Introduction to Terminal

Computing in Optimization and Statistics: Lecture 1

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Based on Slides byJackie Baek

MIT

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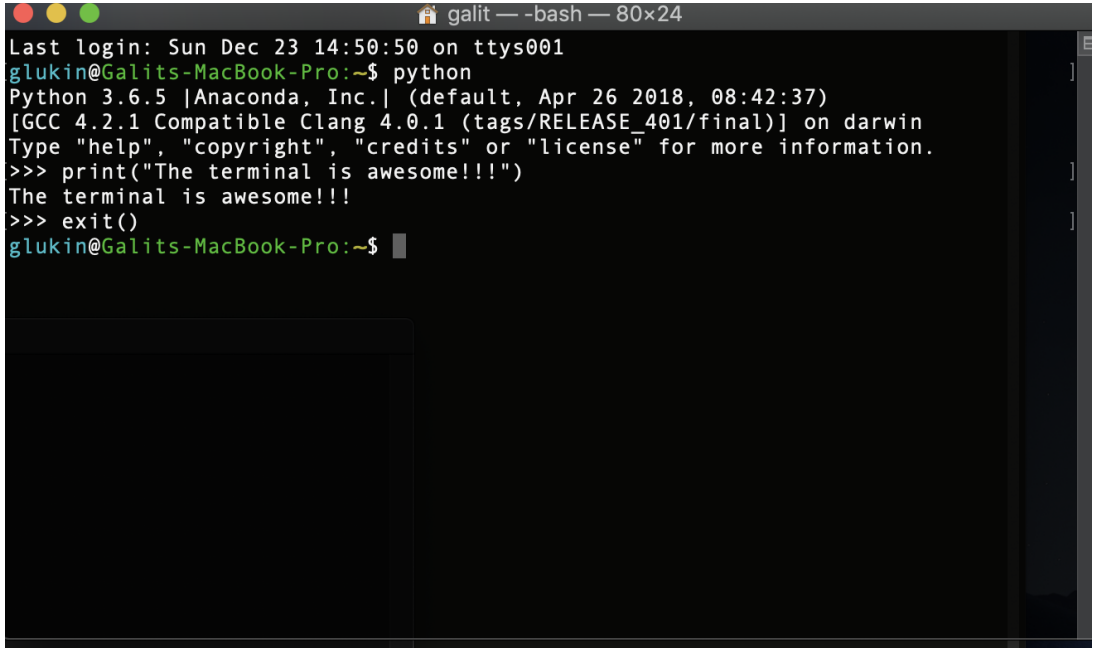
What is the terminal?

- Console, Shell, Command line, Command prompt

What is the terminal?



- The terminal is a text-based interface to interact with the computer.
- For example, it can replace the use of the file system and the use of IDEs

Example

- Say you want to delete all files in a directory that end with .csv

```
$ rm *.csv
```

- Or change their location to a folder for outputs

```
$ mv *.csv ../OutputFolder
```

- This is possible to do without the terminal, but it requires much more effort.

Why should I learn it?

- You can do almost everything using just the terminal.
- It can do many tasks faster than using a graphic interface.
- You can simultaneously run different simulations with different parameters.
- Using the terminal is sometimes the only option (e.g. accessing a client's server using SSH).
- The terminal is universal.

Use case: running code

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  - e.g. RStudio for R
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  - You want to chain commands together.
    - The following command will execute the command on the right if and only if the command on the left succeeded.

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      $ python process_stuff.py && R make_plots.R
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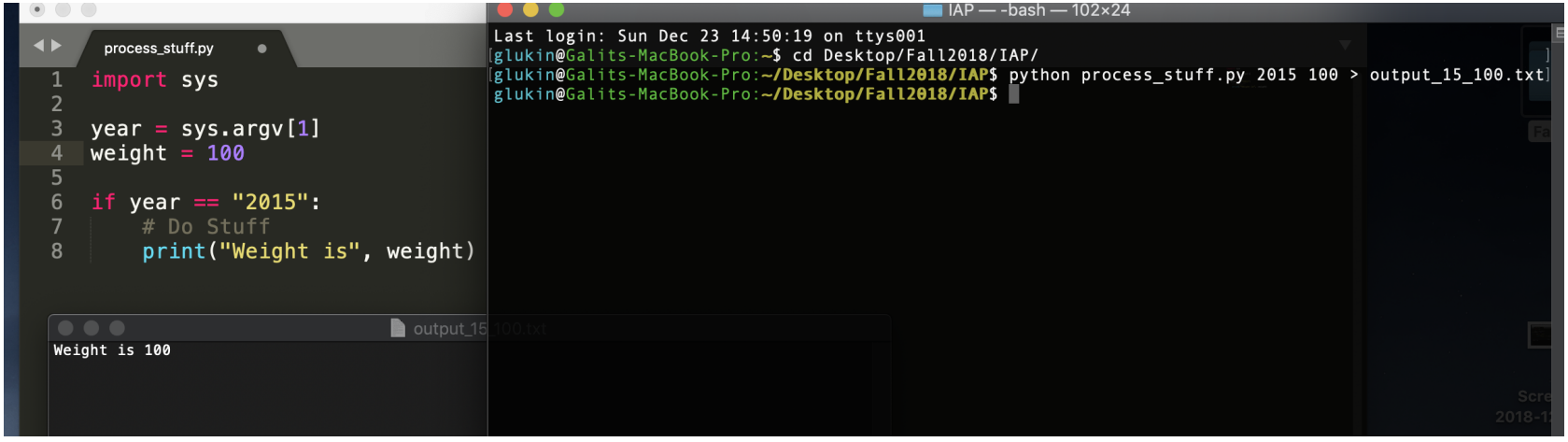
  - You want to run a script with different parameters and different output files.

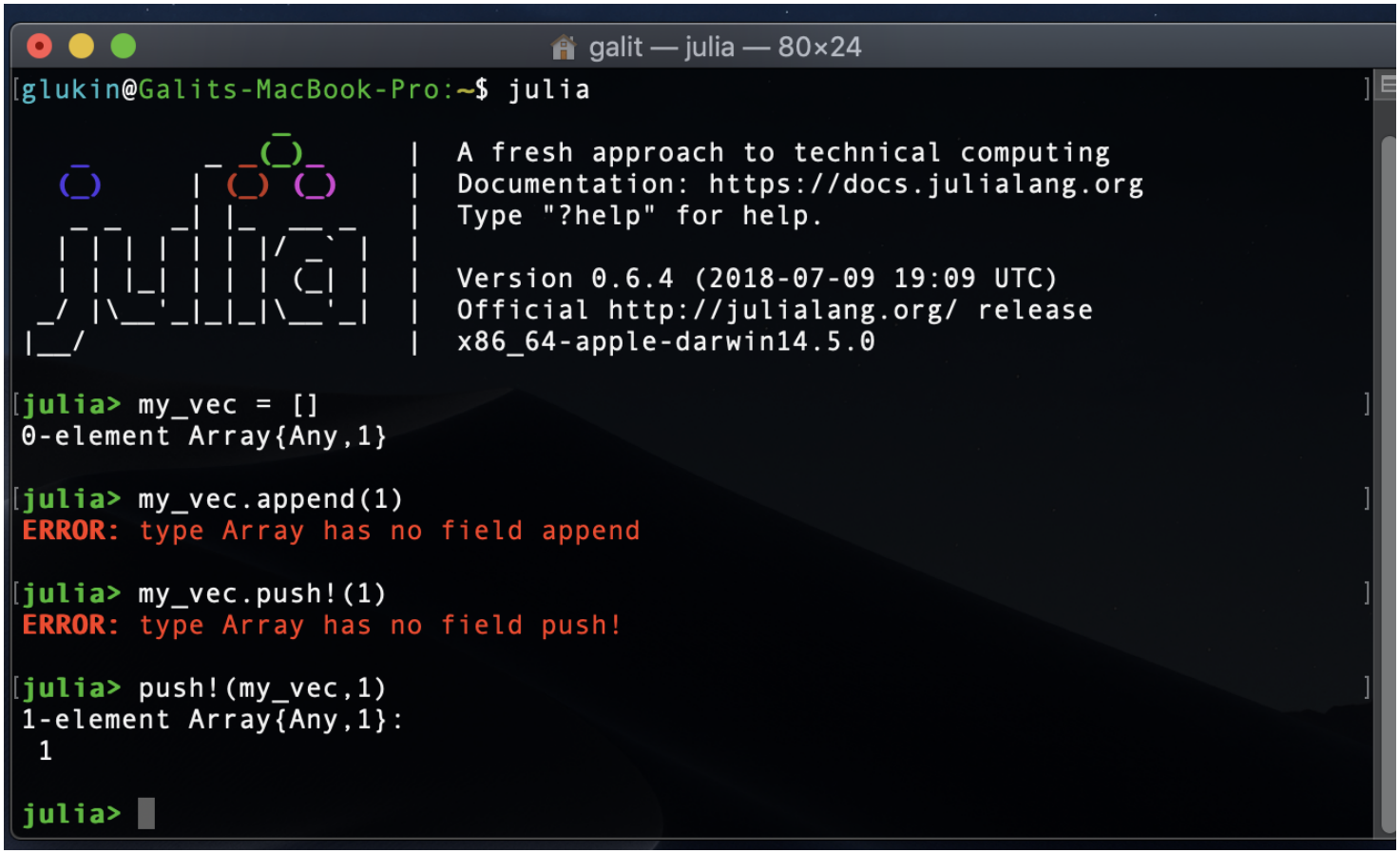
    ```
    $ python process_stuff.py 2015 100 > output_15_100.txt
    ```

Use case: running a script with parameters and output files



Use case: learning a language

- Instead of constantly Googling or running scripts that fail ....
- Have a separate terminal open to test your syntax!



Terminal Basics

- We will be using a **shell** called **bash**: a program that interprets and processes the commands you input into the terminal.
- The shell is always in a **working directory**.
- A typical command looks like:

```
$ command <argument1> <argument2> ...
```

Basic navigation commands

pwd: prints working directory.

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cd <**directory**>: change working directory to new directory.

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$ cd Desktop/Fall2018
$ pwd
/Users/galit/Desktop/Fall2018
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```

open <**filename**>: opens the file - analogous to double-clicking.

```
$ open FallRegistration.pdf
```

Use tab, arrow keys and file path shortcuts

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- Use $\uparrow$ and $\downarrow$ arrow keys to navigate through your command history.

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- . is current directory.

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$ open  ./FallRegistration.pdf
```

- .. is parent directory.

```
$ cd IAP #Fall2018 is the parent directory of IAP
$ open  ../FallRegistration.pdf
```

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- $\sim$ is home.
  - expands to */Users/<username>* (or wherever *home* is on that machine).
  - $\sim$*/Documents* $\rightarrow$ */Users/galit/Documents*
  - The command **cd** (without any arguments) takes you to $\sim$.

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- A file is contained in a **directory** (folder). Files within the same directory have unique names.
- Every file and directory has a unique location in the file system, called a **path**.
  - **Absolute path**: */Users/galit/Desktop/Fall2018/FallRegistration.pdf*
  - **Relative path** (if my current working directory is /Users/galit/Desktop): *Fall2018/FallRegistration.pdf*

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cp *source target*: copy.
mv *source target*: move/rename.

```
$ cp helloworld.txt helloworld_copy.txt
$ mv helloworld.txt goodbyeworld.txt
```

Hidden Files

- Files that start with a dot (.) are called **hidden** files.
- Used for storing preferences, config, settings.
- Use *ls -a* to list all files.

```
$ ls
github_notes.md   presentation     scripts

$ ls -a
.                 .git             github_notes.md    scripts
..                .gitignore       presentation
```

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- This file is a bash script that runs at the beginning of each session (i.e. when you open the terminal).
- This file can be used to set variables or to declare **aliases**.
  - What is the difference?
  - Variables can be used anywhere in a command line (e.g. as parts of program arguments)
  - Aliases can only be used as the names of programs to run (e.g. cd, ssh, mkdir)
- **alias** *new_command=command*

```
$ alias fall2018="cd ~/Desktop/Fall2018"
$ alias athena="ssh glukin@athena.dialup.mit.edu"
```

- **PATH**=*path:$PATH*

```
$ PATH="/Applications/anaconda3/bin:$PATH"
```

Redirection

> redirects output to a file, *overwriting* if file already exists.

```
$ ls > out.txt
```

>> redirects output to a file, *appending* if file already exists.

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$ python fetch_data.py >> output.csv
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$<$ uses contents of file as STDIN (standard input) to the command.

```
$ python process_stuff.py < input.txt
```

Secure Shell (SSH)

- Sometimes we need to work on a remote machine.
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```
$ ssh glukin@athena.dialup.mit.edu
or
$ athena

Password:

Welcome to Ubuntu 14.04.5 LTS
...
Last login:  Sun Dec 23 10:56:22 2018 ....

glukin@buzzword-bingo:~$
```

Use *logout* to exit SSH session.

Secure Copy (scp)

Can transfer files between local and remote machines using the **scp** command on your local machine.

Move *my_file.txt* from local machine to remote home directory.

```
$ scp my_file.txt glukin@athena.dialup.mit.edu:~
```

Move *remote_file.txt* from remote to local machine.

```
$ scp glukin@athena.dialup.mit.edu:~/remote_file.txt .
```

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```
$ ls *.pdf
a2.pdf    bar.pdf
```

```
$ ls a[0-9]*
a1.txt    a2.pdf
```

Simple Pattern Matching (Globbing)

Wildcard	Description	Example	Matches
`*`	matches any number of any characters including none	`Law*`	`Law`, `Laws`, or `Lawyer`
		`*Law*`	`Law`, `GrokLaw`, or `Lawyer`.
`?`	matches any single character	`?at`	`Cat`, `cat`, `Bat` or `bat`
`[abc]`	matches one character given in the bracket	`[CB]at`	`Cat` or `Bat`
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Copy all files that has "dog" in its name to the *animal/* directory.

```
$ cp *dog* animal/
```

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- There are several special "environment" variables (i.e. $PATH, $HOME, $USER, etc.) that many programs rely on.

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```
$ echo $PATH

/Applications/anaconda3/bin:
/Library/Frameworks/Python.framework/Versions/3.6/bin:
/usr/local/bin:/usr/bin:/bin:/usr/sbin:/sbin:
/Library/TeX/texbin
```

- *$PATH* contains is liist of directories separated by :
- Bash looks into each of these directories to look for the program *pwd*.

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- **Solution:** Find where you installed TeX, find the directory with the binary files (usually a directory called *bin*), and add the directory to *$PATH*.
- Add the following to your *∼/.bash_profile*:

```
PATH="$PATH:/Library/TeX/Distributions/Programs/texbin"
export PATH
```

- The export command allows a child process to inherit all marked variables

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- So is *tab* for autocomplete, *arrow keys* for history.
- Be careful with *rm*.
- Getting comfortable with the terminal can be daunting at first, but it has the potential to greatly boost your efficiency!

Thank you!