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# APPLIED ENGINEERING DATA ANALYSIS, OPTIMIZATION AND VISUALIZATION

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Terminal and the command line

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# Last reminder

- Make a TACC account and send your TACC ID to Philip
  - After Thursday, 1 point per day will come off your class participation grade, Friday = 1, Saturday = 2, etc...

# The what and why

- What?
  - We are going to learn some basic commands for the Linux command line
- Why?
  - These can be powerful, time saving tools + this is the only way to interact with TACC

In this class we will be using the command line for most things

- This is how computers really work
- This is how we will interface with R & TACC & Github
- You look super cool when you know how to use it

# We will be learning Bash today, what is Bash?

- Bash is a Unix shell and command language
- The default login shell for most Linux distributions and Apple's macOS
- A version is also available for Windows 10

# [All] the cheat sheets

- <https://www.git-tower.com/blog/command-line-cheat-sheet/>
- <https://www.linuxtrainingacademy.com/linux-commands-cheat-sheet/>
- <https://learnpythononthehardway.org/python3/appendixa.html>

# Let's make the macOS terminal look better before we start, windows users: already ok

- <http://osxdaily.com/2013/02/05/improve-terminal-appearance-mac-os-x/>
  - Open Terminal and type nano .bash\_profile
  - Paste in the following lines:

```
export PS1="\[\033[36m\]\u\[\\033[m\]@\[\033[32m\]\h:\[\033[33;1m\]\w\[\\033[m\]\$ "
export CLICOLOR=1
export LS_COLORS=ExFxBxDxCxegedabagacad
alias ls='ls -GFh'
```

- Hit Control+O to save, then Control+X to exit out of nano

# Who am I? Where am I? Can I do anything?

```
jdr2823@eins-a16551:~/Documents/scratch$
```

User name

Computer name

Current location/directory

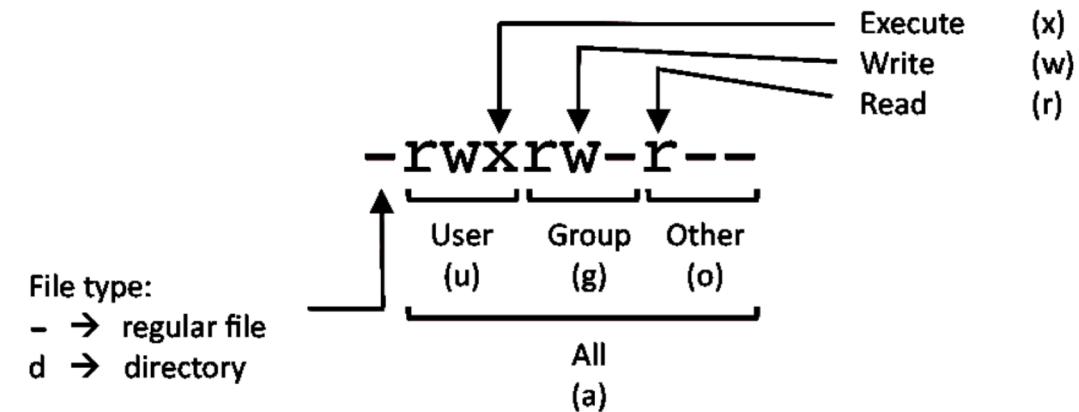
\$ = prompt

But seriously, where am I, and what is all this stuff?

```
jdr2823@eins-a16551:~/Documents/data$ pwd  
/Users/jdr2823/Documents/data  
jdr2823@eins-a16551:~/Documents/data$ ls  
Lecture_list.xlsx          eGRID/  
PLATTS_TX/                 waterfall_charts_twitter/
```

# Sometimes a little more information is helpful

```
jdr2823@eins-a16551:~/Documents/data$ ls -l
total 72
-rw-r--r--@ 1 jdr2823 AUSTIN\Domain Users 33K Jan  8 15:25 Lecture_list.xlsx
drwxr-xr-x 114 jdr2823 AUSTIN\Domain Users 3.8K Aug 24 14:03 PLATTS_TX/
drwxr-xr-x  3 jdr2823 AUSTIN\Domain Users 102B Aug 24 14:01 eGRID/
drwxr-xr-x  15 jdr2823 AUSTIN\Domain Users 510B Nov  6 07:43 waterfall_charts_twitter/
```



\* <https://www.linux.com/learn/understanding-linux-file-permissions>

When you first open terminal, it starts at your home directory

- To change directories, you use the command:
  - cd <dir> = “change directory to <dir>”
- You can change to a far away land too
  - cd far/away/land (you don’t need <> brackets!)
- You can use “shift” key to move faster
- Use cd .. to go backwards one step

# Watch out for spaces in directory/file names – it can be super annoying

```
jdr2823@eins-a16551:~$ pwd  
/Users/jdr2823  
jdr2823@eins-a16551:~$ cd /Users/jdr2823/Box Sync/Teaching/Spring2018/Data_class/Lectures/data_viz_examples  
-bash: cd: /Users/jdr2823/Box: No such file or directory  
jdr2823@eins-a16551:~$ cd /Users/jdr2823/Box\ Sync/Teaching/Spring2018/Data_class/Lectures/data_viz_examples  
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/Lectures/data_viz_examples$ █
```

# There are some other basic commands

- `mkdir` = make a directory
- `rmdir` = remove (delete) an empty directory

```
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class$ ls
Assignments/          EIA_data_for_class/ git_class_demo/
Class_docs/           Lectures/         refs/
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class$ mkdir terminal_demo
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class$ ls
Assignments/          EIA_data_for_class/ git_class_demo/   terminal_demo/
Class_docs/           Lectures/         refs/
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class$ rmdir terminal_demo/
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class$ ls
Assignments/          EIA_data_for_class/ git_class_demo/
Class_docs/           Lectures/         refs/
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class$
```

# Help is found in different locations

```
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ info mkdir
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$
```

```
man pages, Node: mkdir, Up: (dir)
File: +nmpages, Node: mkdir, Up: (dir)

MKDIR(1)          BSD General Commands Manual          MKDIR(1)

NAME
    mkdir -- make directories

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

DESCRIPTION
    The mkdir utility creates the directories named as operands, in the order
    specified, using mode rwxrwxrwx (0777) as modified by the current
    umask(2).

    The options are as follows:

    -m mode
        Set the file permission bits of the final created directory to
        the specified mode. The mode arguments can be in any of the formats
        specified to the chmod(1) command. If a symbolic mode is
        specified, the operation characters '+' and '-' are inter-
        preted relative to an initial mode of ``a=rwx''.

    -p
        Create intermediate directories as required. If this option is
        not specified, the full path prefix of each operand must already
        exist. On the other hand, with this option specified, no error
        will be reported if a directory given as an operand already
        exists. Intermediate directories are created with permission
        bits of rwxrwxrwx (0777) as modified by the current umask, plus
        write and search permission for the owner.

    -v
        Be verbose when creating directories, listing them as they are
        created.

    The user must have write permission in the parent directory.

DIAGNOSTICS
    The mkdir utility exits 0 on success, and >0 if an error occurs.

SEE ALSO
    rmdir(1)

COMPATIBILITY
    The -v option is non-standard and its use in scripts is not recommended.

STANDARDS
    The mkdir utility is expected to be IEEE Std 1003.2 ("POSIX.2") compat-
    ible.

HISTORY
    A mkdir command appeared in Version 1 AT&T UNIX.

BSD                January 25, 1994                BSD
MKDIR(2)          BSD System Calls Manual          MKDIR(2)

NAME
    Info: (+nmpages)mkdir, 188 lines --Top
Welcome to Info version 5.2. Type h for help, m for menu item.
```

<- press q to exit help menu (OSX)  
Linux help is Windows style ->

```
Joshua Rhodes@THOR MINGW64 ~/Documents/scratch
$ mkdir --help
Usage: mkdir [OPTION]... DIRECTORY...
Create the DIRECTORY(ies), if they do not already exist.

Mandatory arguments to long options are mandatory for short options too.
  -m, --mode=MODE      set file mode (as in chmod), not a=rwx - umask
  -p, --parents        no error if existing, make parent directories as needed
  -v, --verbose        print a message for each created directory
  -Z                  set SELinux security context of each created directory
                      to the default type
  --context[=CTX]      Like -Z, or if CTX is specified then set the SELinux
                      or SMACK security context to CTX
  --help              display this help and exit
  --version           output version information and exit

GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
Full documentation at: <http://www.gnu.org/software/coreutils/mkdir>
or available locally via: info '(coreutils) mkdir invocation'
```

# Terminal Exercise 1:

```
$ pwd  
$ cd ~  
$ mkdir temp  
$ mkdir temp/stuff  
$ mkdir temp/stuff/things  
$ mkdir -p temp/stuff/things/orange/apple/pear/grape  
$
```

What is the `-p` for?

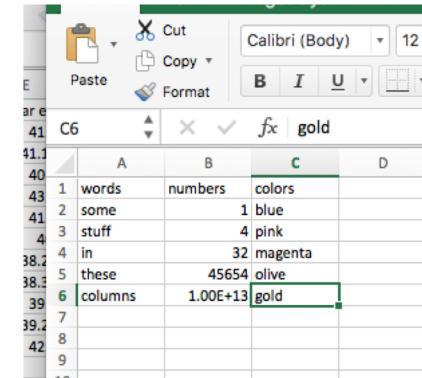
# Make and remove a file in a given directory

```
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ touch my_csv.csv
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
my_csv.csv
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ rm my_csv.csv
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ]
```

# Terminal Exercise 2:

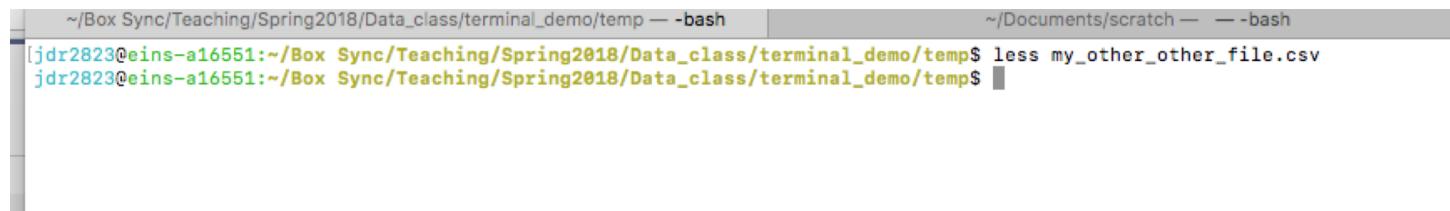
```
[jdr2823@eins-a16551:~$ pwd
/Users/jdr2823
[jdr2823@eins-a16551:~$ cd temp
[jdr2823@eins-a16551:~/temp$ touch iamcool.txt
[jdr2823@eins-a16551:~/temp$ ls
iamcool.txt  stuff/
[jdr2823@eins-a16551:~/temp$ cp iamcool.txt neat.txt
[jdr2823@eins-a16551:~/temp$ ls
iamcool.txt  neat.txt  stuff/
[jdr2823@eins-a16551:~/temp$ subl neat.txt
[jdr2823@eins-a16551:~/temp$ cp neat.txt awesome.txt
[jdr2823@eins-a16551:~/temp$ ls
awesome.txt  iamcool.txt  neat.txt  stuff/
[jdr2823@eins-a16551:~/temp$ cp awesome.txt moreawesomer.txt
[jdr2823@eins-a16551:~/temp$ ls
awesome.txt  iamcool.txt  moreawesomer.txt  neat.txt      stuff/
[jdr2823@eins-a16551:~/temp$ mkdir something
[jdr2823@eins-a16551:~/temp$ ls
awesome.txt  iamcool.txt  moreawesomer.txt  neat.txt      something/      stuff/
[jdr2823@eins-a16551:~/temp$ cp awesome.txt something/
[jdr2823@eins-a16551:~/temp$ ls
awesome.txt  iamcool.txt  moreawesomer.txt  neat.txt      something/      stuff/
[jdr2823@eins-a16551:~/temp$ ls something/
awesome.txt
[jdr2823@eins-a16551:~/temp$ cp something/ newplace/
cp: directory newplace does not exist
[jdr2823@eins-a16551:~/temp$ cp -r something/ newplace/
[jdr2823@eins-a16551:~/temp$ ls
awesome.txt  iamcool.txt  moreawesomer.txt  neat.txt      newplace/      something/      stuff/
[jdr2823@eins-a16551:~/temp$ ls newplace/
awesome.txt
[jdr2823@eins-a16551:~/temp$ ]
```

# Check out a file



A screenshot of Microsoft Excel showing a small CSV file. The file has four columns: words, numbers, colors, and a fourth column which appears to be a timestamp. The data is as follows:

	words	numbers	colors
1	some	1	blue
2	stuff	4	pink
3	in	32	magenta
4	these	45654	olive
5	columns	1.00E+13	gold
6			
7			
8			
9			
10			



~/Box Sync/Teaching/Spring2018/Data\_class/terminal\_demo/temp — -bash

```
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ less my_other_other_file.csv
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ]
```



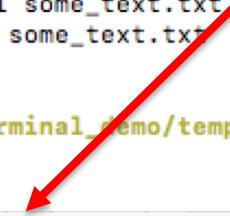
...spring2018/Data\_class/terminal\_demo/temp — less my\_other\_other\_file.csv

~/Documents/scratch — — bash

```
words    numbers   colors
some      1         blue
stuff     4         pink
in        32        magenta
these    45654     olive
columns  1.00E+13  gold
my_other_other_file.csv (END)
```

# Maybe a better example

```
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ touch some_text.txt
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ subl some_text.txt
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ cat some_text.txt
Just some random text.
Nothing to make notes about.
You might not notice.jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$
```



A screenshot of a Mac OS X desktop environment showing a terminal window and a preview window. The terminal window shows the command 'cat some\_text.txt' being run, followed by the contents of the file: 'Just some random text.', 'Nothing to make notes about.', and 'You might not notice.' Below the terminal is a preview window for the file 'some\_text.txt'. The preview shows the same three lines of text, each preceded by a small numbered callout (1, 2, 3). A red arrow points from the terminal's 'cat' command to the preview window.

some\_text.txt

1 Just some random text.  
2 Nothing to make notes about.  
3 You might not notice.

# <example CAT for class period>

- touch some\_file.csv
- cat some\_file.csv
- subl some\_file.csv
- cat some\_file.csv

# Maybe you feel like this cat?



# Some of that code not work?

- I chose Sublime Text 3 as my default text editor
- This shows how to call it from the command line
  - <https://gist.github.com/adrianorsouza/df4759b0583dc112da4>
- Windows version? :/

# When a directory is not empty, you have to force it if you want to remove it

```
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
my_other_file.csv      my_other_other_file.csv  some_files/          some_text.txt
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ rm my_other_other_file.csv
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
my_other_file.csv      some_files/          some_text.txt
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ rm my_other_file.csv some_text.txt
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
some_files/
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls some_files/
my_other_other_file.csv myfile.csv
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
some_files/
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ rmdir some_files/
rmdir: some_files/: Directory not empty
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ rm -rf some_files/
[jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ ls
jdr2823@eins-a16551:~/Box Sync/Teaching/Spring2018/Data_class/terminal_demo/temp$ █
```

# Terminal Exercise #3:

```
[jdr2823@eins-a16551:~/temp$ ls
awesome.txt      iamcool.txt      moreawesomer.txt  neat.txt          newplace/      something/      stuff/
[jdr2823@eins-a16551:~/temp$ rm iamcool.txt
[jdr2823@eins-a16551:~/temp$ ls
awesome.txt      moreawesomer.txt  neat.txt          newplace/      something/      stuff/
[jdr2823@eins-a16551:~/temp$ rm *.txt
[jdr2823@eins-a16551:~/temp$ ls
newplace/  something/  stuff/
[jdr2823@eins-a16551:~/temp$ ls something/
awesome.txt
[jdr2823@eins-a16551:~/temp$ ls newplace/
awesome.txt
[jdr2823@eins-a16551:~/temp$ mkdir empty
[jdr2823@eins-a16551:~/temp$ ls
empty/  newplace/  something/  stuff/
[jdr2823@eins-a16551:~/temp$ rm empty/
rm: empty/: is a directory
[jdr2823@eins-a16551:~/temp$ rmdir empty/
[jdr2823@eins-a16551:~/temp$ ls
newplace/  something/  stuff/
[jdr2823@eins-a16551:~/temp$ rmdir something/
rmdir: something/: Directory not empty
[jdr2823@eins-a16551:~/temp$ rmdir -rf something/
rmdir: illegal option -- r
usage: rmdir [-p] directory ...
[jdr2823@eins-a16551:~/temp$ rmdir -r something/
rmdir: illegal option -- r
usage: rmdir [-p] directory ...
[jdr2823@eins-a16551:~/temp$ info rmdir
[jdr2823@eins-a16551:~/temp$ rmdir -p something/
rmdir: something/: Directory not empty
[jdr2823@eins-a16551:~/temp$ rm something/
rm: something/: is a directory
[jdr2823@eins-a16551:~/temp$ rm -r something/
[jdr2823@eins-a16551:~/temp$ ls
newplace/  stuff/
[jdr2823@eins-a16551:~/temp$ rm *
rm: newplace: is a directory
rm: stuff: is a directory
[jdr2823@eins-a16551:~/temp$ rm -r *
[jdr2823@eins-a16551:~/temp$ ls
jdr2823@eins-a16551:~/temp$ ]<- be careful!
```

# Next class: R – I recommend using the RStudio platform

- The free version is good for this class
  - And likely for your research
- Get it here: <https://www.rstudio.com/>