

Introduction to Terminal

Computing in Optimization and Statistics: Lecture 1
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Overview

Introduction & Motivation

Navigation commands

Files

- Basic file commands

- File path shortcuts

- Hidden Files

Simple Pattern Matching

SSH

How bash works

- Environment Variables

- .bashrc / .bash_profile

Aliases

Documentation

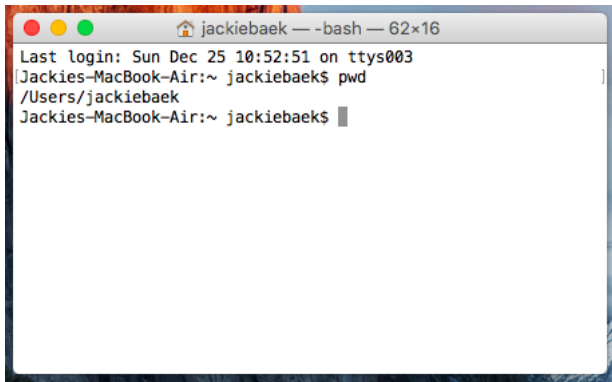
Common Errors

Key Takeaways

What is the terminal?



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```
jackiebaek — -bash — 62x16
Last login: Sun Dec 25 10:52:51 on ttys003
[Jackies-MacBook-Air:~ jackiebaek$ pwd
/Users/jackiebaek
Jackies-MacBook-Air:~ jackiebaek$
```

- ▶ The terminal is a text-based interface to interact with the computer.
- ▶ Alternate names: console, shell, command line, command prompt

Example

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

```
$ rm *.pyc
```

- ▶ 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.
- ▶ It is sometimes the only option (e.g. accessing a client's server using SSH).
- ▶ It is universal.

Terminal Basics

- ▶ The **shell** is the program that processes the commands you input into the terminal.
- ▶ The particular shell we will be using is **bash**, indicated by prompt **\$**.
- ▶ The shell is always in a **working directory**.
- ▶ A typical command looks like:

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

Basic navigation commands

pwd: prints working directory.

```
$ pwd  
/Users/jackiebaek
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ls: lists directory contents.

```
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Applications      Movies  
Desktop           Music  
Documents         Pictures
```

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Applications                Movies  
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```

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

```
$ cd Documents  
$ pwd  
/Users/jackiebaek/Documents
```

Tab and arrow keys are your friends

- ▶ Use **tab** to autocomplete *commands* and *file paths*.
- ▶ Use ↑ and ↓ arrow keys to navigate through your command history.
- ▶ Use **ctrl-c** to cancel/abort.
- ▶ Use **ctrl-d** to exit/logout.
- ▶ Use **clear** or **ctrl-k** to clear screen.

What is a file?

A file is a container of data (0's and 1's).

Most files have a **file extension**.

- ▶ Examples: .doc, .pdf, .csv, .jpg, .jl
- ▶ However, these extensions are just *conventions*.

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Every file and directory has a unique location in the file system, called a **path**.

- ▶ **Absolute path:**

`/Users/jackiebaek/Dropbox/Documents/hello.txt`

- ▶ **Relative path** (if my current working directory is `/Users/jackiebaek/Dropbox`): `Documents/hello.txt`

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cp *source target*: copy.

mv *source target*: move/rename.

```
$ cp helloworld.txt helloworld_copy.txt
```

```
$ mv helloworld.txt goodbyeworld.txt
```

File path shortcuts

. is current directory.

.. is parent directory.

- ▶ ../*file.txt* references a file named *file.txt* in the parent directory.

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`.` is current directory.

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- ▶ `../file.txt` references a file named `file.txt` in the parent directory.

`~` is home.

- ▶ expands to `/Users/<username>` (or wherever *home* is on that machine).
- ▶ `~/Documents` → `/Users/jackiebaek/Documents`
- ▶ The command **cd** (without any arguments) takes you to `~`.

Hidden Files

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
```

Simple Pattern Matching (Globbing)

- ▶ Match [multiple] filenames with wildcard characters.
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```

```
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```

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

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```
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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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Source: Wikipedia

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Remove all files that end with .pyc

```
$ rm *.pyc
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```
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```

Copy all files that has "dog" in its name to the *animal/* directory.

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

Secure Shell (SSH)

- ▶ Sometimes we need to work on a remote machine.
 - ▶ We need more computing power than just our local machine.
 - ▶ We need to access data from a client's server.
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$ ssh baek@athena.dialup.mit.edu
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```
$ ssh baek@athena.dialup.mit.edu
```

```
Password:
```

```
Welcome to Ubuntu 14.04.5 LTS
```

```
...
```

```
Last login: Tue Aug 30 10:11:49 2016 from howe-and-ser-...
```

```
baek@howe-and-ser-moving:~$
```

Now I can do anything on this terminal as I did on the terminal on my local machine.

Secure Copy (scp)

Can transfer files between local and remote machines using **scp**.

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

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

Move remote_file.txt from remote to local machine.

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

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- ▶ Bash is a programming language.
 - ▶ Can set variables, use for loops, if statements, comments, etc.
- ▶ There are several special "environment" variables (i.e. \$PATH, \$HOME, \$USER, etc.) that many programs rely on.
- ▶ Must use \$ to refer to a variable; otherwise, interpreted as a command.

```
$ my_variable=pwd
```

```
$ my_variable
```

```
bash: my_variable: command not found
```

```
$ $my_variable
```

```
/Users/jackiebaek
```


How bash works con't

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```
$ echo $PATH
```

```
/Users/jackiebaek/.local/bin:/Users/jackiebaek/.cabal/bin:/Applications/ghc-7.10.3.app/Contents/bin:/usr/local/bin:/usr/bin:/bin:/usr/sbin:/sbin:/usr/texbin
```

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

.bashrc / .bash_profile

- ▶ There is a hidden file in `~` directory called `.bashrc` or `.bash_profile`.
- ▶ This file is a bash script that runs at the beginning of each session (i.e. when you open the terminal).

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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**.
- ▶ **alias** *new_command=command*

```
$ alias athena="ssh baek@athena.dialup.mit.edu"
```

Useful Aliases

Change directory to the paths that you visit the most often (i.e. the main directory of your research project).

```
$ alias re="cd ~/Dropbox/Documents/Research/"
```

Commands to compile/run your program with flags.

```
$ alias cjs="coffee --compile --output js/ coffee/"
```

Shorten the commands that you use the most often.

```
$ alias py="python"
```

Documentation

- ▶ Commands can have required and/or optional arguments.
- ▶ Optional arguments usually come first, and are indicated by a hyphen (-). These are called **flags**.

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- ▶ To look up documentation for a particular command, use '**man** *command*'. (man = manual)

```
$ man mkdir
```

NAME

```
mkdir -- make directories
```

SYNOPSIS

```
mkdir [-pv] [-m mode] directory_name ...
```

DESCRIPTION

```
The mkdir utility creates the directories named as operands  
...
```

Common Error 1: Command not found

You installed a new software (e.g. TeX), but as soon as you try to run it, you get this error:

```
$ pdflatex
```

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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 $\sim/.bash_profile$:

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

Common Error 2: Permission denied

You try to run a program or install a software, and you get this message:

```
$ python -m pip install --upgrade --force-reinstall pip
```

```
OSError: [Errno 13] Permission denied: '/usr/local/lib/pytho...'
```

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```

Solution: use **sudo**.

- ▶ sudo runs the command as the root user.
- ▶ It will ask you for your password before the command is run.
- ▶ Similar to when you go click through an install wizard for some software, and they ask you for your password before installation.

```
$ sudo python -m pip install --upgrade --force-reinstall pip
```

This may be dangerous if you don't know what you are doing.

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Be especially careful of:

- ▶ **rm -r**

- ▶ -r stands for *recursive* - removes directories.

- ▶ **rm -f**

- ▶ -f stands for *force*.

- ▶ For most commands. the flag -f usually stands for force. Be wary any time you need to use this.

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- ▶ So is *tab* for autocomplete, *arrow keys* for history, *man* for manual.
- ▶ Be careful with *rm* and any time you use *-f* flag.
- ▶ Getting comfortable with the terminal can be daunting at first, but it has the potential to greatly boost your efficiency!

Thank you!