because /Users is the first part of its name - and /Users is stored inside the root directory, its name begins with /

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- The `cd` command allows you to navigate through the repositories
- Ex : `cd + Desktop`, `cd + .` (also, try `cd + ~` or simply `cd`), `cd + ..`

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- Ex : `cd + Desktop`, `cd + .` (also, try `cd + ~` or simply `cd`), `cd + ..`
- **Exercise 1** : Using `cd`, `ls` and `pwd` find your current working directory, navigate to the desktop and print your directory.

# Fundamentals (II)

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⇒ Use the command `mkdir + NameOfTheFolder`

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- **How to create a file ?** Most generic command is `touch`

⇒ Ex : `touch a-blank-file.txt` or `nano a-blank-file.txt`. (This will create a blank file. Work with any extension (.txt, .csv, .jl etc.))

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- **Exercise 3** : Create a file called `test-file.txt` into the folder IntroProg2021

# Fundamentals (II)

## Remove a directory / a file

- You can **remove** files with the command `rm` and directory with `rm -r`
- **Be extremely careful** : the Unix shell doesn't have a trash bin. Deleting is permanent
- `rm -r` can be a very dangerous command, since you might remove loads of files. To be certain that you are not removing too many files, you can type `rm -r -i` thesis, and the Shell will ask you whether you want to remove this or that file

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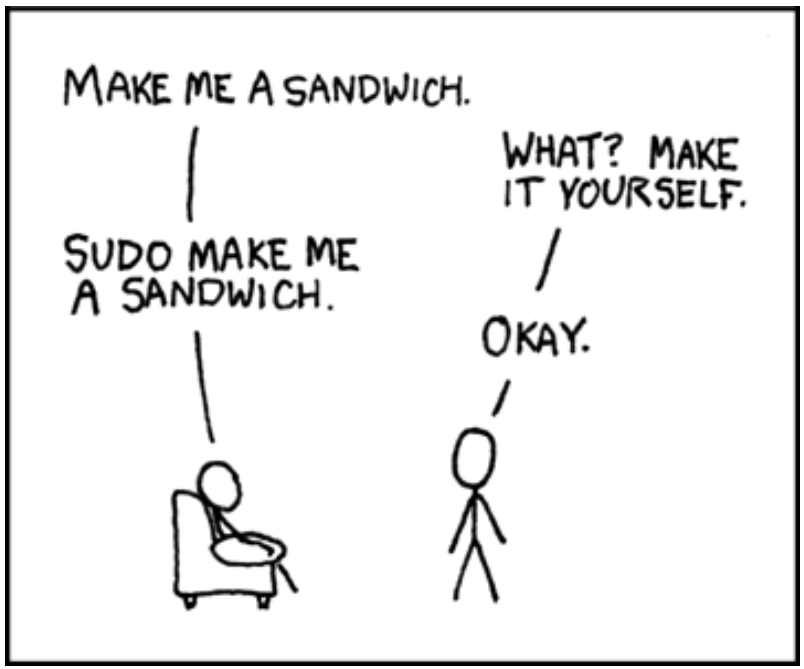
- **Exercise 4** : in the directory IntroProg2021, create draft.txt. Then, rename it to quote.txt. Finally, move quote.txt from the IntroProg2019 directory to its parent directory, the Desktop.
- cp works like `mv`, but makes a copy of the file instead of (re)moving it

# Fundamentals (IV)

## Substitute user do

- Useful : `sudo + command` ("superuser do", or "switch user do") allows a user with proper permissions to execute a command as another user, such as the superuser.



# Fundamentals (V)

## Choose a good Text Editor !

- **Sublime Text 3.0**
- Notepad++
- etc.

# Final Exercise

## Customise your prompt !

- Navigate to your home with `cd ~`
- Type `ls -la` and look for `.bash_profile` file
- If it does not exists, create one. If it exists, just open it with command `open` (or `explorer` for those using Windows)
- Write in the file export PS1 = "\u $"
- try to add \d, \h, \W etc.

# Why is this useful ?

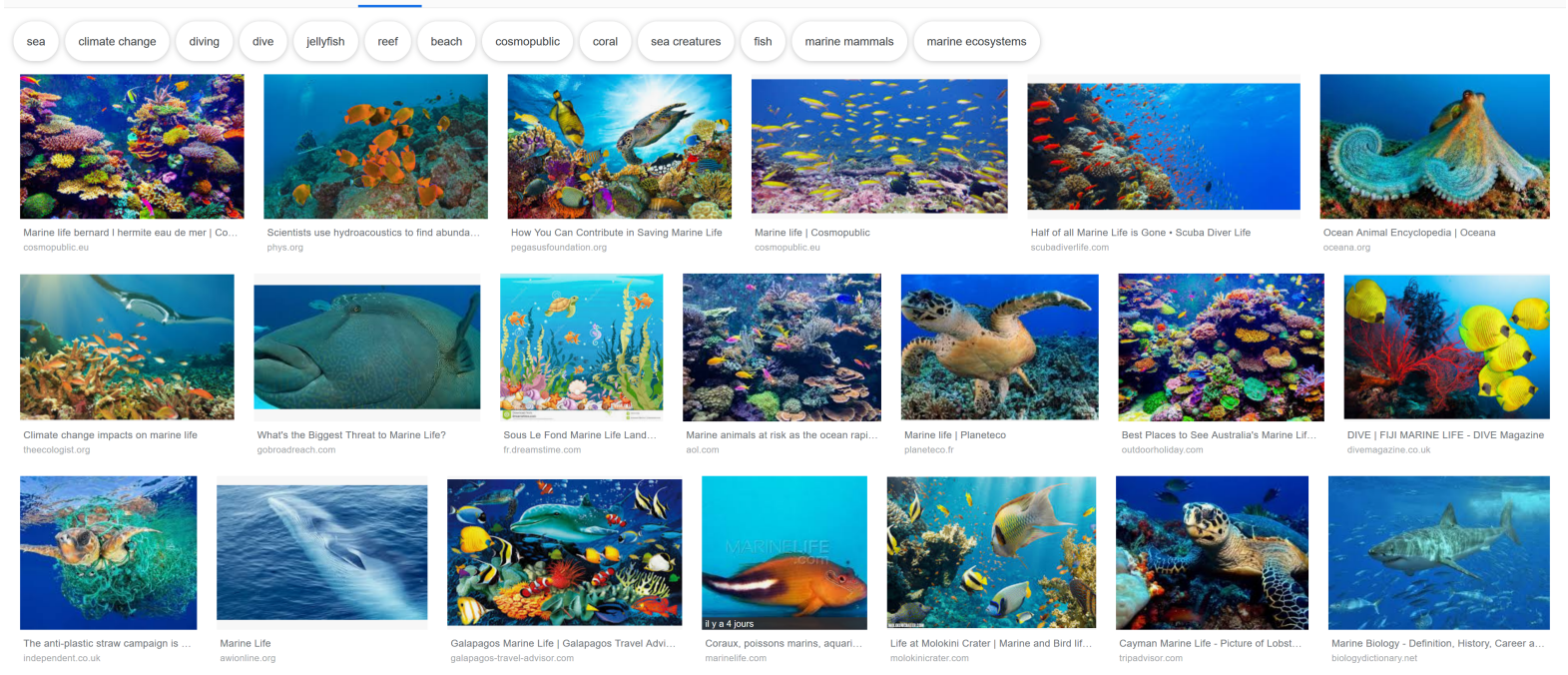
## Context I

- Now we need an example : go to my website (`cms27.github.io`)
- In the `Teaching` section, click on `Data Shell` to download a zip file called `data-shell`.
- Save it on your desktop.

# Why is this useful ?

## Context II

- Nelle is a marine biologist who collected 1520 samples on marine life stuff (text, pictures, maps, etc.)



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## Filters : a simple example

- **Exercise 1** : Count the number of words in a file ?
  1. go to the folder molecules
  2. display the files
  3. use the command `wc` to count the number of words in each file

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- Answer : `wc *.pdb`

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- **Exercise 2 bis** : Go back to folder molecule and let's find which of these files is the shortest !

# Why is this useful ?

## Loops

- **Why should you use loops ?**
  1. Allow us to execute commands repetitively
  2. Reduces the amount of typing
  3. Less typing = less likely to do a typing mistakes

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## Loops

- **Exercise 3** : Nelle would like to copy several files
- Go to the directory `data-shell/creatures`
- Try `cp *.dat original-*.dat` (This command should not work !)

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⇒ When cp receives more than two inputs, it expects the last input to be a directory where it can copy all the files it was passed. Since there is no directory named original-*.dat in the creatures directory we get an error.

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- Solution : **use a loop !**

# Why is this useful ?

## Loops

- Example of a loop :

```
for filename in basilisk.dat unicorn.dat
  do
     cp $filename original-$filename
  done
```

- Astuce : always write the beginning (do) and the ending of the loop (done) at the beginning

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## Loops

- **Exercise 4** : for each files in the creatures directory, print the name of the file (may want to check the echo command), and the last 20 lines of the file (have a look at the tail command)

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- **Exercise 4** : for each files in the creatures directory, print the name of the file (may want to check the echo command), and the last 20 lines of the file (have a look at the tail command)
- **Exercise 5** : write another loop to show that your previous code indeed printed only 20 lines per file

# Nelle's original problem

- **Remember** : Nelle wants to run a statistical program, `goostats`, on the sample contained in north-pacific-gyre/2017-07-03

- **Info** :
  - run only the program on the sample finishing by A or B
  - hint 1 : goostats takes two inputs : i) the file on which to run the program and ii) the file that's going to store the results to run an external program
  - hint 2 : `bash` goostats filename resultfile

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- **Exercise 6** : Write a program that's going to run goostats on each file of the sample, and store each results in a different file, with name stats-ORIGINAL_NAME_OF_THE_FILE. Debug as much as possible your code.

# Finding things

## grep

- `grep` = "global/regular expression/print", a finder in Shell
- Example : find the word "The" in a Haiku (in the folder writings)
- Try `grep The haiku.txt`
- retry with `grep -w The haiku.txt`. What the difference ?

!! if expressions use "my expression"

# Finding things

## Flags

- Several **flags** that are useful
  - -w : the expression is searched for as a word
  - -n : each output line is numbered
  - -i : perform case insensitive matching
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- Example : Try `grep -n -w -i "the" haiku.txt`
- More complex : `grep -E '^.o' haiku.txt`. What does this command do ?

# Finding things

## find

- `grep` finds patterns in files ; `find` finds pattern in folders (try `find .`)
- Again, some flags are really useful :
  - -type d : lists only the directories
  - -type f : lists only the files
  - -name some_name : list only the files mathcing some_name

+ You can combine : Example : Try `c -l $(find . -name '*.txt')`

# Others useful commands

- Use the keyboard's arrows to retrieve past commands
- Stop a running program at any point in time using `Ctrl + c`
- `Ctrl + a` and `Ctrl + e` brings the pointer to the beginning and the end of the line respectively history lists the last few hundred commands, and !123 runs the command associated with line 123.

# Others funny (but very useless ?) commands

- Install and run `sl`
- Try `telnet towel.blinkenlights.nl`
- Compute factors using the command `factor + X`
- etc.

# Shell scripts

- The UNIX-shell was supposed to be **reusable and efficient** but we have to retype command again and again ! ?

$\Rightarrow$ **Write Shell scripts** !

- A shell script : a small programs that contains a list of Shell commands that end with `.sh`

# Shell scripts

## How to ?

1. Open your text editor
2. Write your bash command as if it was in the terminal
3. Save the file, ex : `ScriptName.sh`
4. Run the file in the terminal typing : `bash ScriptName.sh`

# Shell scripts

## How to ?

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- **Exercise 7** : Write a bash script that select the 15 first lines of the file octane.pdb and only display the last 5 (hint : use head and tail)
- **Exercise 8** : Write a bash script that select the 15 first lines of any file *.pdb that you choose and only display the last 5 (hint : use head and tail) + don't forget to document your code !