

Introduction to Terminal

Computing in Optimization and Statistics: Lecture 1
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January 7, 2017

Overview

Introduction & Motivation

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Files

- Basic file commands

- File path shortcuts

- Hidden Files

- .bashrc / .bash_profile

Redirection

sudo

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Simple Pattern Matching

How bash works

- Environment Variables

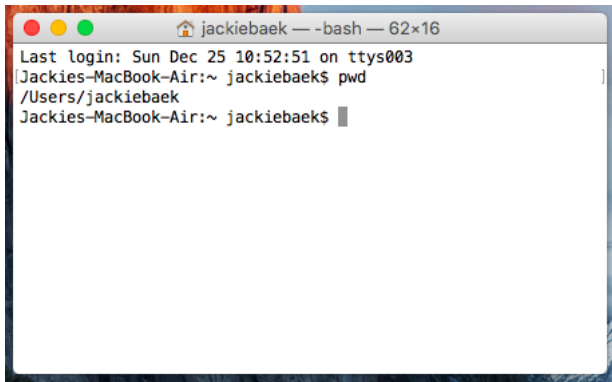
Documentation

Key Takeaways

What is the terminal?



What is the terminal?



```
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

- ▶ 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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/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 **clear** or **cmd-k** to clear screen.

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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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$ nano helloworld.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

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.. is parent directory.

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`.` is current directory.

`..` is parent directory.

- ▶ `../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

- ▶ 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
```


.bashrc / .bash_profile

- ▶ There is a hidden file in `~` directory called `.bashrc` or `.bash_profile`.
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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"
```

Redirection

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

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< uses contents of file as STDIN (standard input) to the command.

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

Sudo

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

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

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.
- ▶ Can use SSH to securely access the terminal for the remote machine.

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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:~$
```

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 baek@athena.dialup.mit.edu:~
```

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

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

Simple Pattern Matching (Globbing)

- ▶ Match [multiple] filenames with wildcard characters.
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Example:

```
$ ls
```

```
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Example:

```
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```
$ echo a*  
a1.txt      a2.txt      apple.pdf
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Example:

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

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

```
$ echo *.pdf  
a2.pdf      b.pdf
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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
[a-z]	matches one character from the range given in the bracket	Letter[0-9]	Letter0 , Letter1 , Letter2 up to Letter9

Figure: Source: Wikipedia

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

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

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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.

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 - ▶ Usually under a directory called *bin*, which stands for *binary*.

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- ▶ Where is this program?
 - ▶ Usually under a directory called *bin*, which stands for *binary*.
- ▶ When you type in a command, bash looks for a program with that name under the directories listed in the *\$PATH* environment variable.

```
$ 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*.

Common Error: Command not found

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

```
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```

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- ▶ This means that bash cannot find the program 'pdflatex' in the $\$PATH$ variable.
- ▶ **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"
```


Documentation

- ▶ 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  
...
```

- ▶ 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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- ▶ So is *tab* for autocomplete, *arrow keys* for history, *man* for manual.
- ▶ 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!