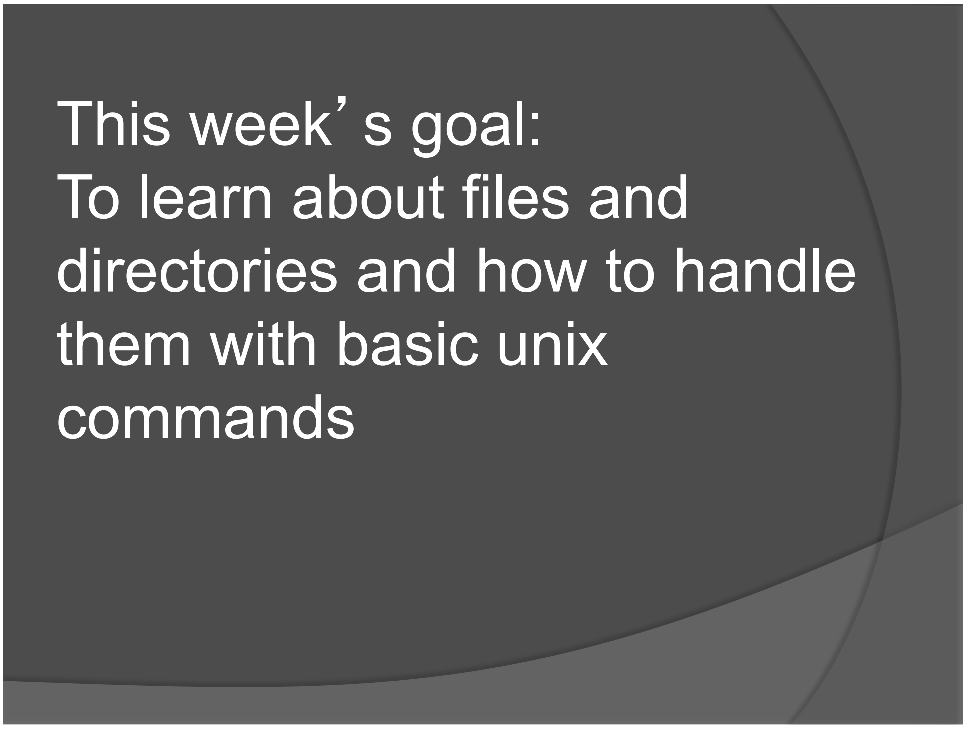
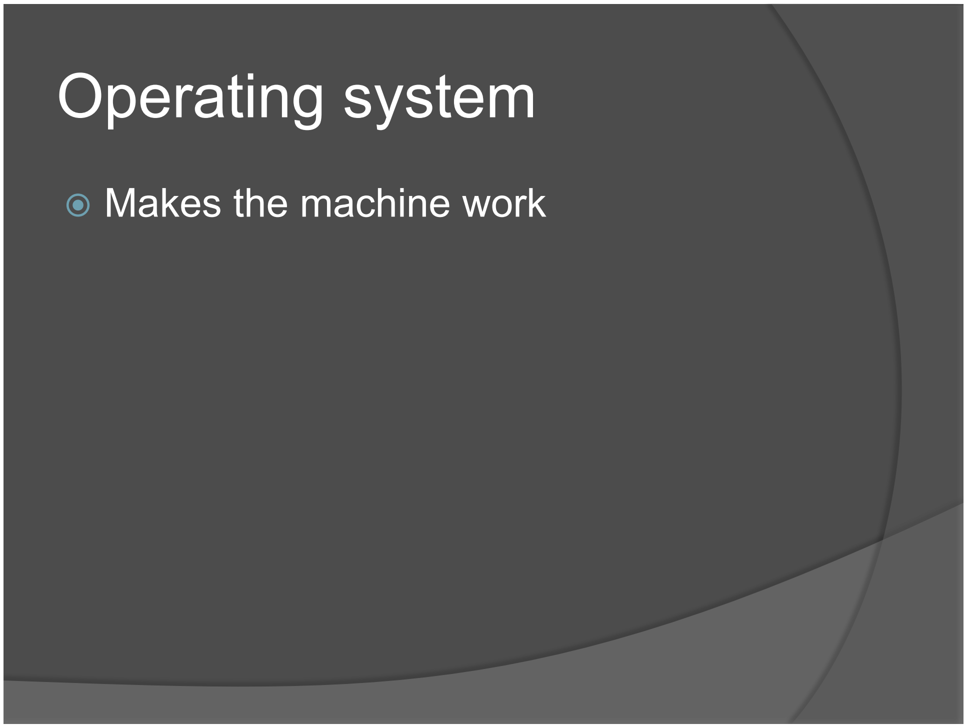
BASIC UNIX SKILLS

BINF 511, Winter 2017

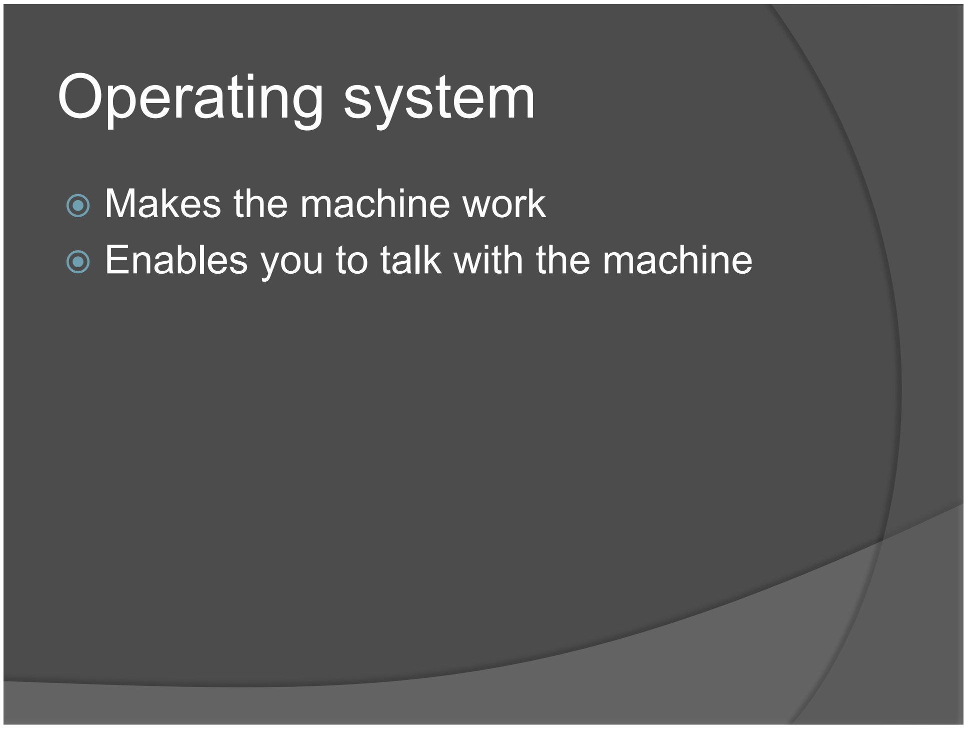


This week’s goal:
To learn about files and directories and how to handle them with basic unix commands



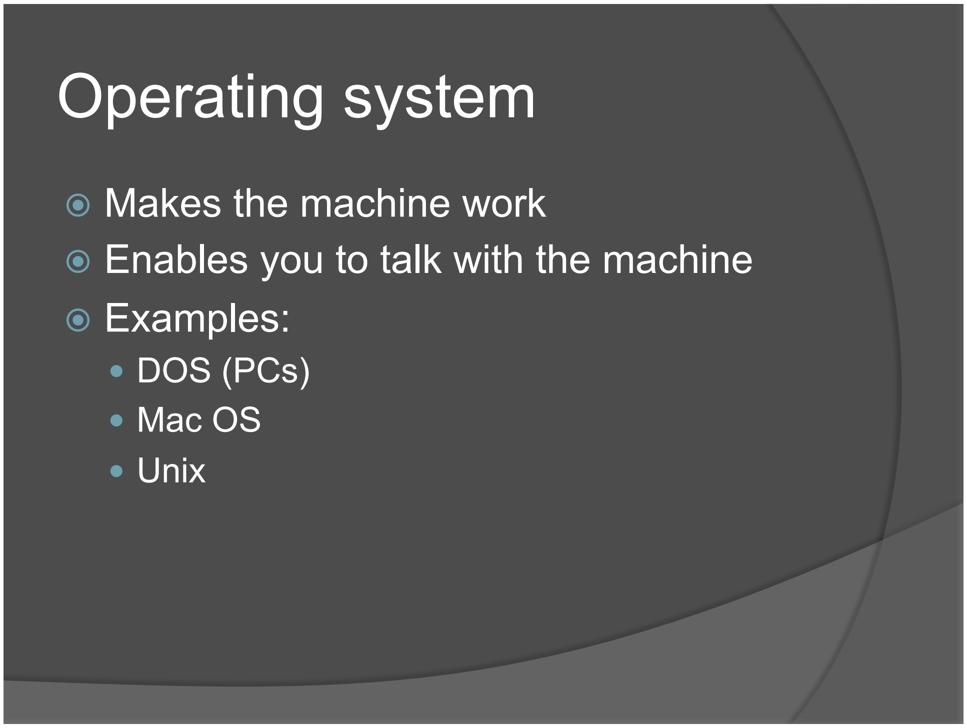
Operating system

- Makes the machine work



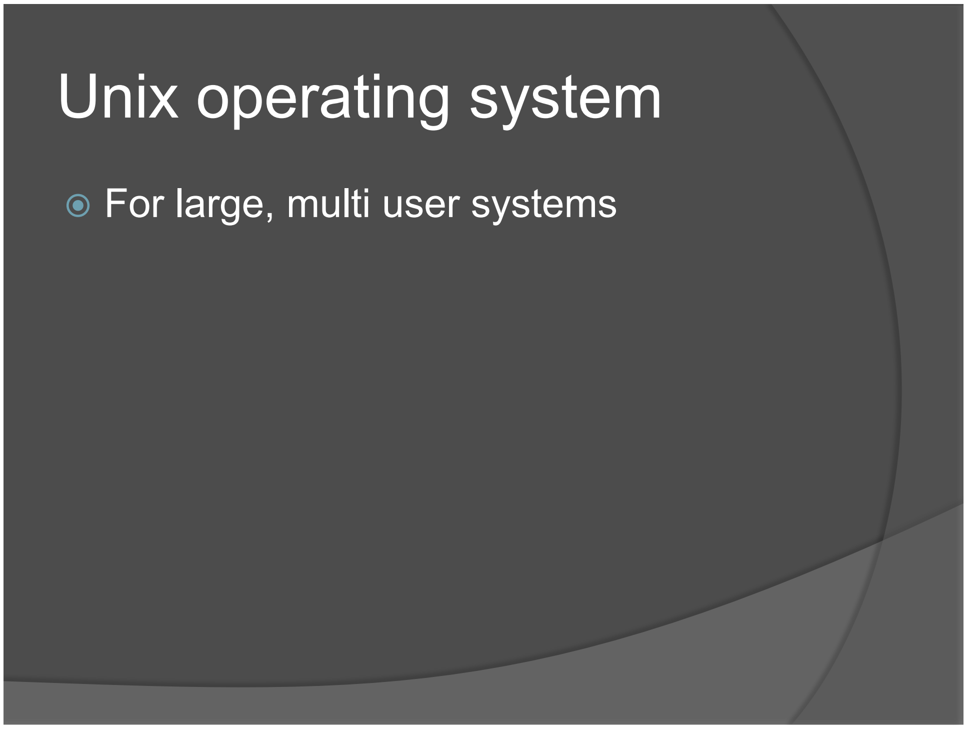
Operating system

- Makes the machine work
- Enables you to talk with the machine



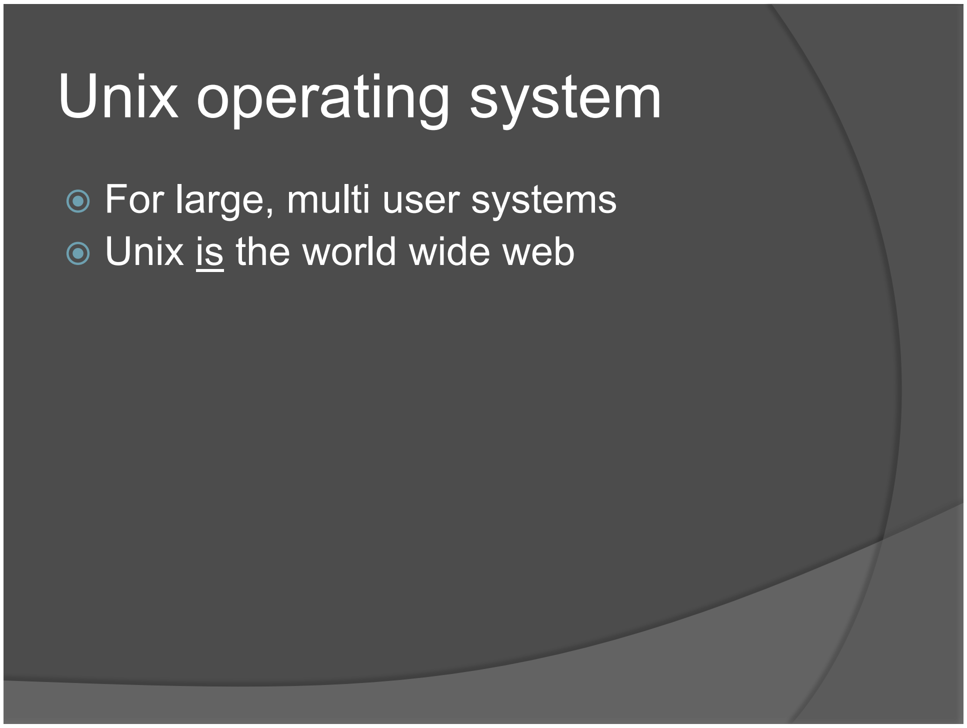
Operating system

- Makes the machine work
- Enables you to talk with the machine
- Examples:
  - DOS (PCs)
  - Mac OS
  - Unix



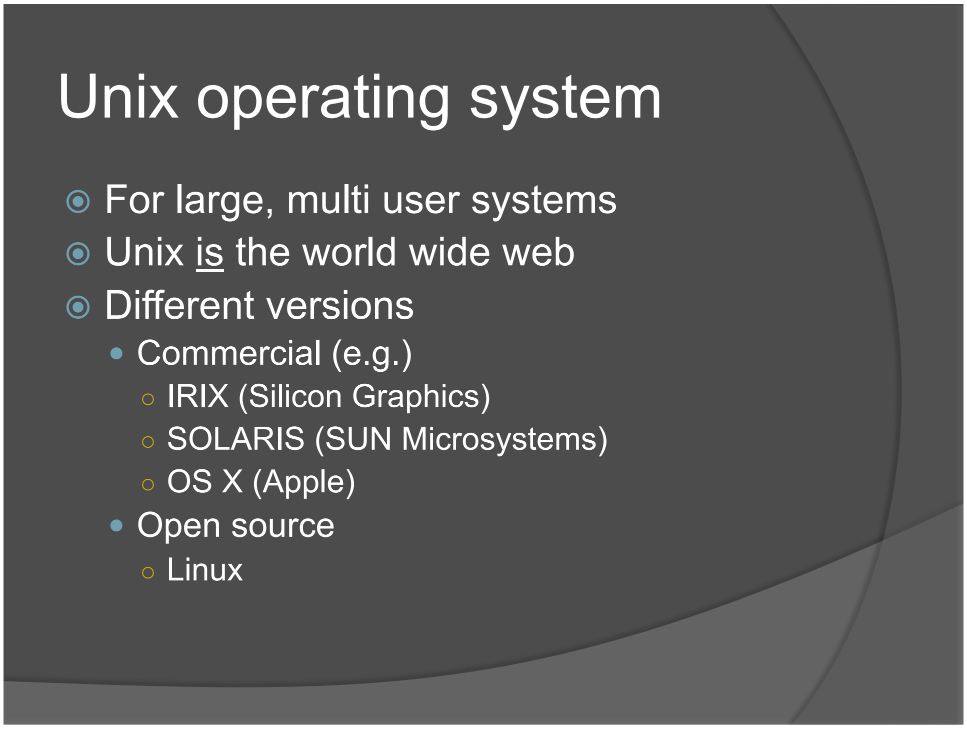
Unix operating system

- For large, multi user systems



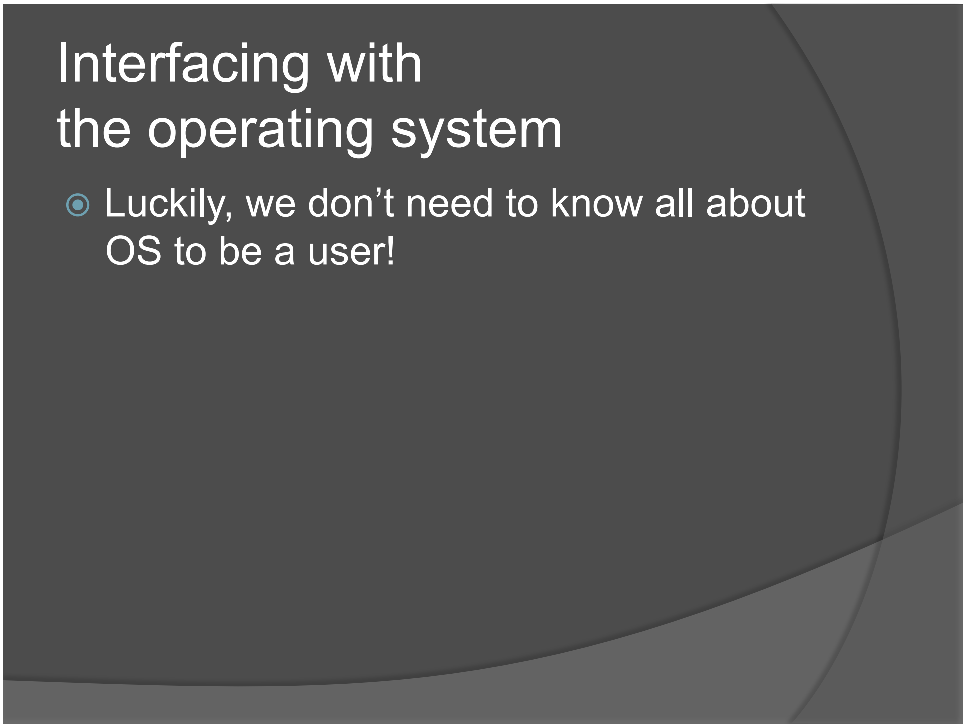
Unix operating system

- For large, multi user systems
- Unix is the world wide web



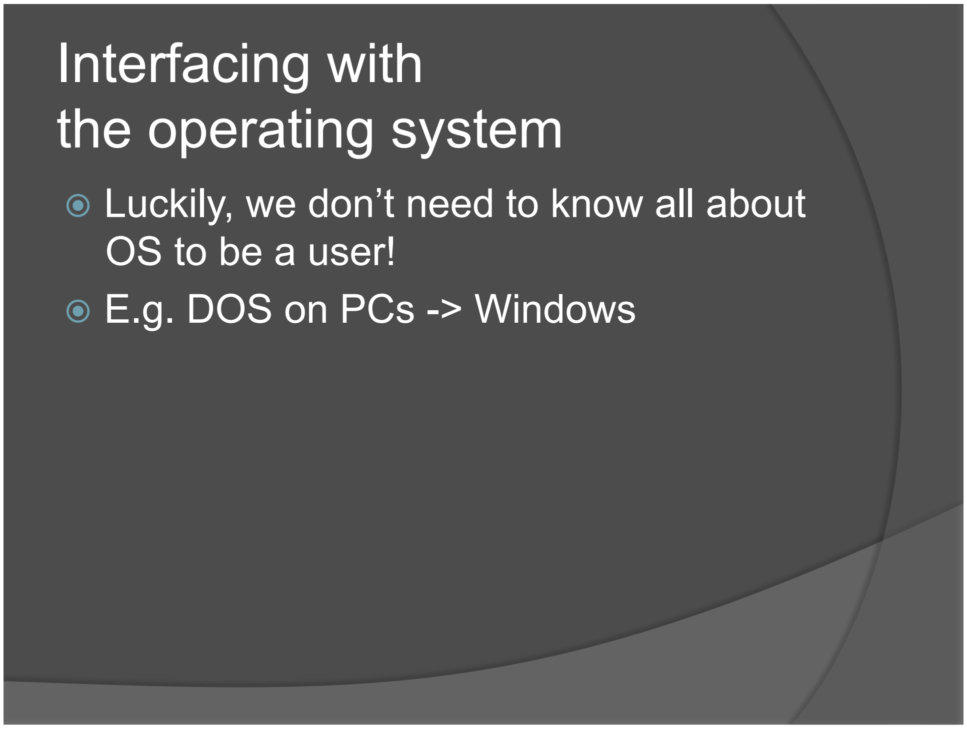
Unix operating system

- For large, multi user systems
- Unix is the world wide web
- Different versions
  - Commercial (e.g.)
    - IRIX (Silicon Graphics)
    - SOLARIS (SUN Microsystems)
    - OS X (Apple)
  - Open source
    - Linux



Interfacing with the operating system

- Luckily, we don’t need to know all about OS to be a user!



Interfacing with the operating system

- Luckily, we don’t need to know all about OS to be a user!
- E.g. DOS on PCs -> Windows

Interfacing with the operating system

- Luckily, we don’t need to know all about OS to be a user!
- E.g. DOS on PCs -> Windows
- Unix systems use X-window
  - You can have many windows open at once

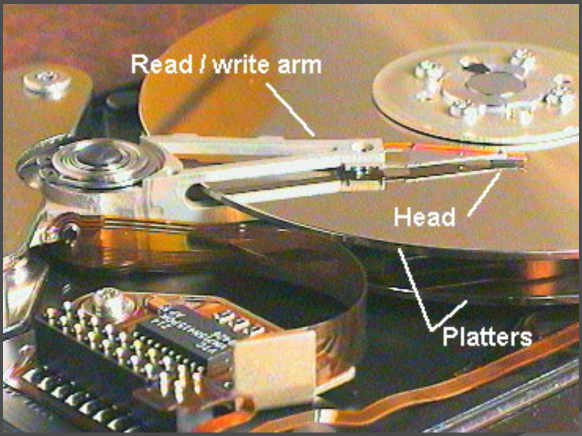
(File, don’t pile!)

FILE SYSTEMS BASICS

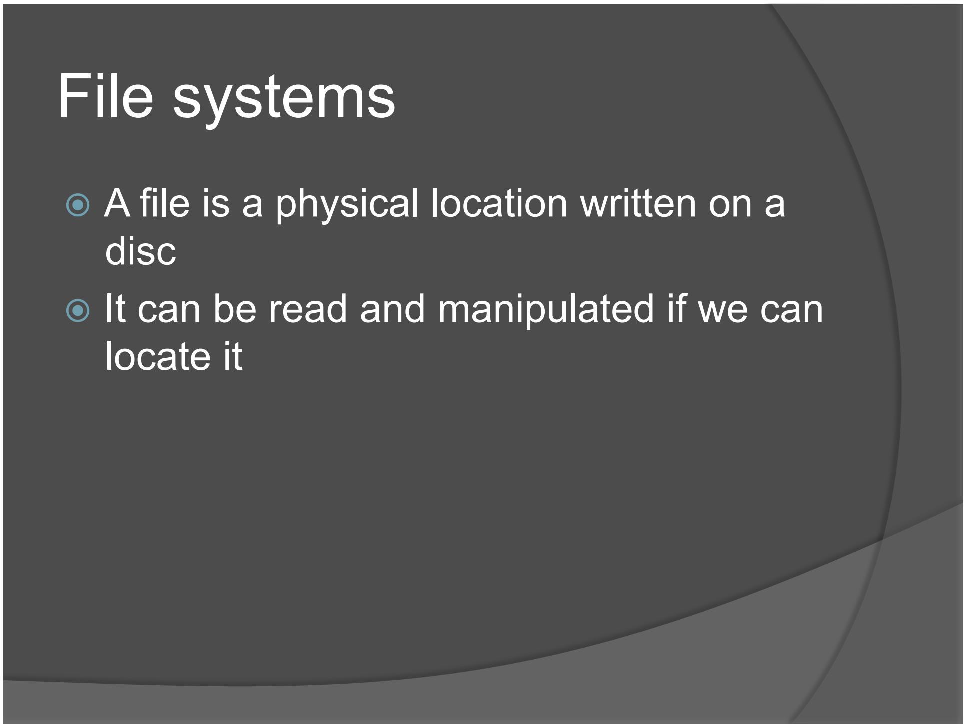
File systems

- A file is a physical location written on a disc

Hard disc

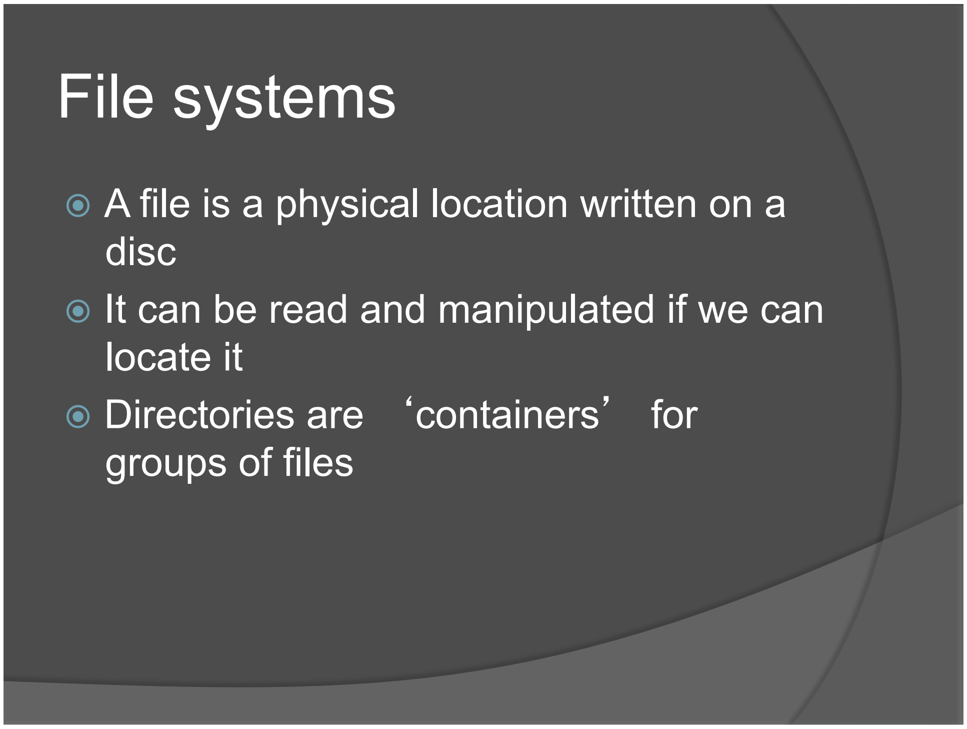


http://www.microscopy-uk.net/mag/indexmag.html



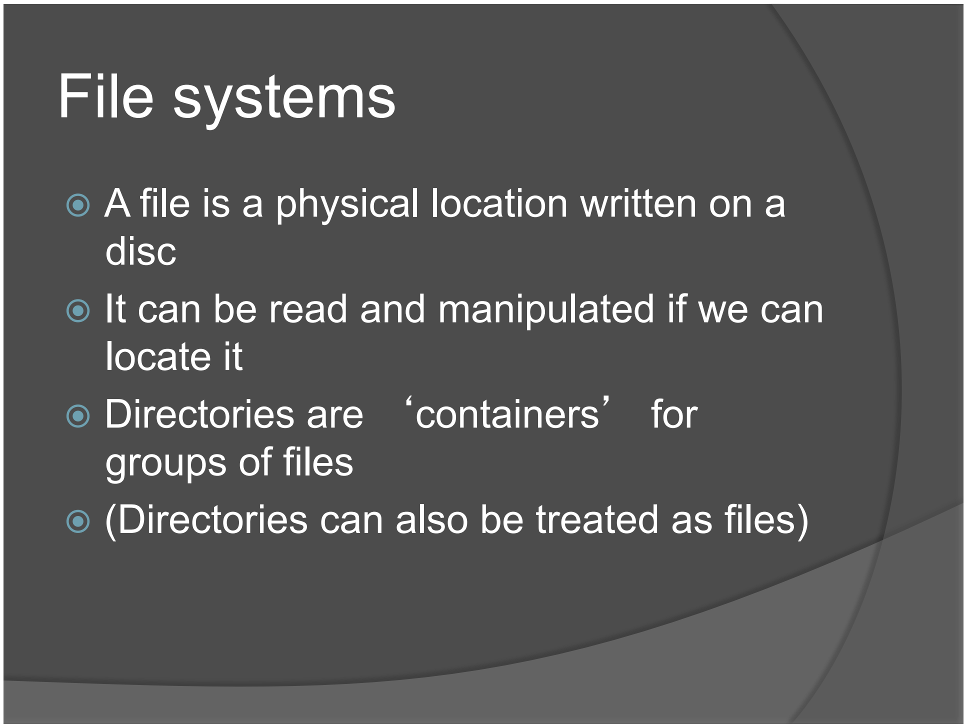
File systems

- A file is a physical location written on a disc
- It can be read and manipulated if we can locate it



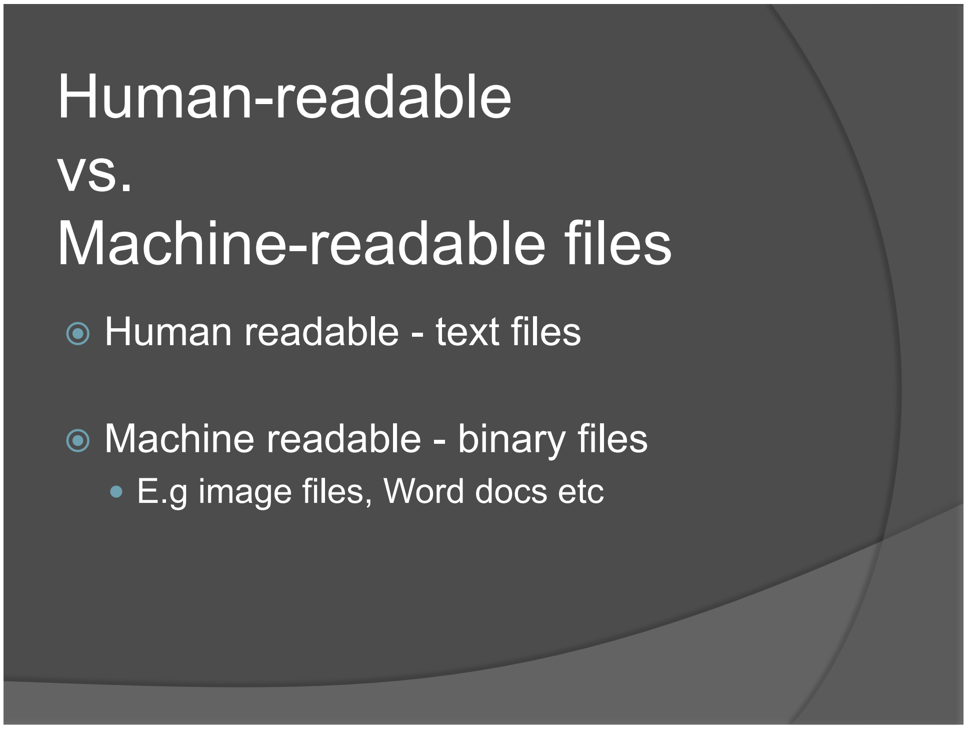
File systems

- A file is a physical location written on a disc
- It can be read and manipulated if we can locate it
- Directories are ‘containers’ for groups of files



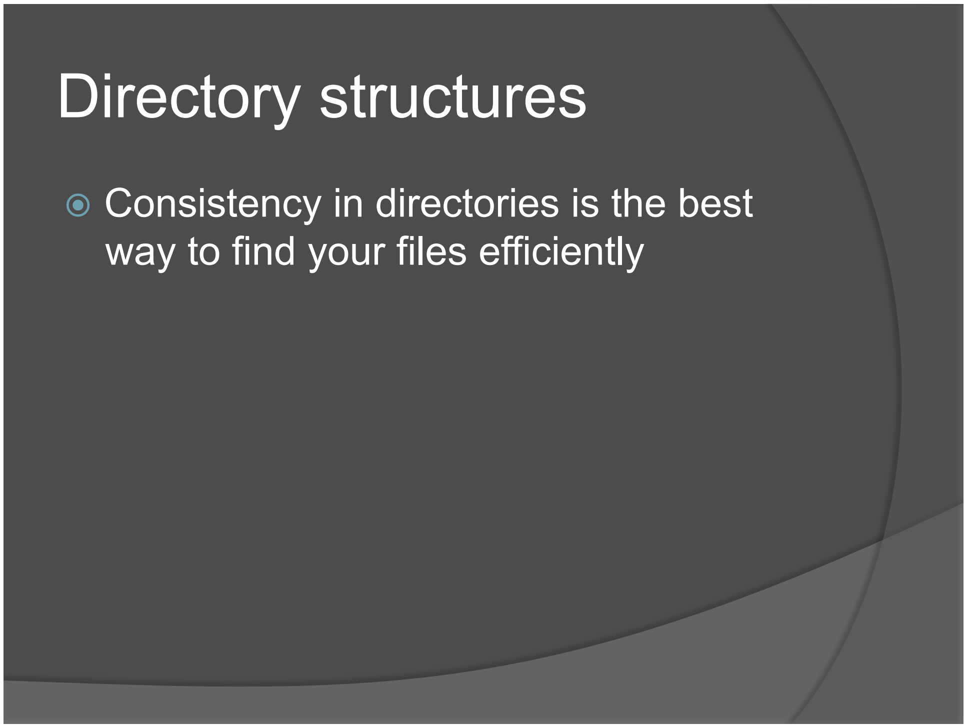
File systems

- A file is a physical location written on a disc
- It can be read and manipulated if we can locate it
- Directories are ‘containers’ for groups of files
- (Directories can also be treated as files)



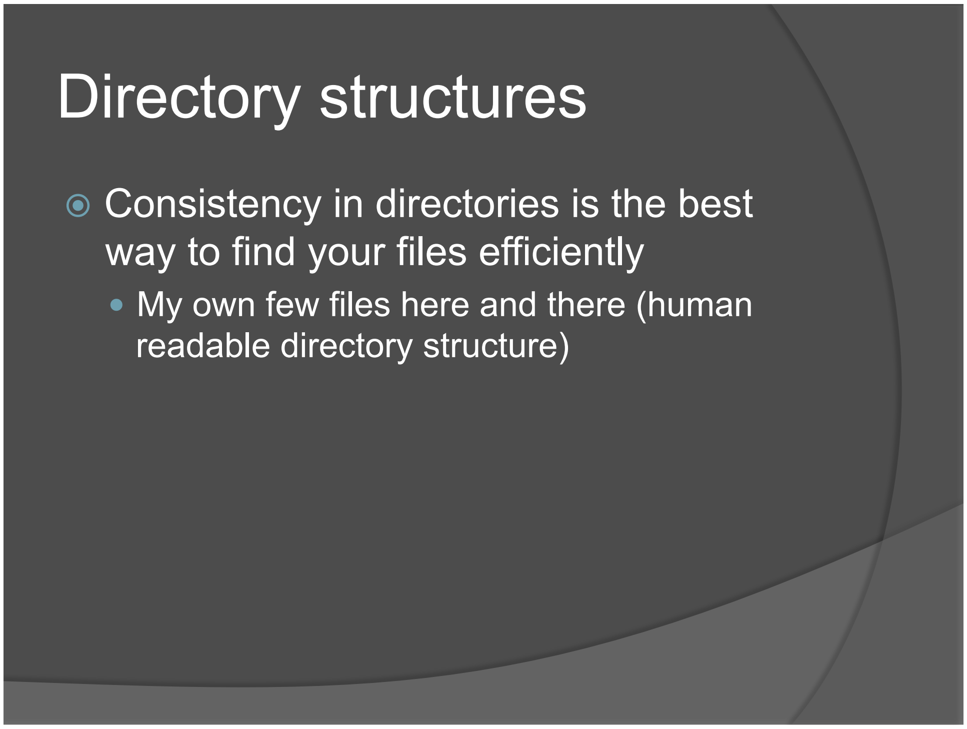
Human-readable vs. Machine-readable files

- Human readable - text files
- Machine readable - binary files
  - E.g image files, Word docs etc



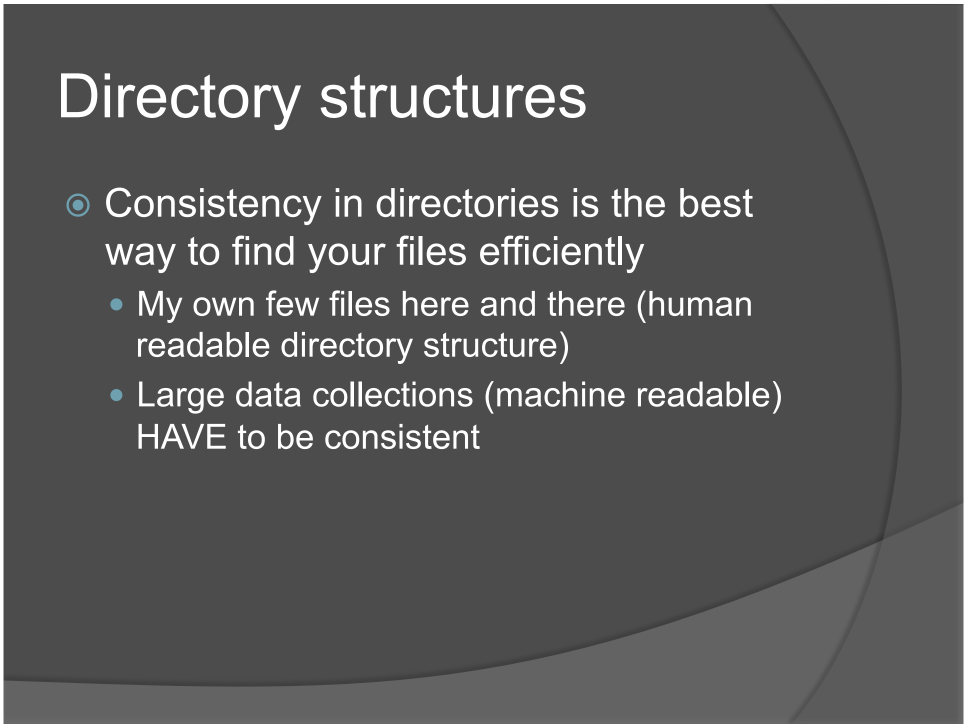
Directory structures

- Consistency in directories is the best way to find your files efficiently



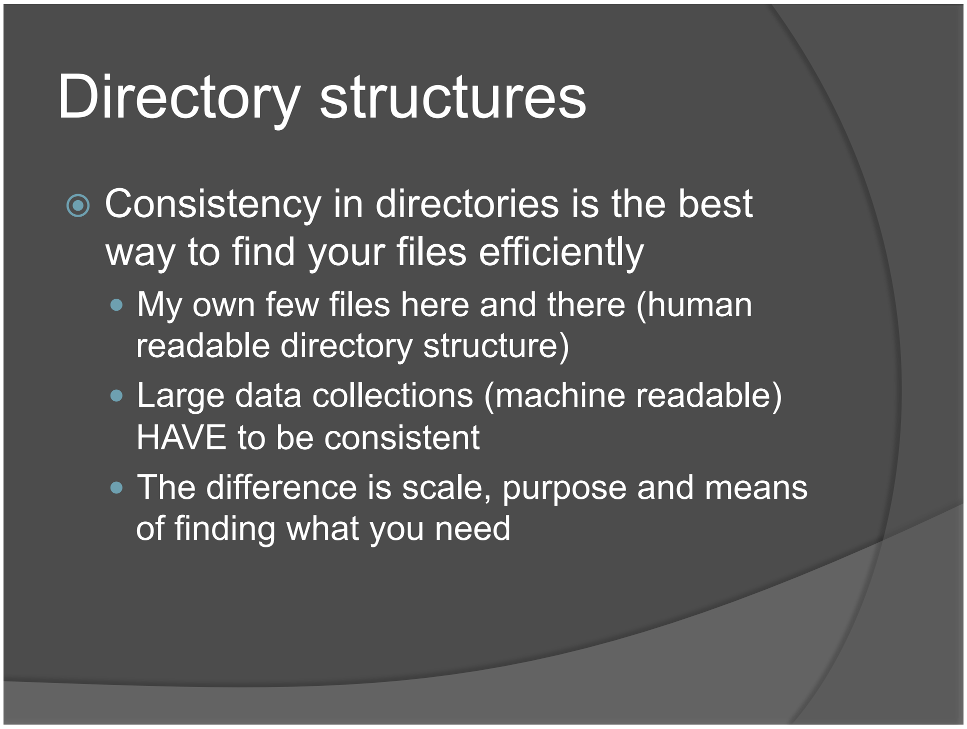
Directory structures

- Consistency in directories is the best way to find your files efficiently
  - My own few files here and there (human readable directory structure)



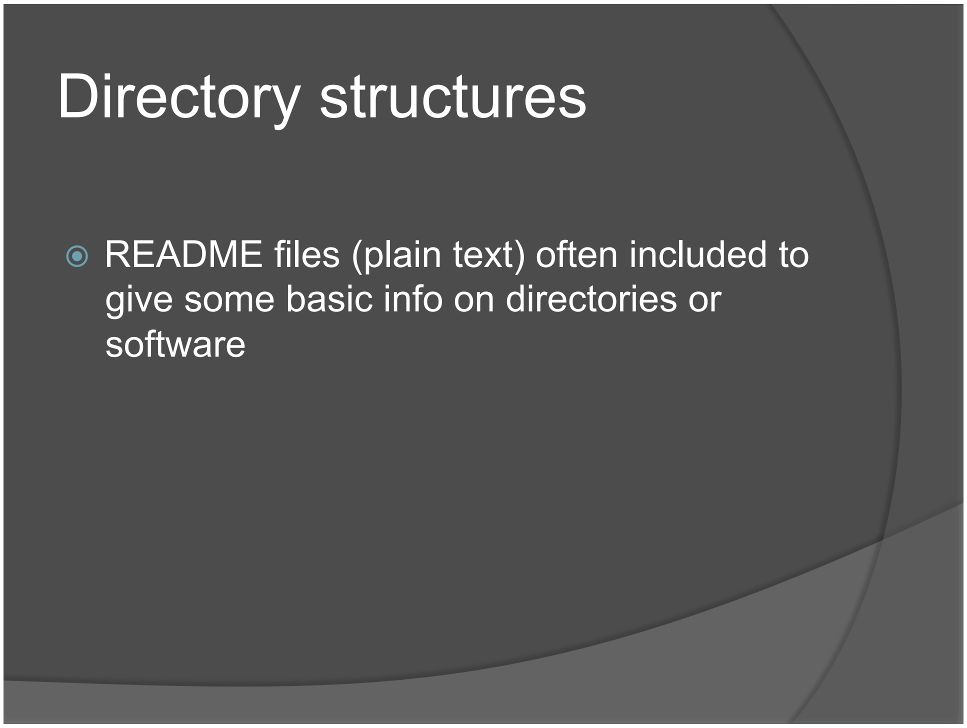
Directory structures

- Consistency in directories is the best way to find your files efficiently
  - My own few files here and there (human readable directory structure)
  - Large data collections (machine readable) HAVE to be consistent



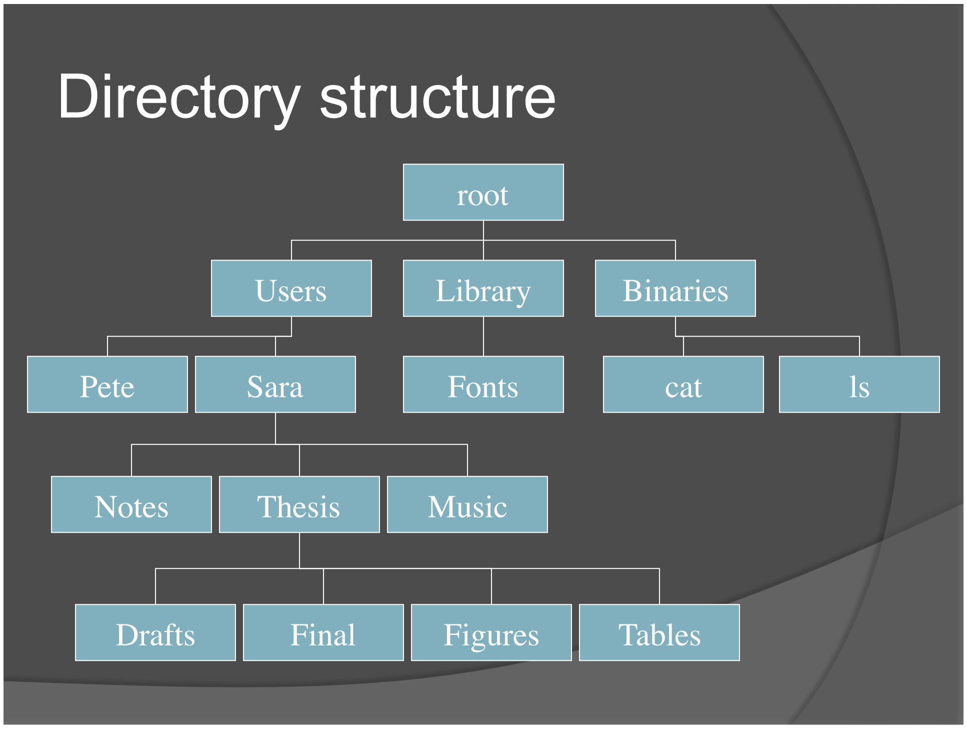
Directory structures

- Consistency in directories is the best way to find your files efficiently
  - My own few files here and there (human readable directory structure)
  - Large data collections (machine readable) HAVE to be consistent
  - The difference is scale, purpose and means of finding what you need



Directory structures

- README files (plain text) often included to give some basic info on directories or software



Directory structure

root

Users Library Binaries

Pete Sara Fonts cat ls

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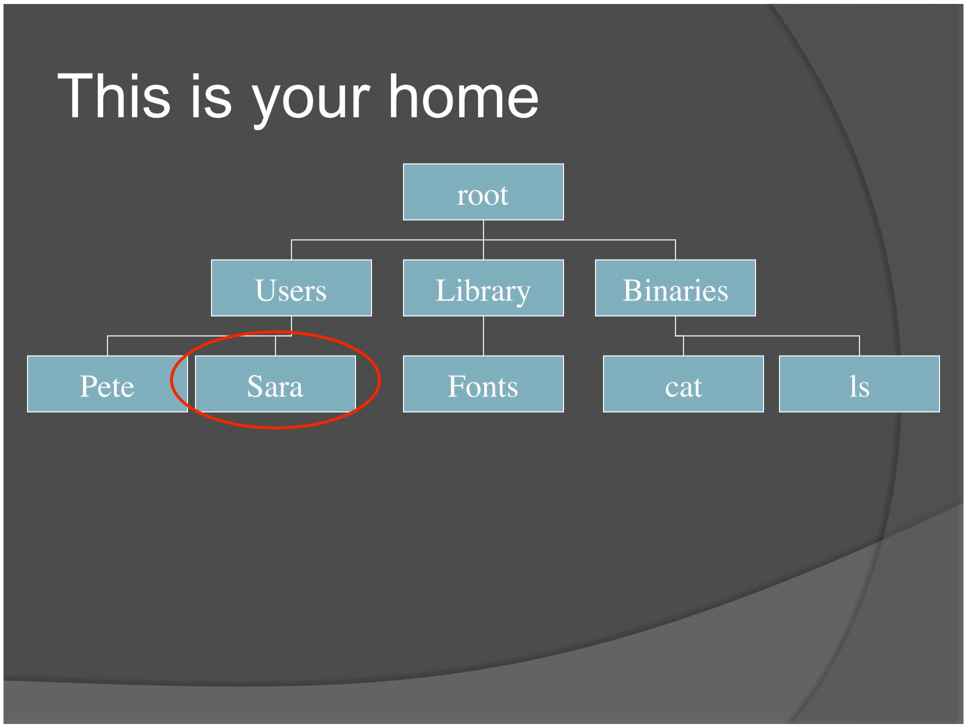
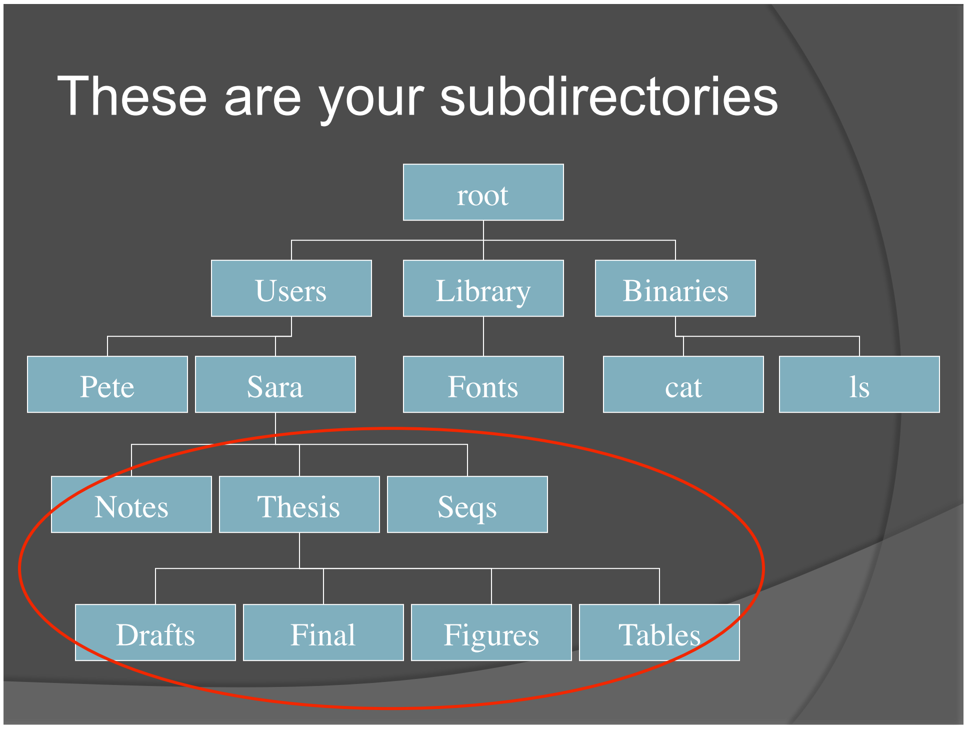


This is your home

root

Users Library Binaries

Pete Sara Fonts cat ls



These are your subdirectories

root

Users Library Binaries

Pete Sara Fonts cat ls

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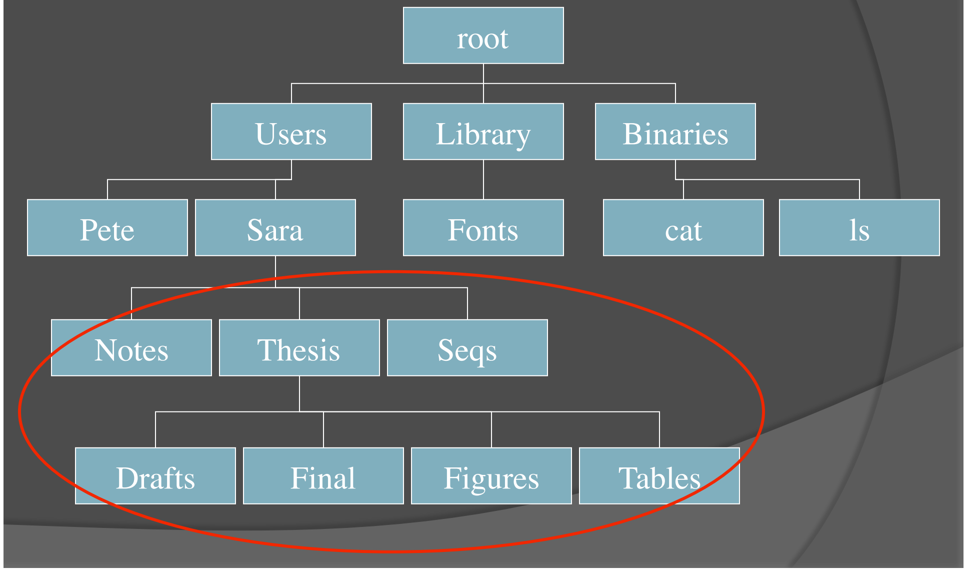
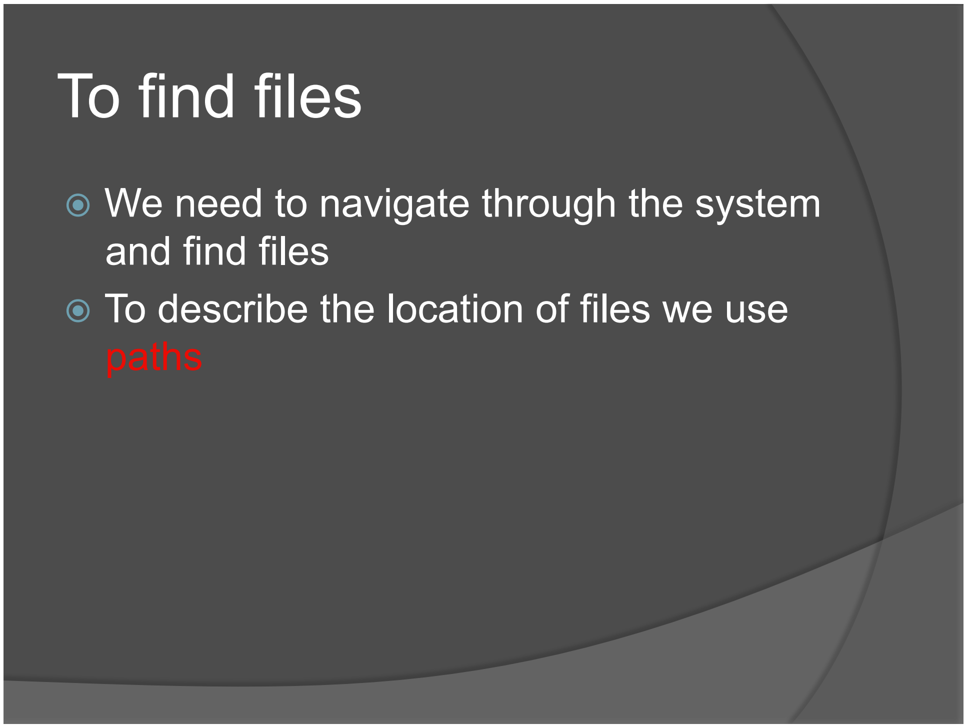
“Sara” is the parent of those subdirectories



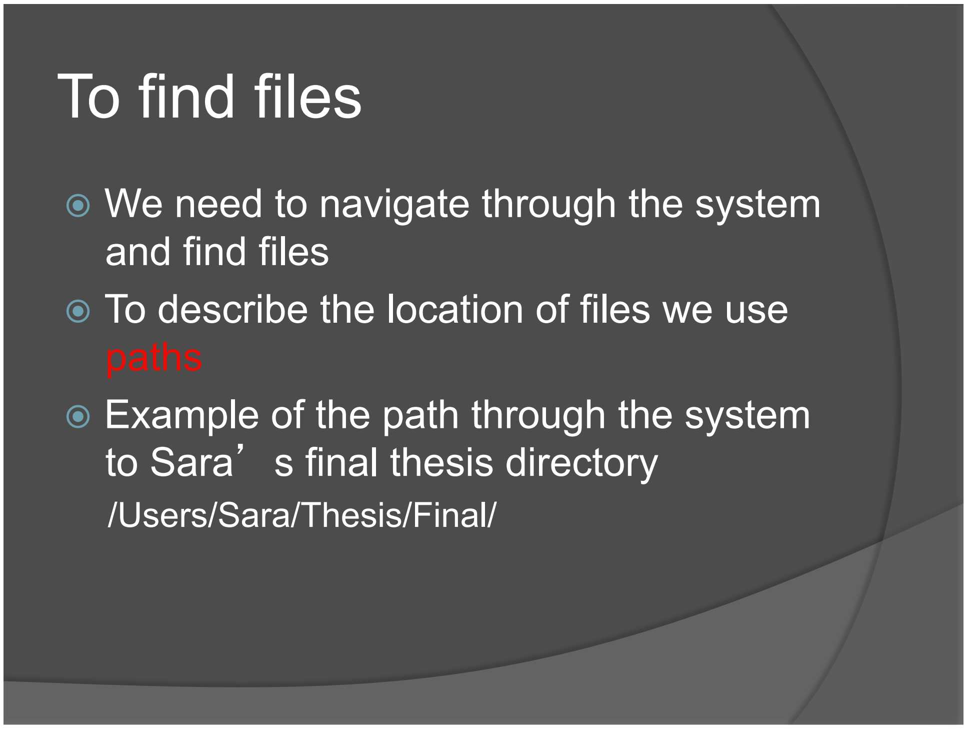
To find files

- We need to navigate through the system and find files



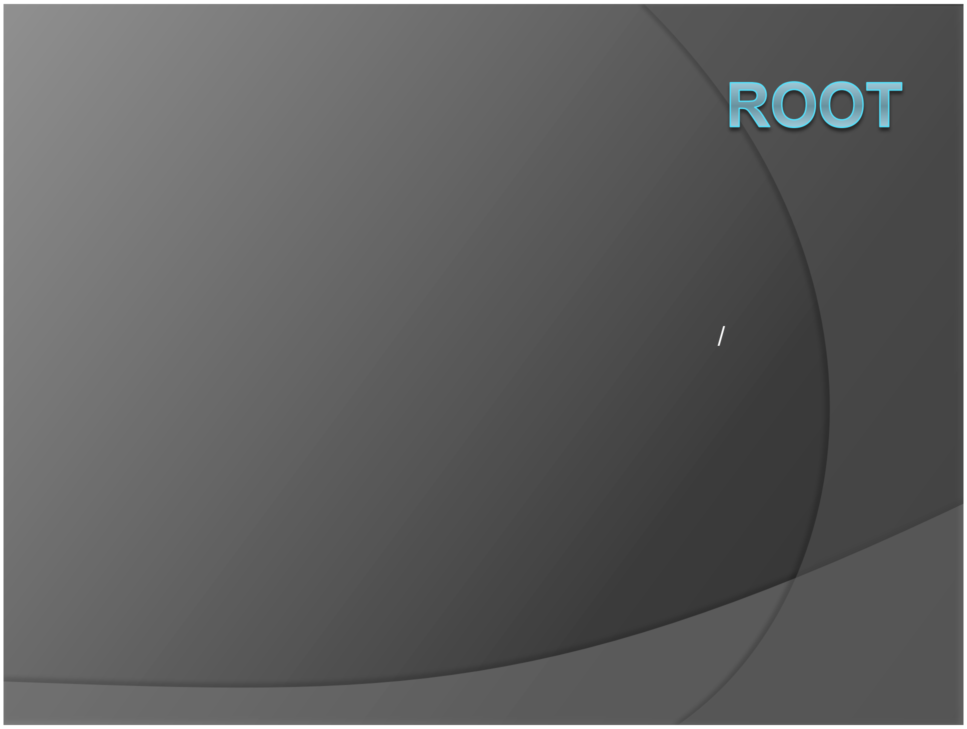
To find files

- We need to navigate through the system and find files
- To describe the location of files we use paths



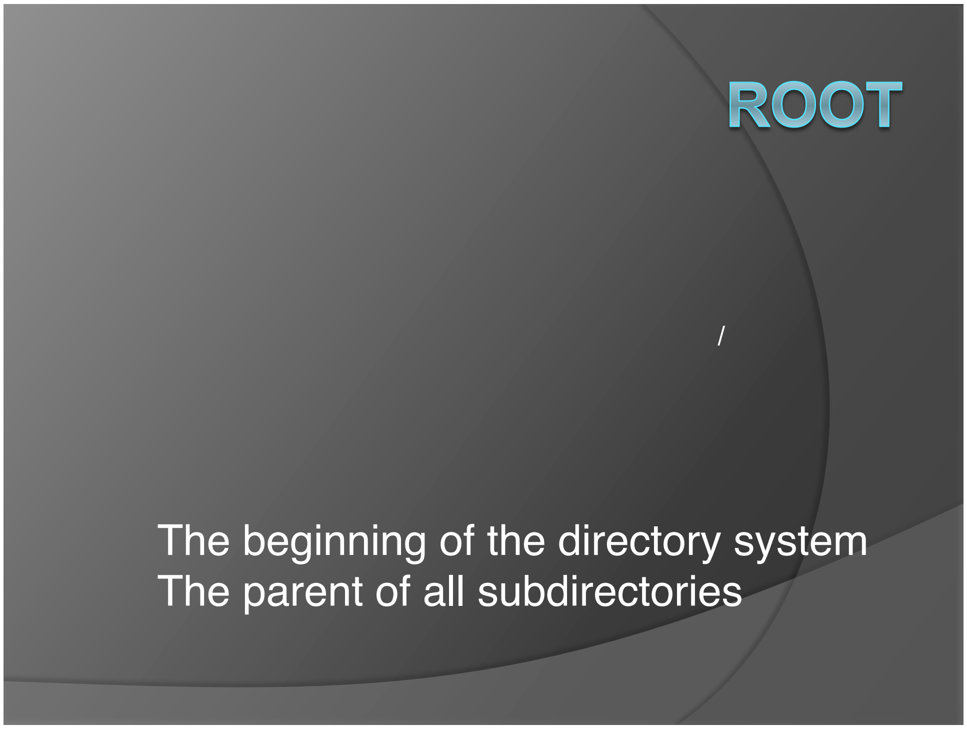
To find files

- We need to navigate through the system and find files
- To describe the location of files we use paths
- Example of the path through the system to Sara' s final thesis directory /Users/Sara/Thesis/Final/



ROOT

/



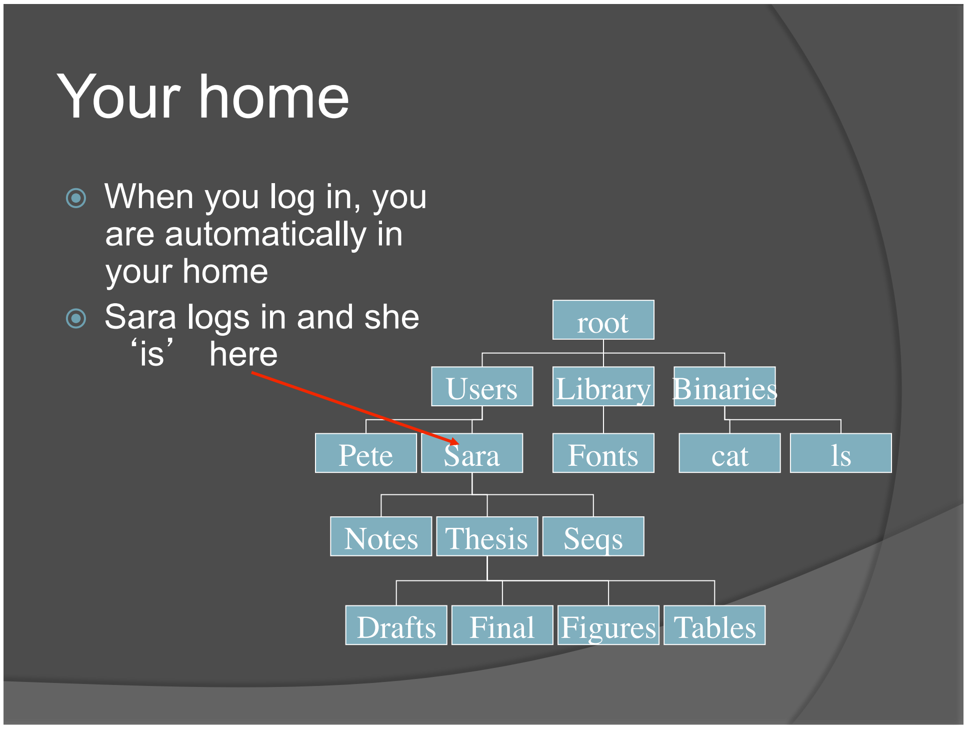
ROOT

/

The beginning of the directory system
The parent of all subdirectories

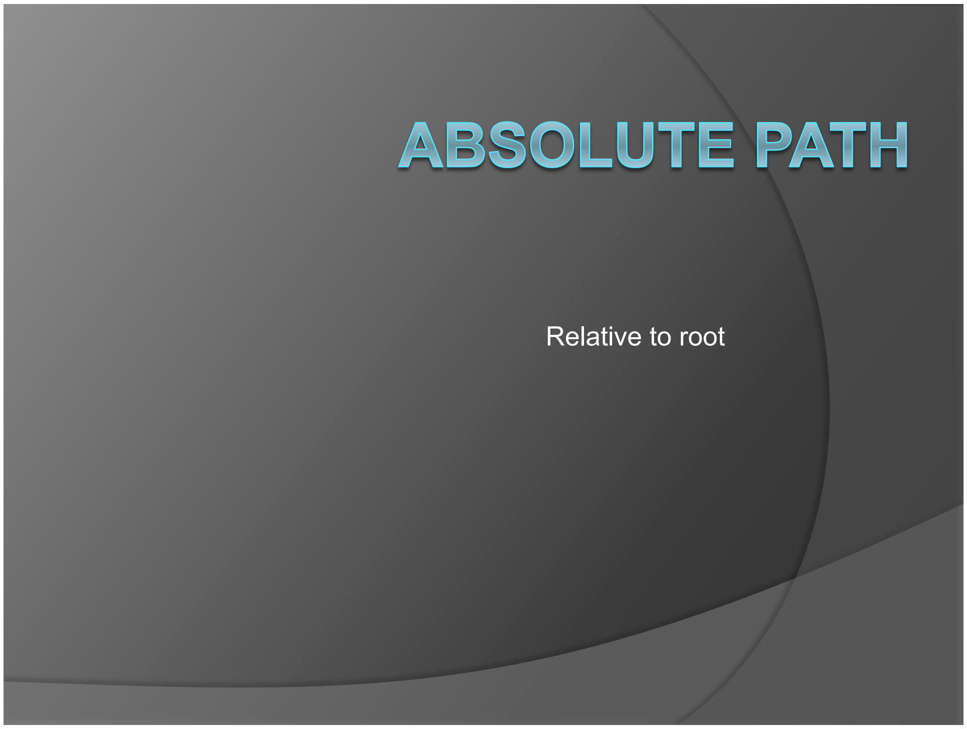
WORKING DIRECTORY

"Where you are"



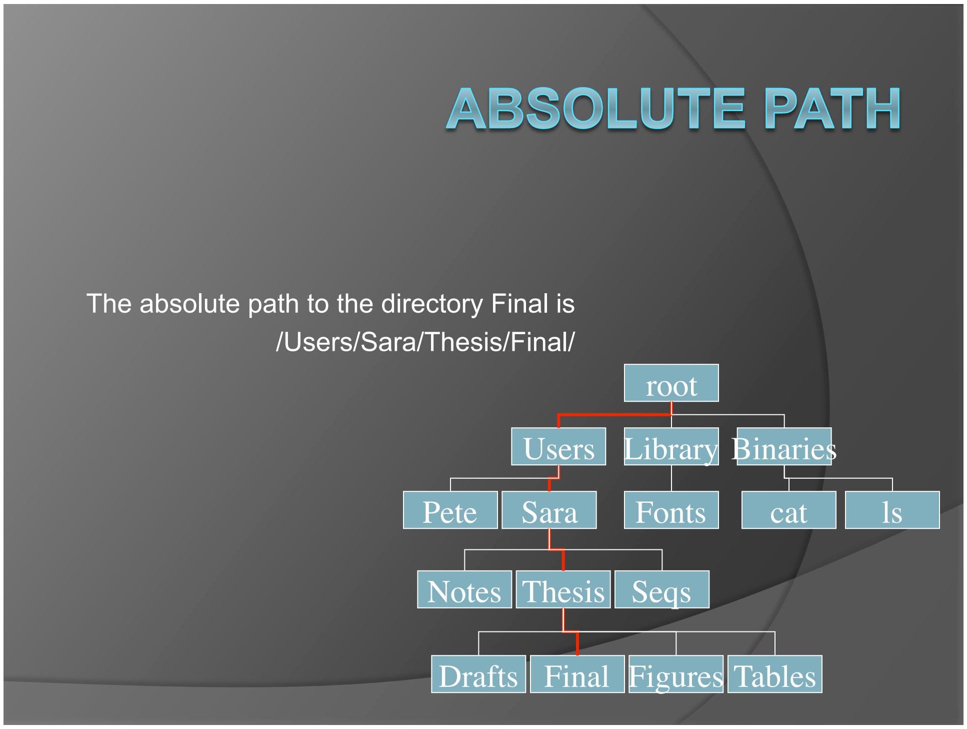
Your home

- When you log in, you are automatically in your home
- Sara logs in and she 'is' here



ABSOLUTE PATH

Relative to root



ABSOLUTE PATH

The absolute path to the directory Final is /Users/Sara/Thesis/Final/

root

Users Library Binaries

Pete Sara Fonts cat ls

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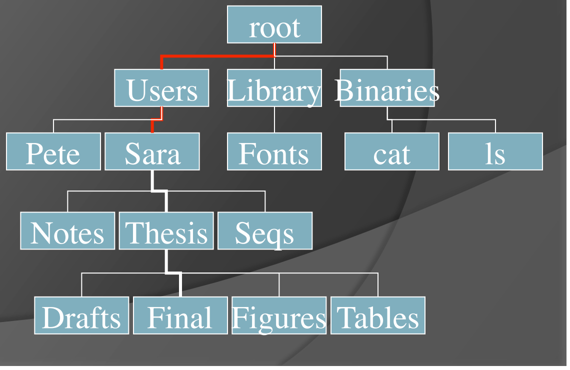
ABSOLUTE PATH

From the directory Final, the absolute path home for Sara is /Users/Sara/



root

Users Library Binaries

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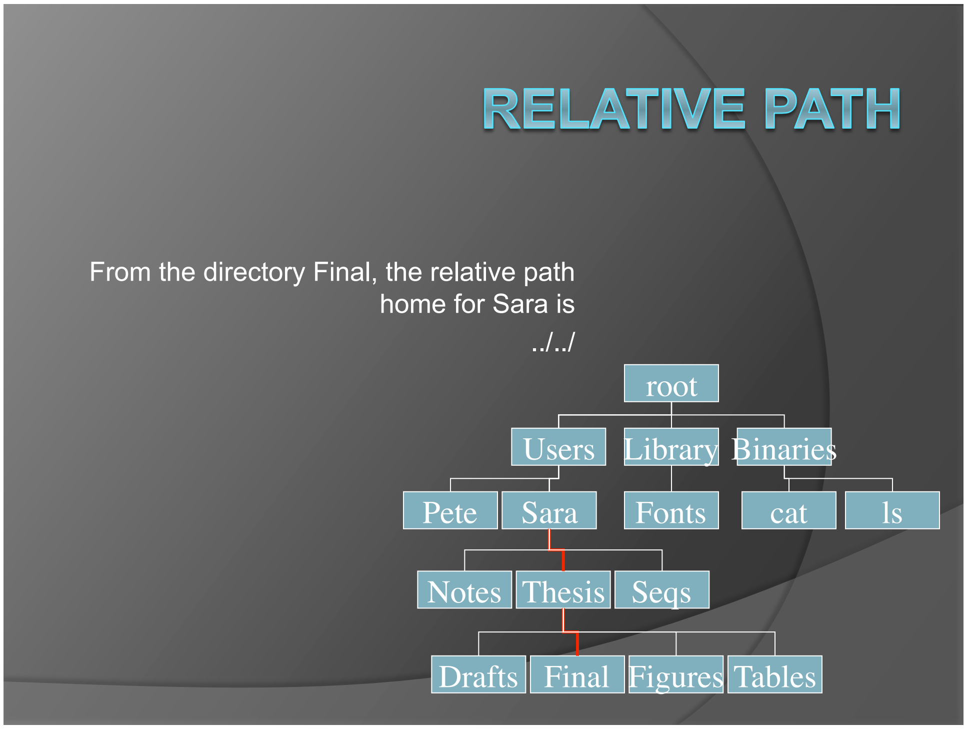
RELATIVE PATH

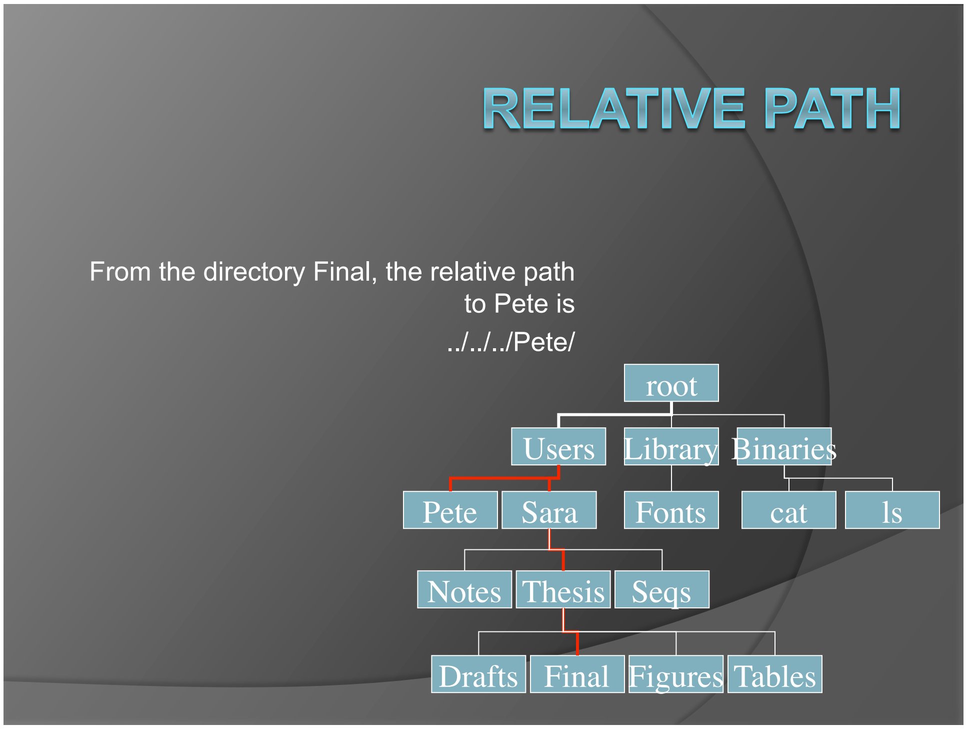
Relative to working directory



RELATIVE PATH

From the directory Final, the relative path home for Sara is

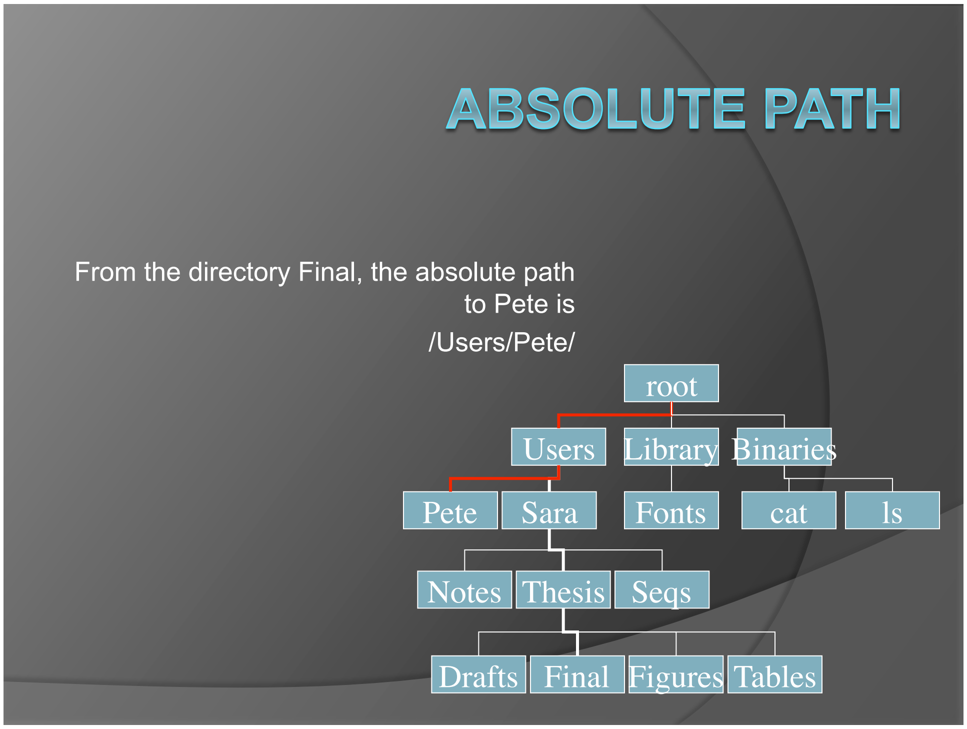
../../



RELATIVE PATH

From the directory Final, the relative path to Pete is

../../../Pete/



ABSOLUTE PATH

From the directory Final, the absolute path to Pete is

/Users/Pete/

root

Users Library Binaries

Pete Sara Fonts cat ls

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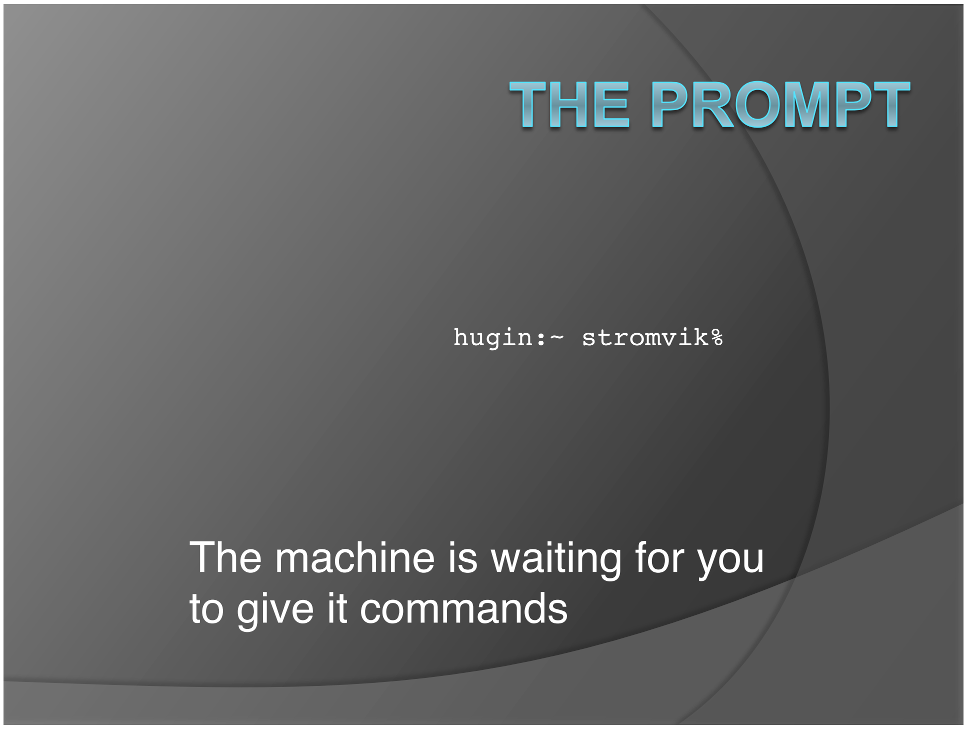
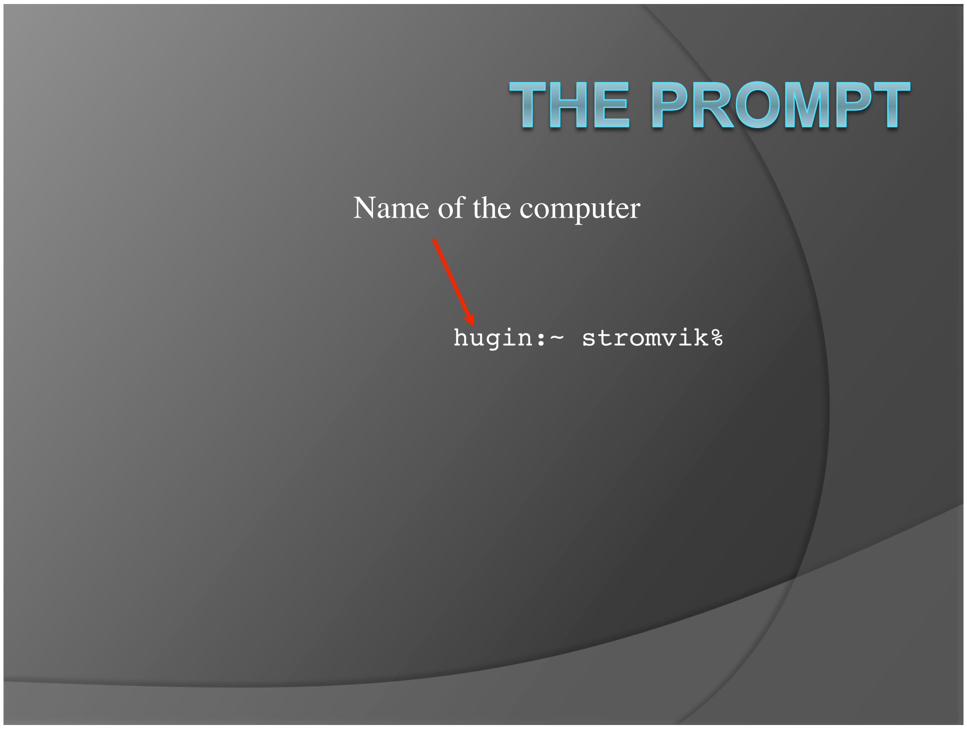


THE PROMPT

```
hugin:~ stromvik%
```

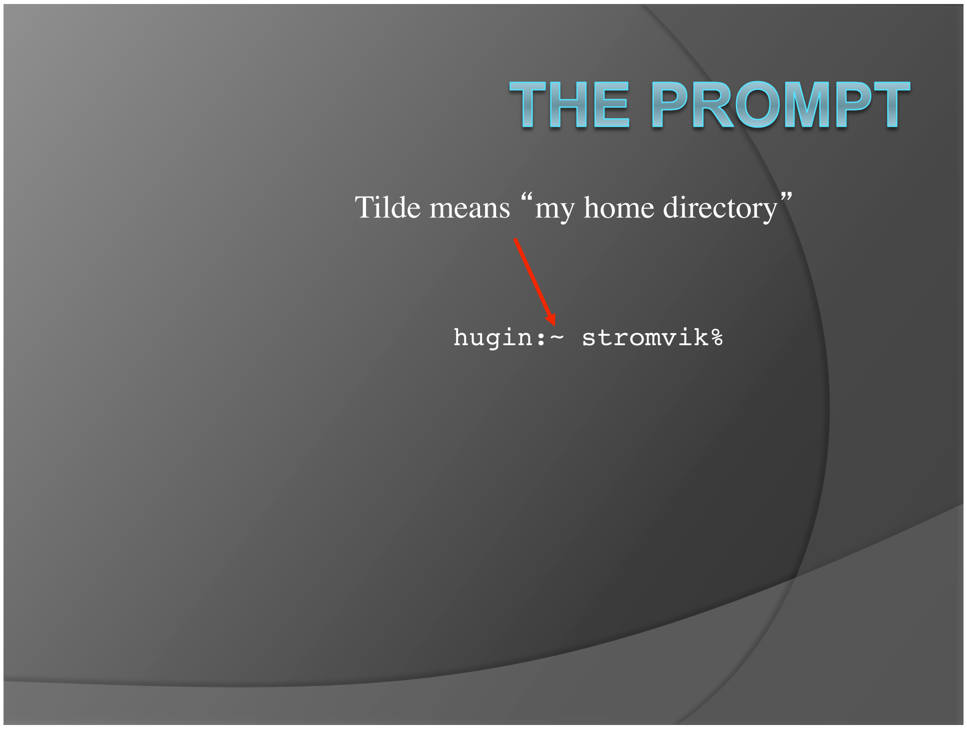
The machine is waiting for you to give it commands



THE PROMPT

Name of the computer

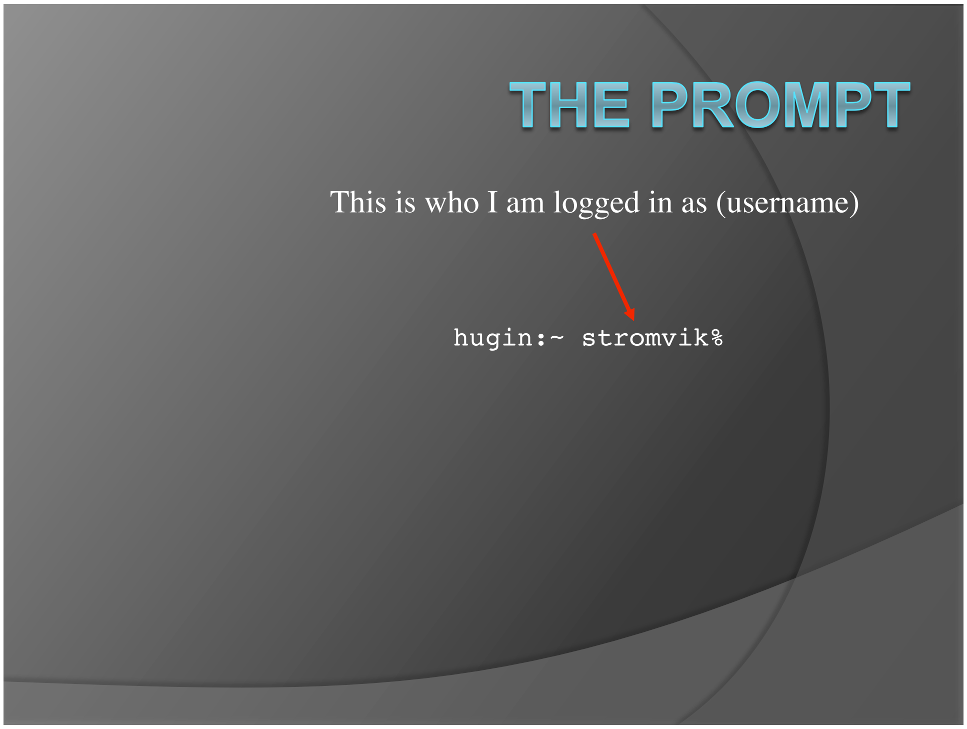
```
hugin:~ stromvik%
```



THE PROMPT

Tilde means “my home directory”

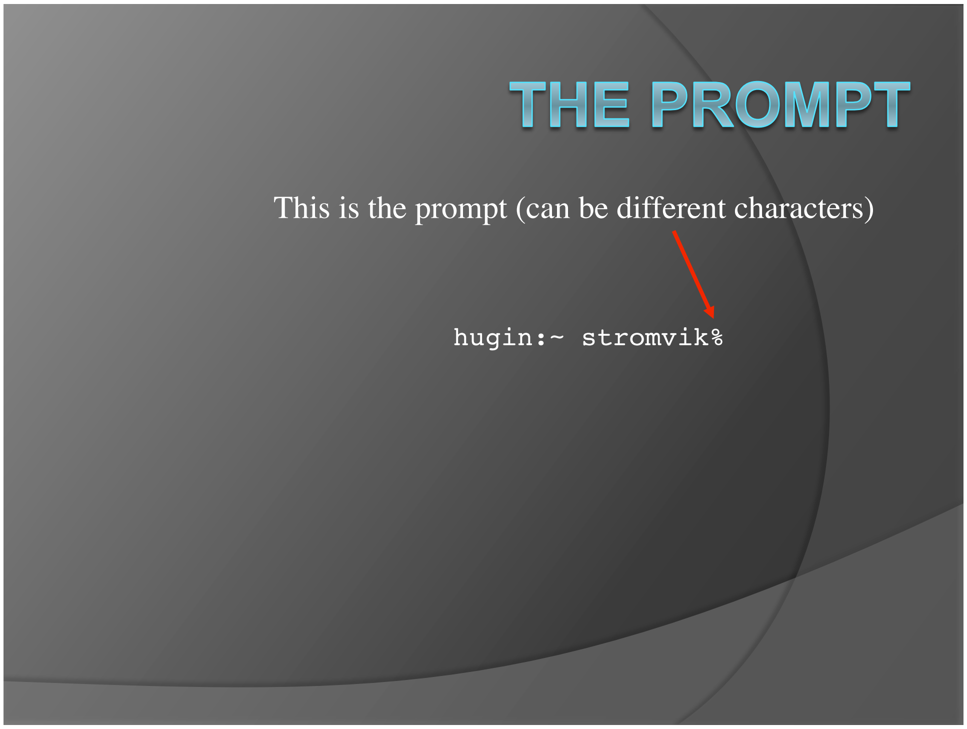
```
hugin:~ stromvik%
```



THE PROMPT

This is who I am logged in as (username)

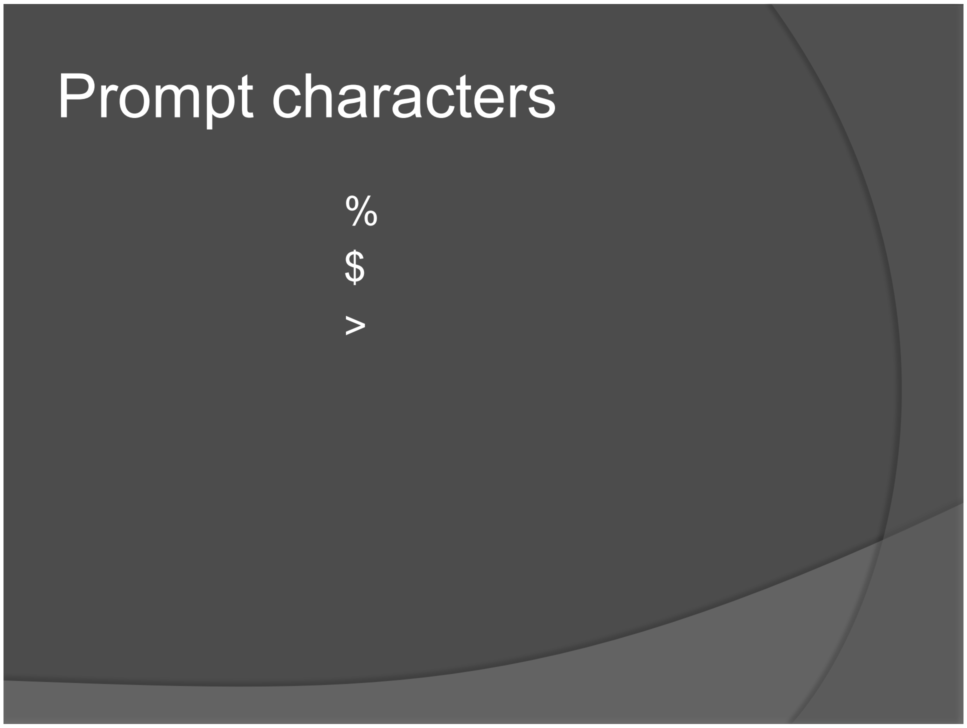
```
hugin:~ stromvik%
```



THE PROMPT

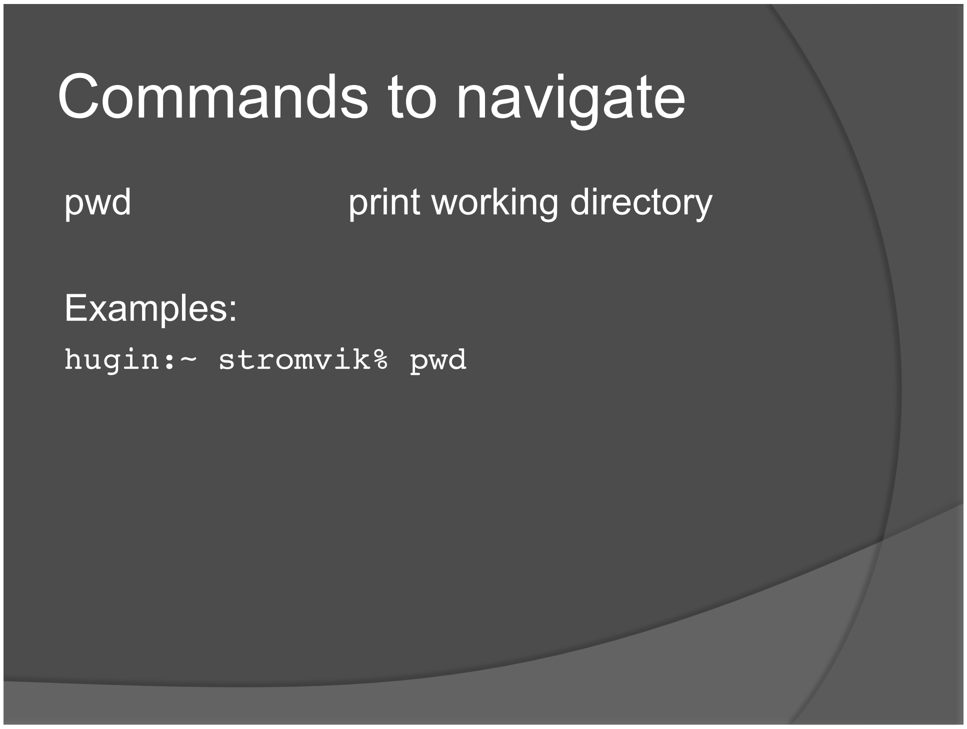
This is the prompt (can be different characters)

```
hugin:~ stromvik%
```



Prompt characters

%
$
>

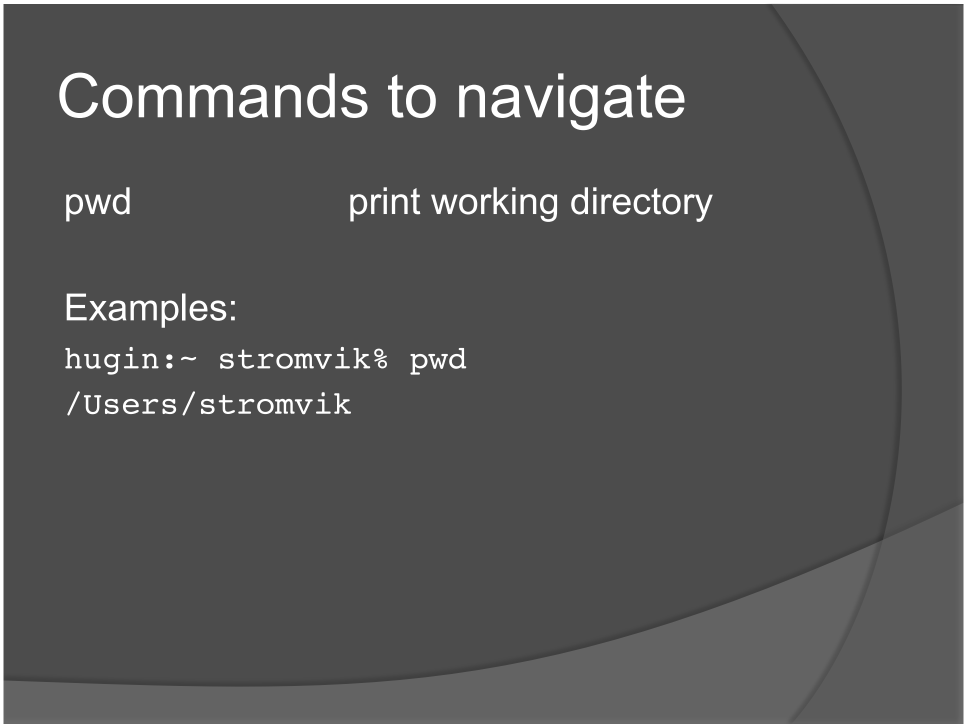


Commands to navigate

pwd print working directory

Examples:

```
hugin:~ stromvik% pwd
```

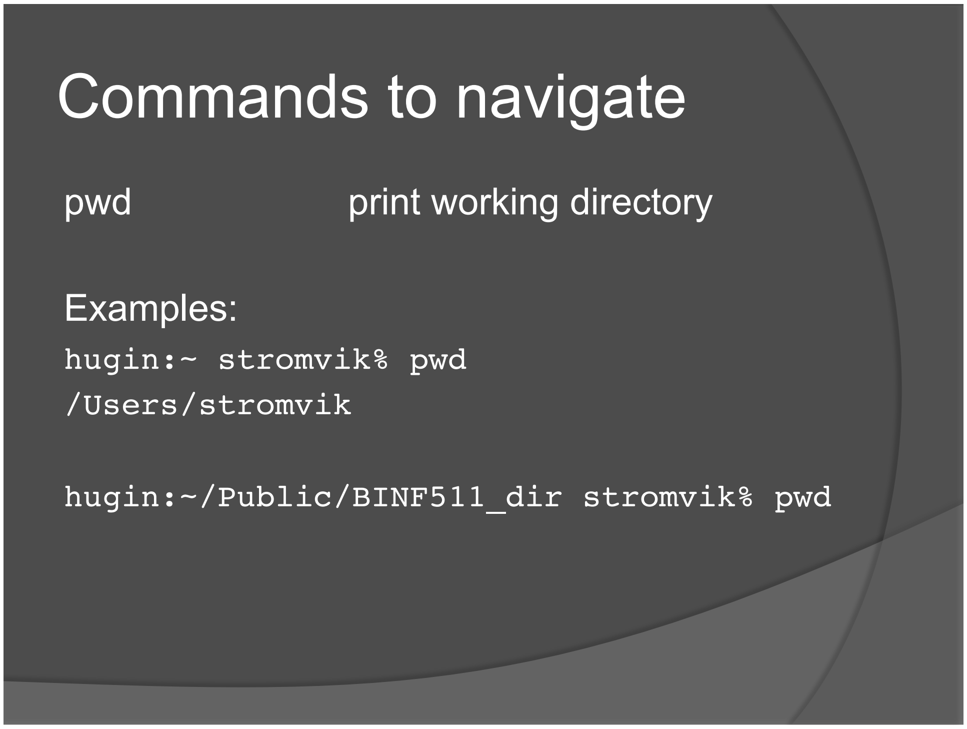


Commands to navigate

pwd print working directory

Examples:

```
hugin:~ stromvik% pwd
/Users/stromvik
```

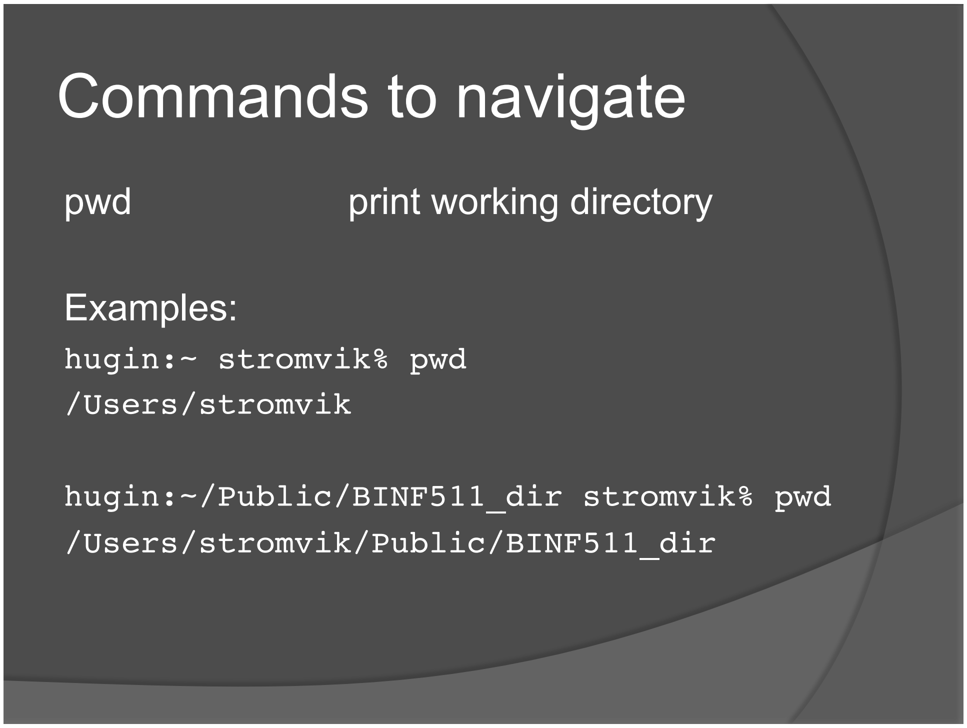


Commands to navigate

pwd print working directory

Examples:

```
hugin:~ stromvik% pwd
/Users/stromvik

hugin:~/Public/BINF511_dir stromvik% pwd
```

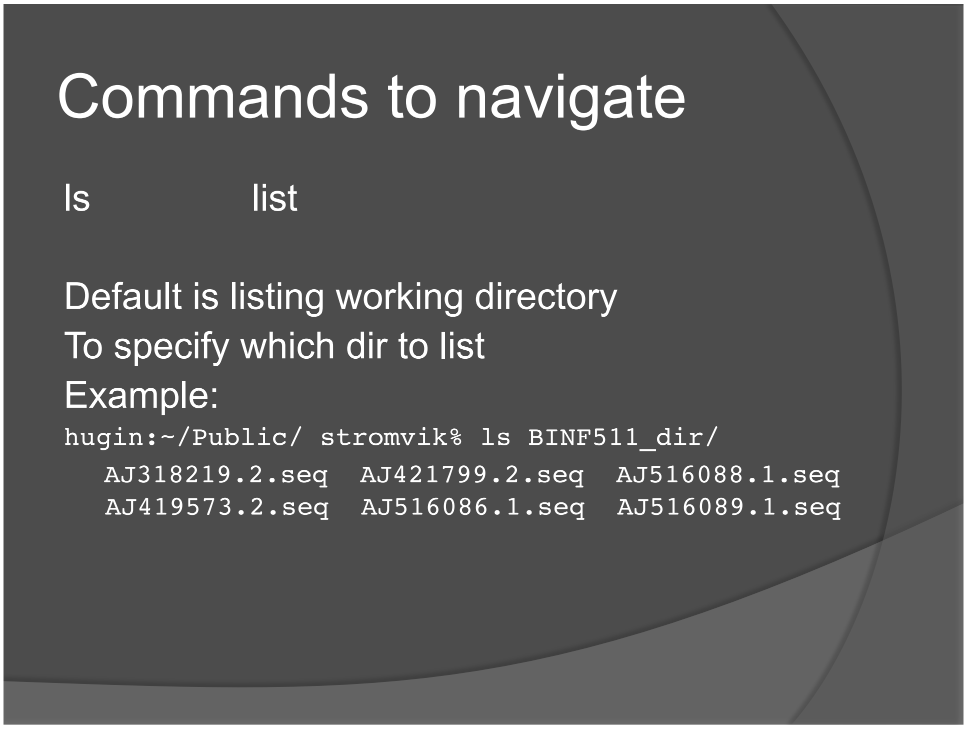


Commands to navigate

pwd print working directory

Examples:

```
hugin:~ stromvik% pwd
/Users/stromvik

hugin:~/Public/BINF511_dir stromvik% pwd
/Users/stromvik/Public/BINF511_dir
```



Commands to navigate

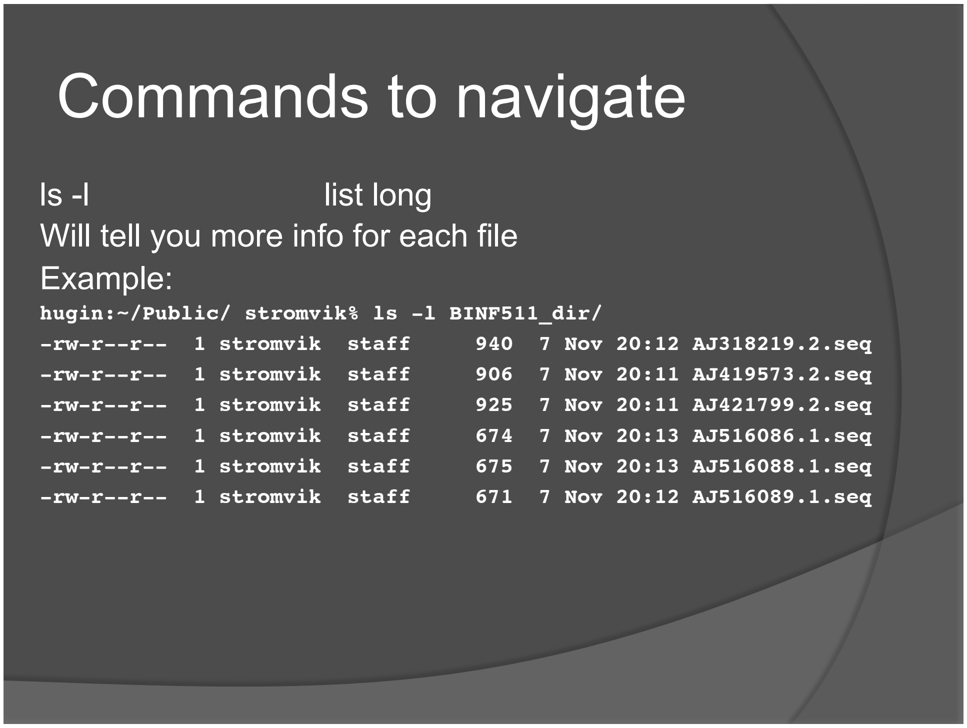
ls list

Default is listing working directory

To specify which dir to list

Example:

```
hugin:~/Public/ stromvik% ls BINF511_dir/
   AJ318219.2.seq  AJ421799.2.seq  AJ516088.1.seq
   AJ419573.2.seq  AJ516086.1.seq  AJ516089.1.seq
```



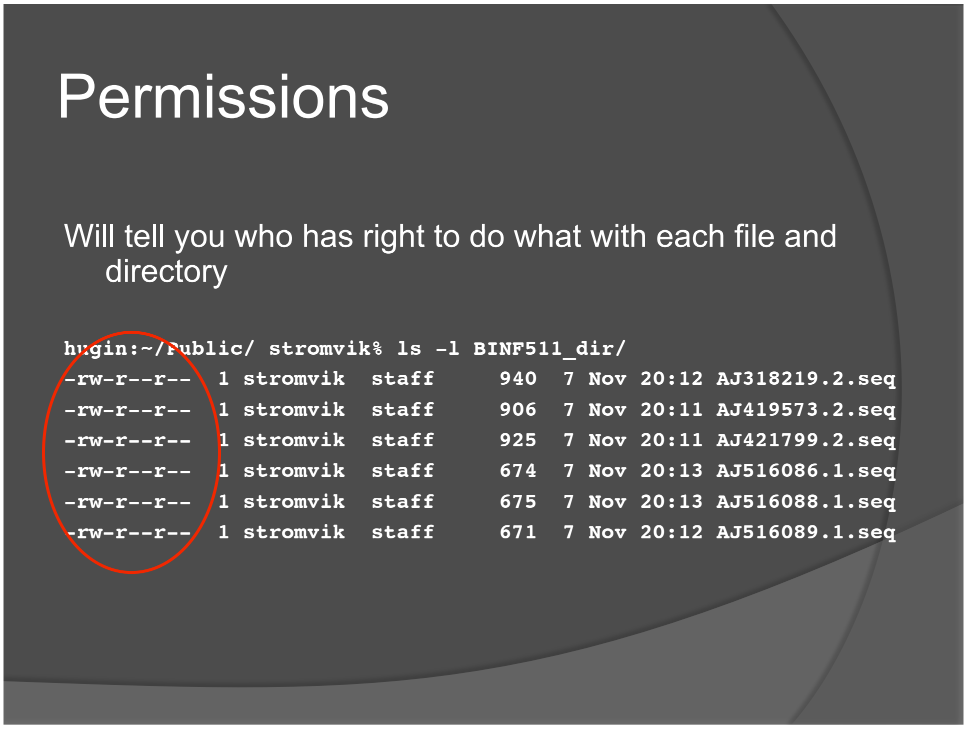
Commands to navigate

ls -l list long

Will tell you more info for each file

Example:

```
hugin:~/Public/ stromvik% ls -l BINF511_dir/
-rw-r--r--  1 stromvik  staff    940  7 Nov 20:12 AJ318219.2.seq
-rw-r--r--  1 stromvik  staff    906  7 Nov 20:11 AJ419573.2.seq
-rw-r--r--  1 stromvik  staff    925  7 Nov 20:11 AJ421799.2.seq
-rw-r--r--  1 stromvik  staff    674  7 Nov 20:13 AJ516086.1.seq
-rw-r--r--  1 stromvik  staff    675  7 Nov 20:13 AJ516088.1.seq
-rw-r--r--  1 stromvik  staff    671  7 Nov 20:12 AJ516089.1.seq
```

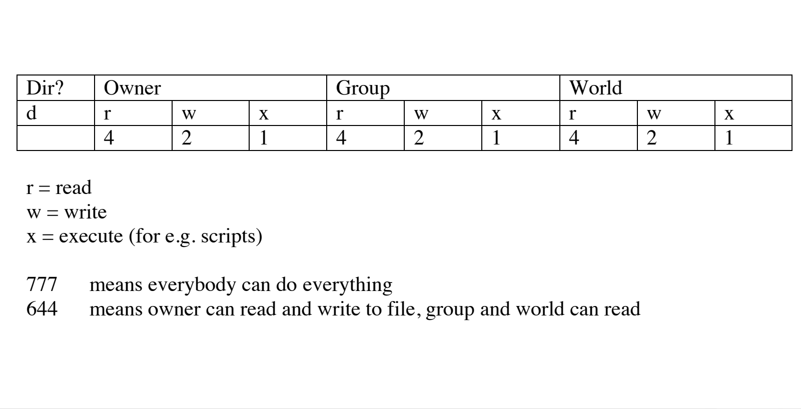


Permissions

Will tell you who has right to do what with each file and directory

```
hugin:~/Public/ stromvik% ls -l BINF511_dir/
-rw-r--r--  1 stromvik  staff    940  7 Nov 20:12 AJ318219.2.seq
-rw-r--r--  1 stromvik  staff    906  7 Nov 20:11 AJ419573.2.seq
-rw-r--r--  1 stromvik  staff    925  7 Nov 20:11 AJ421799.2.seq
-rw-r--r--  1 stromvik  staff    674  7 Nov 20:13 AJ516086.1.seq
-rw-r--r--  1 stromvik  staff    675  7 Nov 20:13 AJ516088.1.seq
-rw-r--r--  1 stromvik  staff    671  7 Nov 20:12 AJ516089.1.seq
```

Permissions

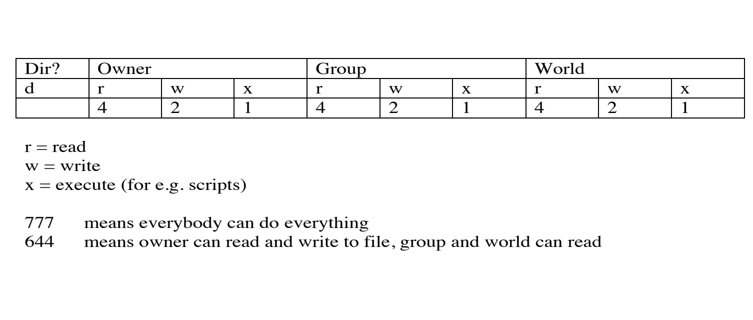


Dir?	Owner			Group			World		
d	r	w	x	r	w	x	r	w	x
	4	2	1	4	2	1	4	2	1

r = read
w = write
x = execute (for e.g. scripts)

777 means everybody can do everything
644 means owner can read and write to file, group and world can read

Permissions (mode)



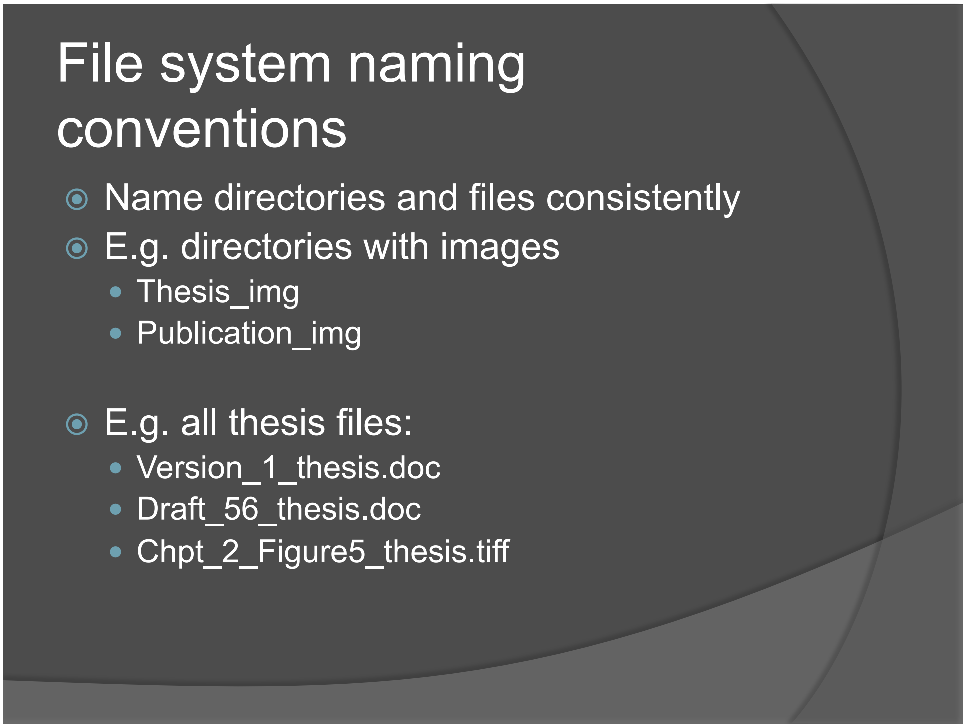
Dir?	Owner			Group			World		
d	r	w	x	r	w	x	r	w	x
	4	2	1	4	2	1	4	2	1

r = read
w = write
x = execute (for e.g. scripts)

777 means everybody can do everything
644 means owner can read and write to file, group and world can read

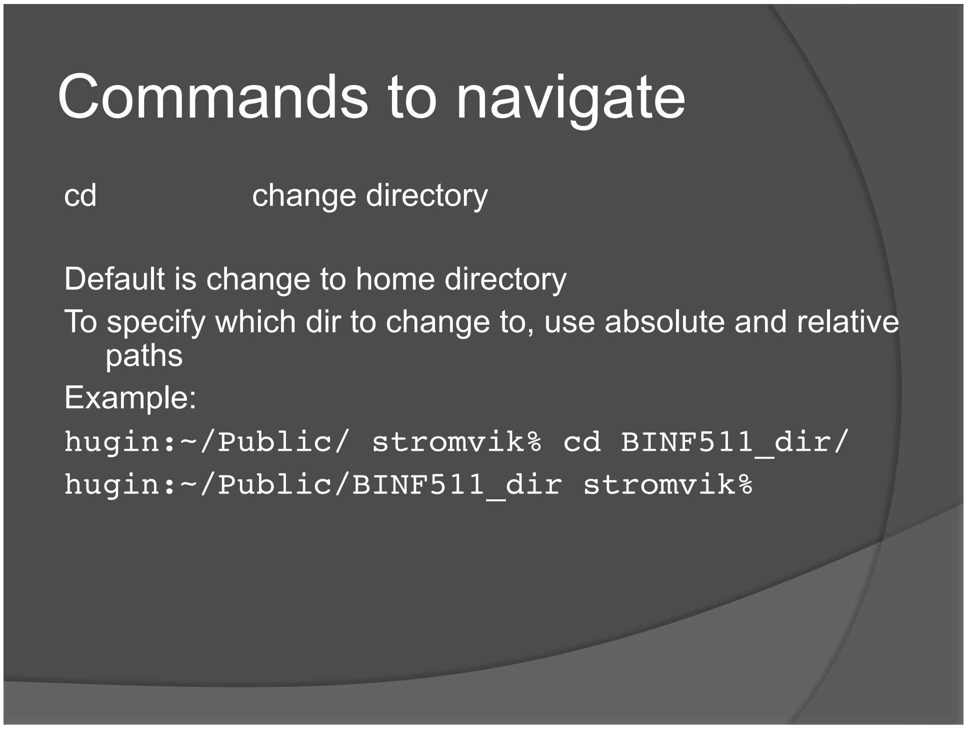
chmod 777 *mytestfile.txt*

will change the permissions on the file mytestfile.txt



File system naming conventions

- Name directories and files consistently
- E.g. directories with images
  - Thesis_img
  - Publication_img
- E.g. all thesis files:
  - Version_1_thesis.doc
  - Draft_56_thesis.doc
  - Chpt_2_Figure5_thesis.tiff



Commands to navigate

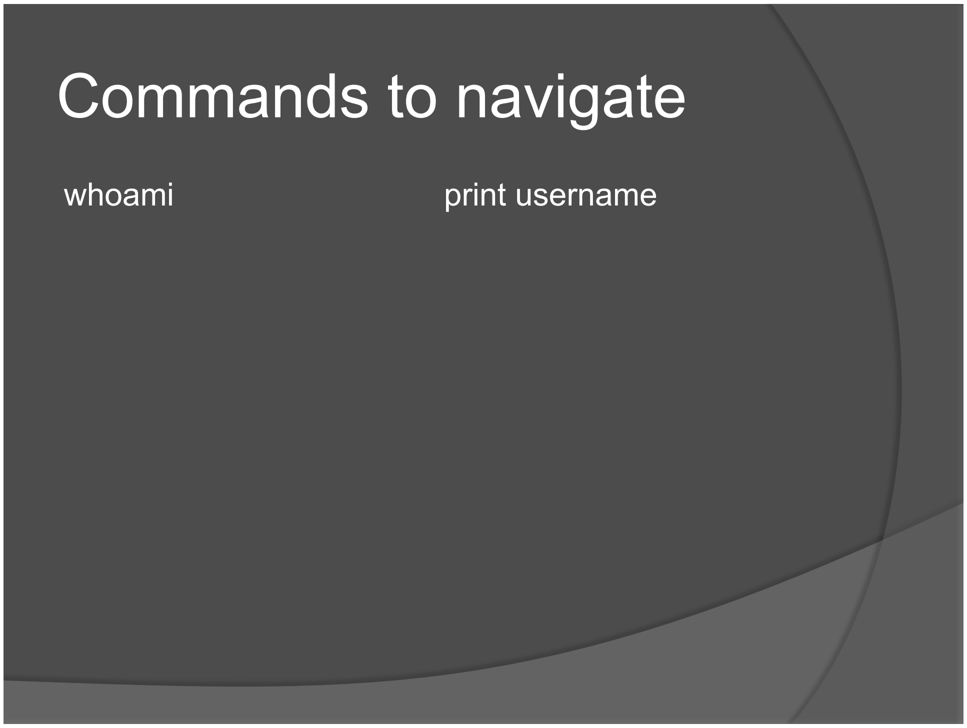
cd change directory

Default is change to home directory

To specify which dir to change to, use absolute and relative paths

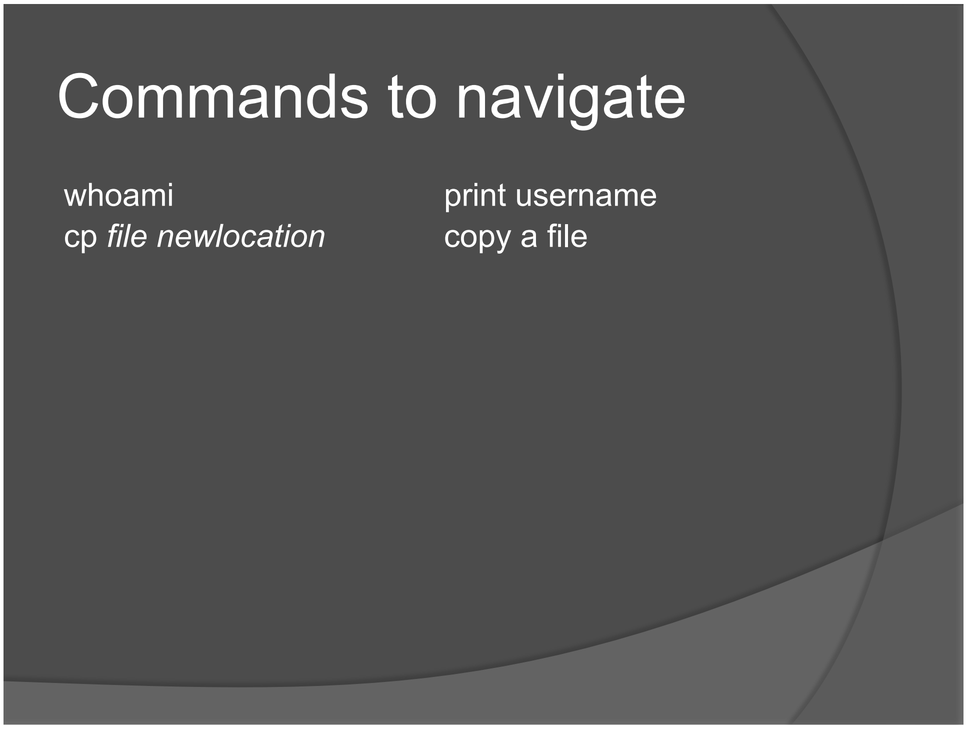
Example:

```
hugin:~/Public/ stromvik% cd BINF511_dir/
hugin:~/Public/BINF511_dir stromvik%
```



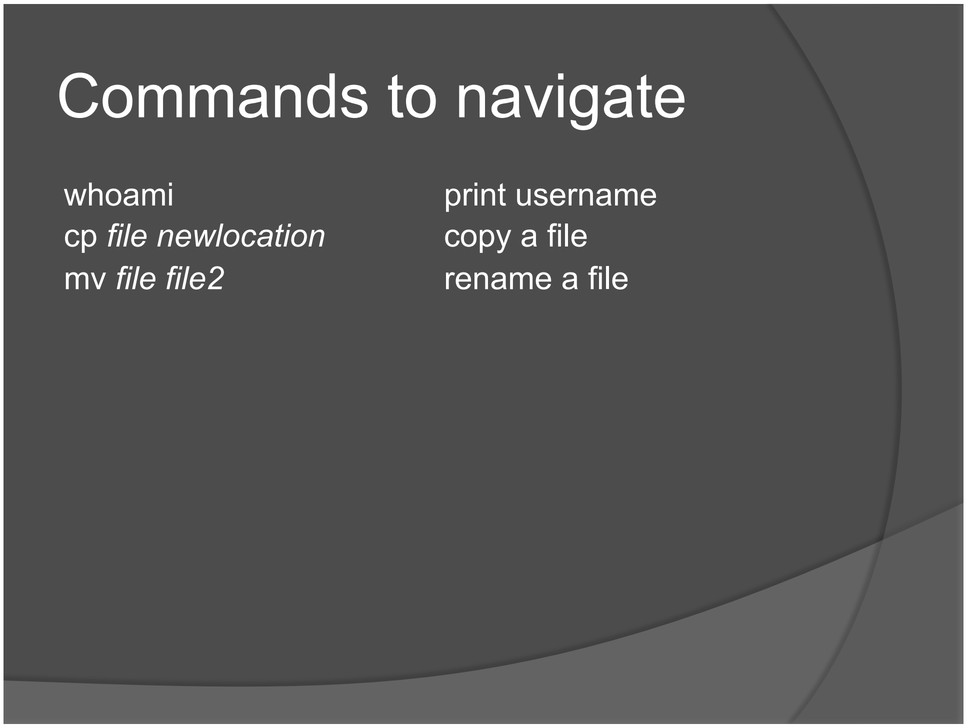
Commands to navigate

whoami	print username



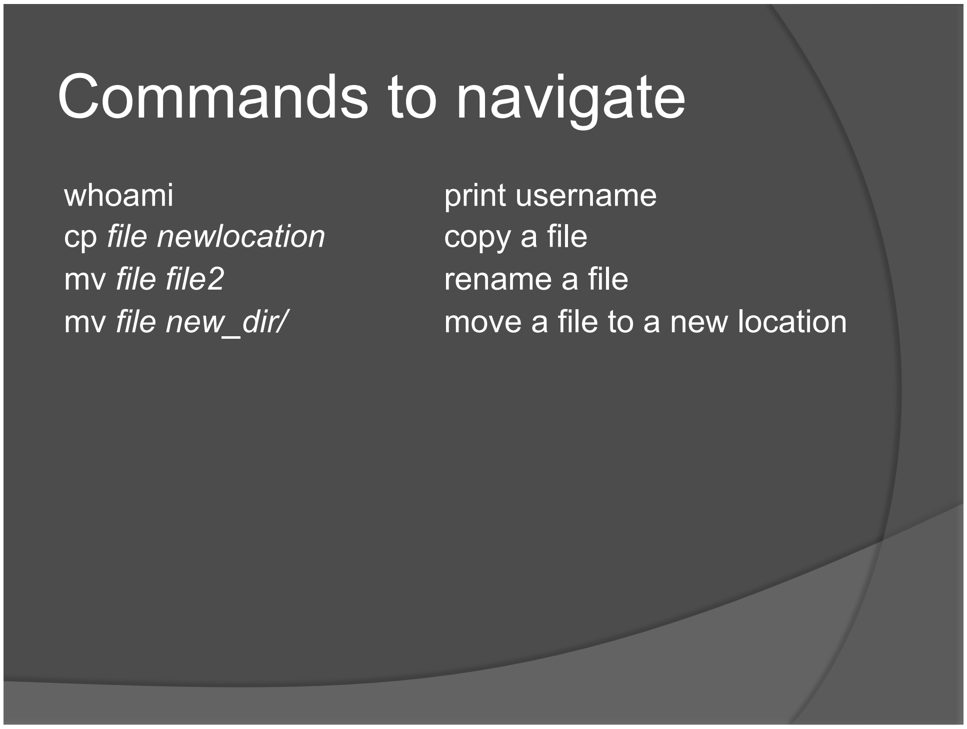
Commands to navigate

whoami	print username
cp *file newlocation*	copy a file



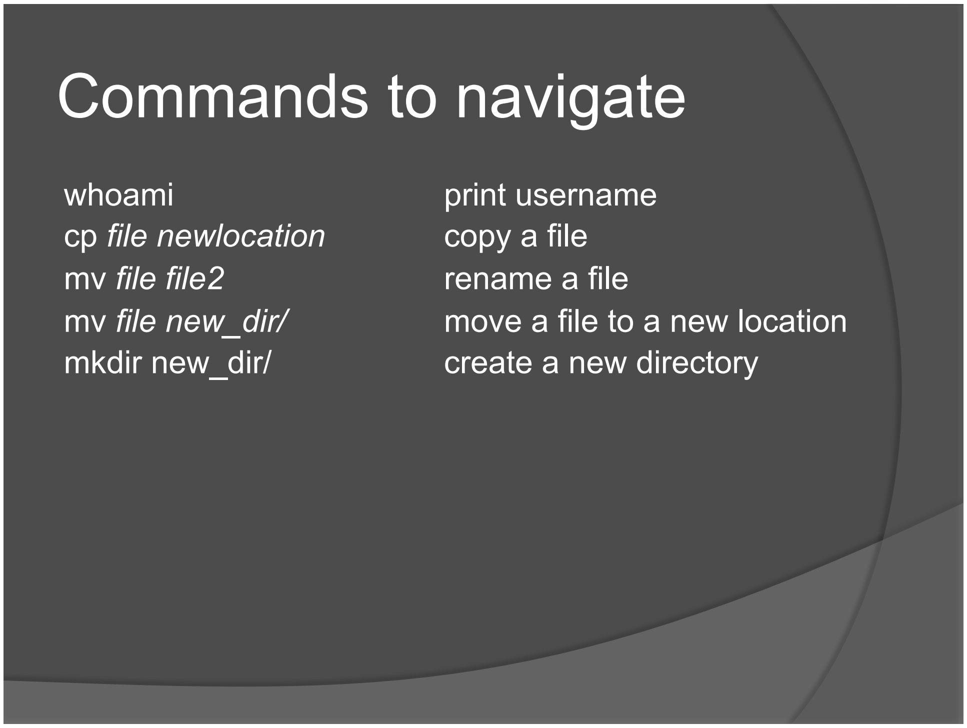
Commands to navigate

whoami	print username
cp *file newlocation*	copy a file
mv *file file2*	rename a file



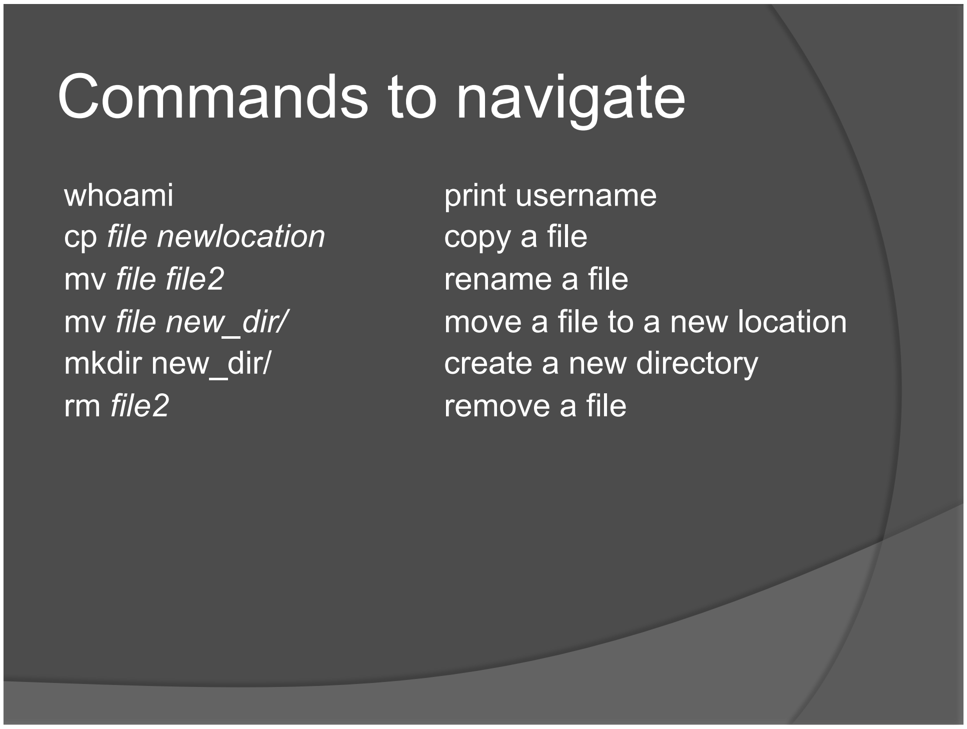
Commands to navigate

whoami	print username
cp *file newlocation*	copy a file
mv *file file2*	rename a file
mv *file new_dir/*	move a file to a new location



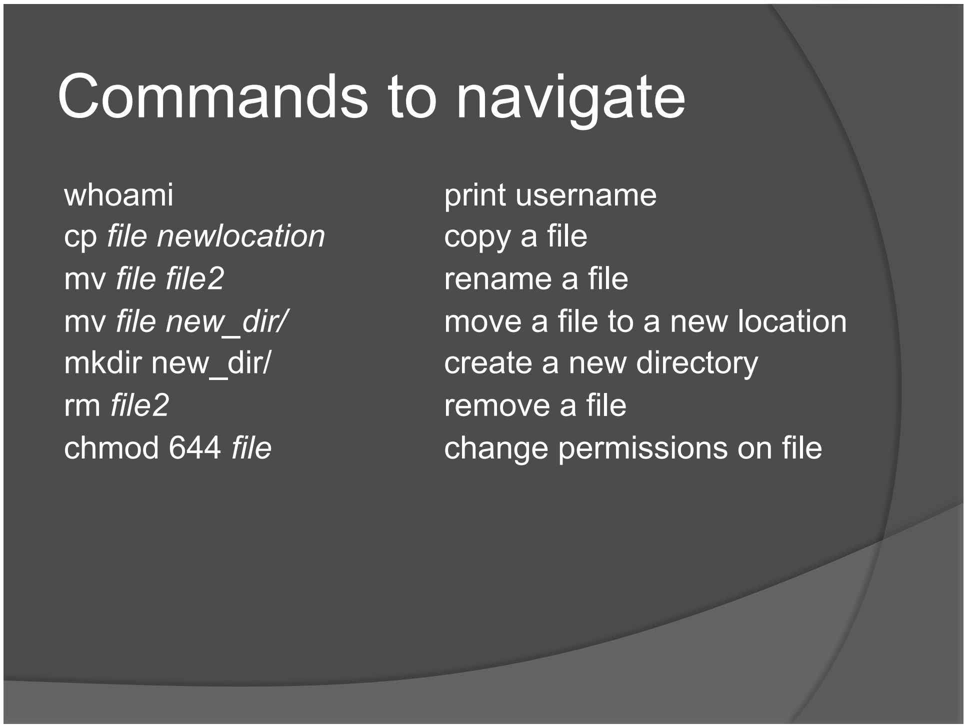
Commands to navigate

whoami	print username
cp *file newlocation*	copy a file
mv *file file2*	rename a file
mv *file new_dir/*	move a file to a new location
mkdir new_dir/	create a new directory



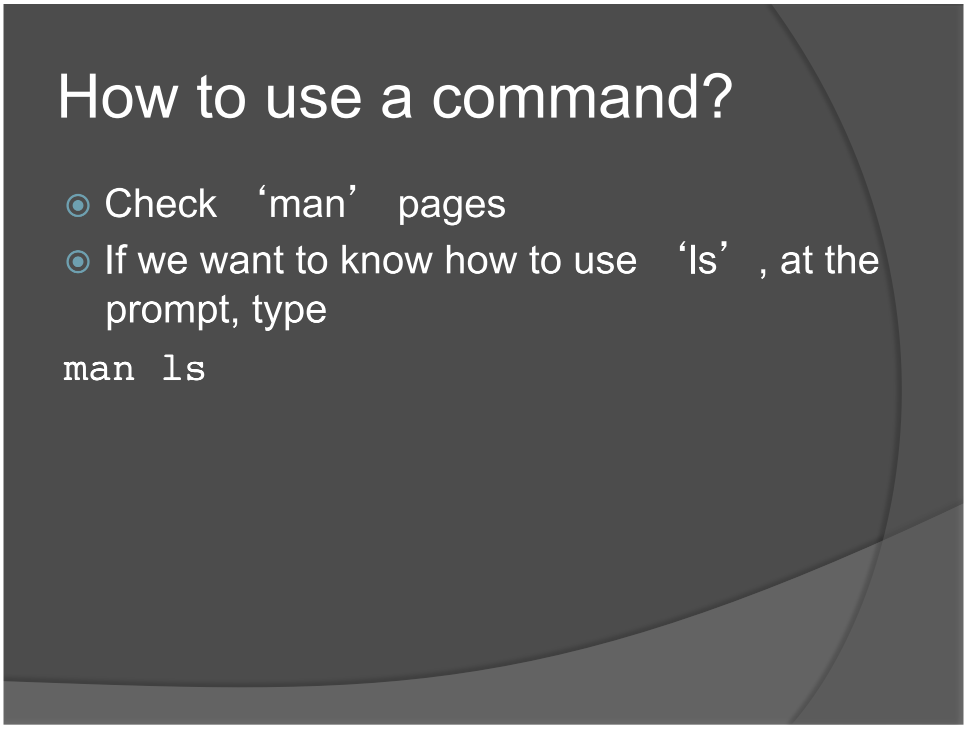
Commands to navigate

whoami	print username
cp *file newlocation*	copy a file
mv *file file2*	rename a file
mv *file new_dir/*	move a file to a new location
mkdir new_dir/	create a new directory
rm *file2*	remove a file



Commands to navigate

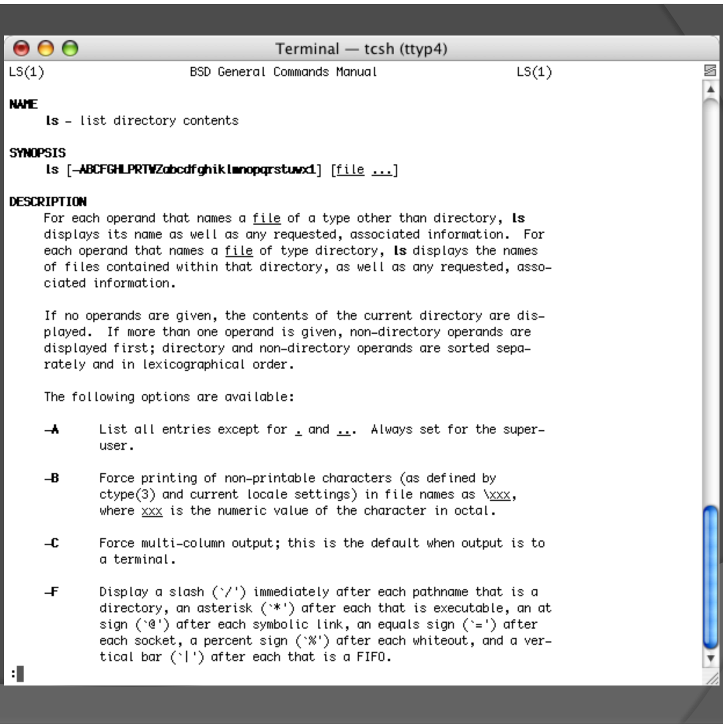
whoami	print username
cp *file newlocation*	copy a file
mv *file file2*	rename a file
mv *file new_dir/*	move a file to a new location
mkdir new_dir/	create a new directory
rm *file2*	remove a file
chmod 644 *file*	change permissions on file



How to use a command?

- Check ‘man’ pages
- If we want to know how to use ‘ls’, at the prompt, type

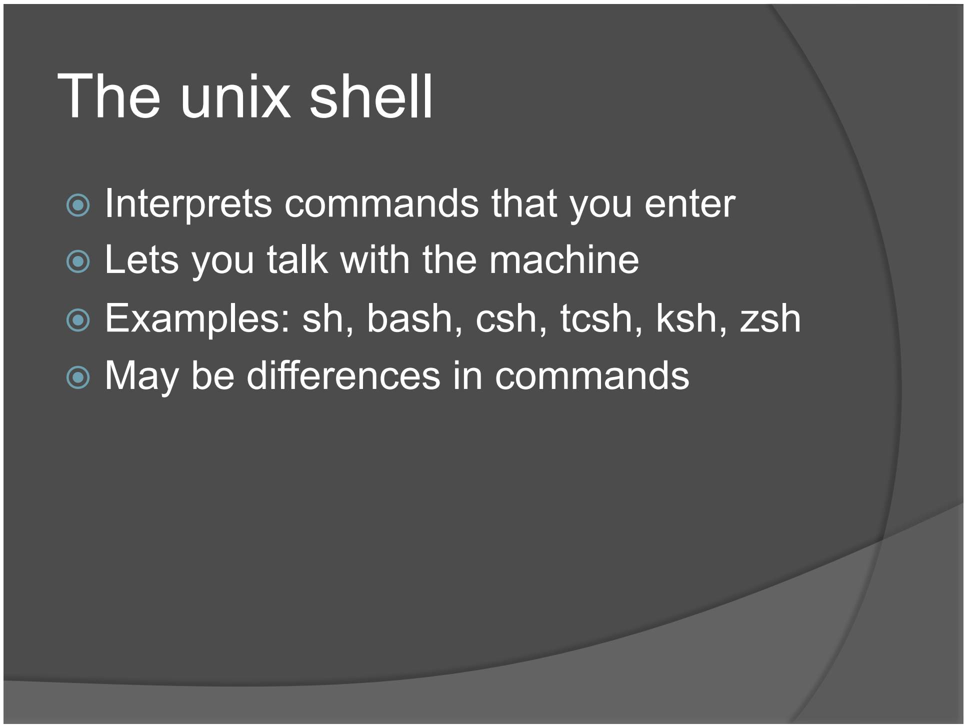
```
man ls
```



```
LS(1)                   BSD General Commands Manual                  LS(1)

NAME
     ls - list directory contents

SYNOPSIS
     ls [-ABCFGHLPRTWZabcdfghiklmnopqrstuwx1] [file ...]

DESCRIPTION
     For each operand that names a file of a type other than directory, ls
     displays its name as well as any requested, associated information.  For
     each operand that names a file of type directory, ls displays the names
     of files contained within that directory, as well as any requested, asso-
     ciated information.

     If no operands are given, the contents of the current directory are dis-
     played.  If more than one operand is given, non-directory operands are
     displayed first; directory and non-directory operands are sorted sepa-
     rately and in lexicographical order.

     The following options are available:

     -A      List all entries except for . and ...  Always set for the super-
             user.

     -B      Force printing of non-printable characters (as defined by
             ctype(3) and current locale settings) in file names as \xxx,
             where xxx is the numeric value of the character in octal.

     -C      Force multi-column output; this is the default when output is to
             a terminal.

     -F      Display a slash (`/') immediately after each pathname that is a
             directory, an asterisk (`*') after each that is executable, an at
             sign (`@') after each symbolic link, an equals sign (`=') after
             each socket, a percent sign (`%') after each whiteout, and a ver-
             tical bar (`|') after each that is a FIFO.
:
```

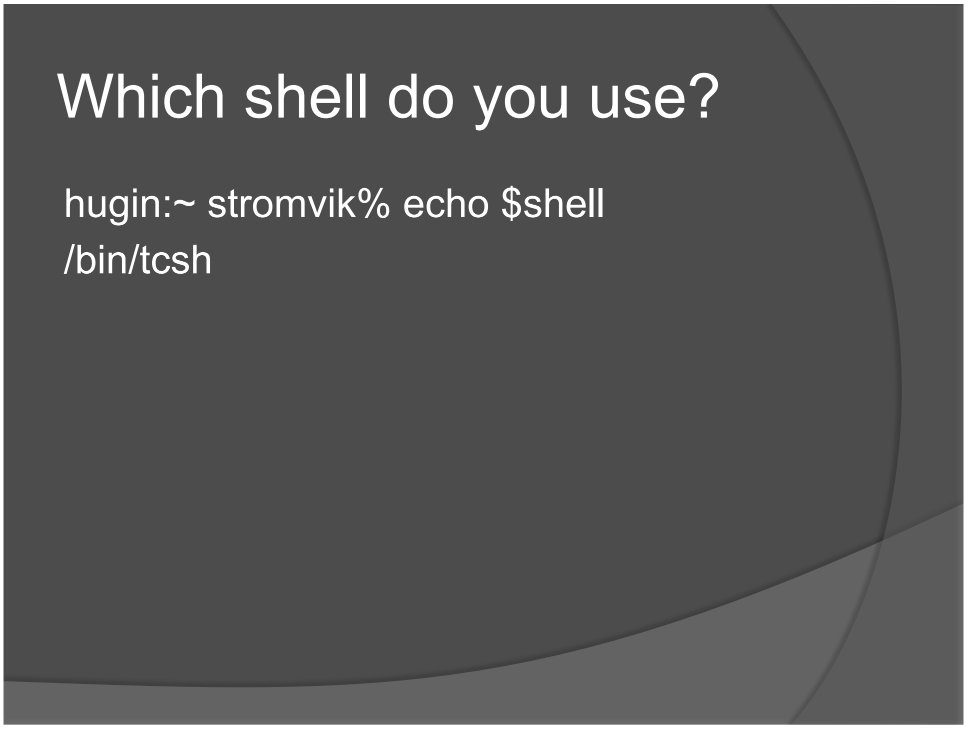
SHELLS

http://www.seashellworld.com/



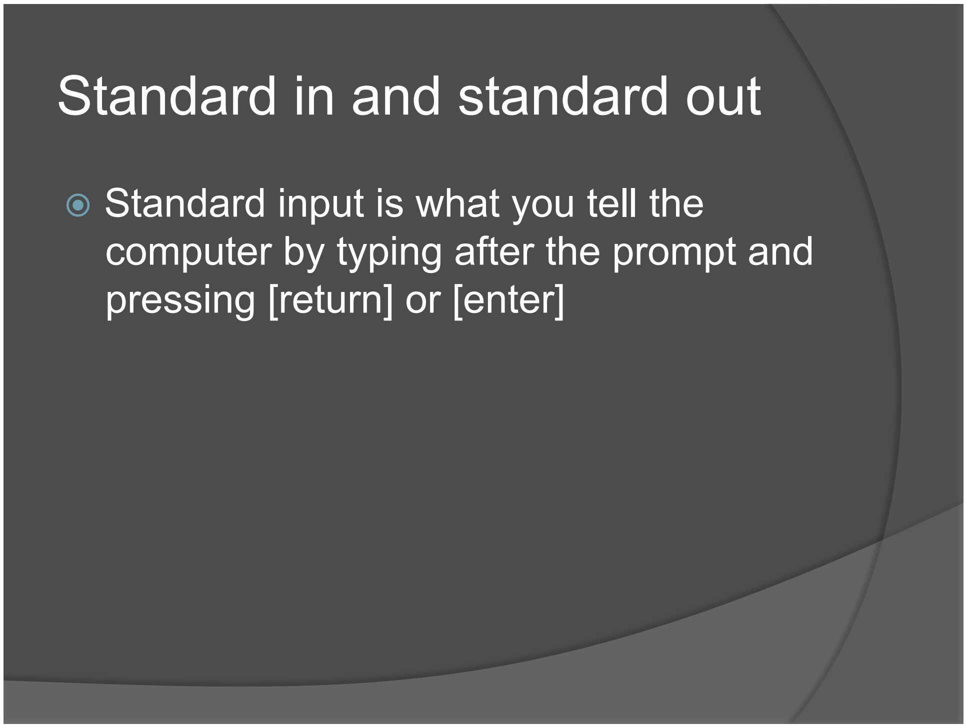
The unix shell

- Interprets commands that you enter
- Lets you talk with the machine
- Examples: sh, bash, csh, tcsh, ksh, zsh
- May be differences in commands



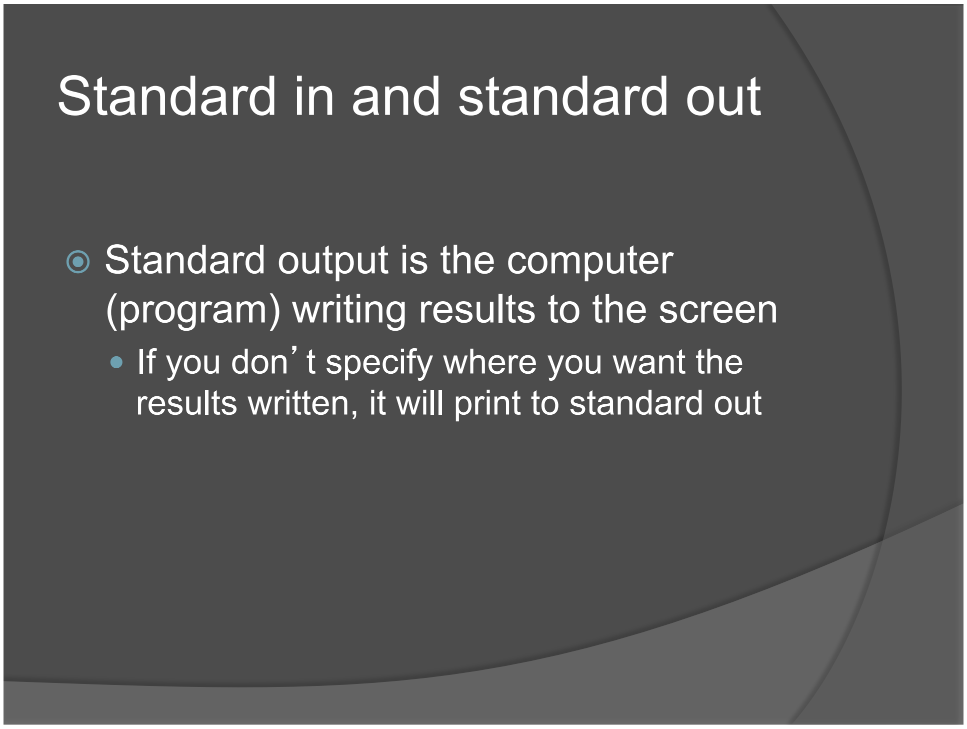
Which shell do you use?

```
hugin:~ stromvik% echo $shell
/bin/tcsh
```



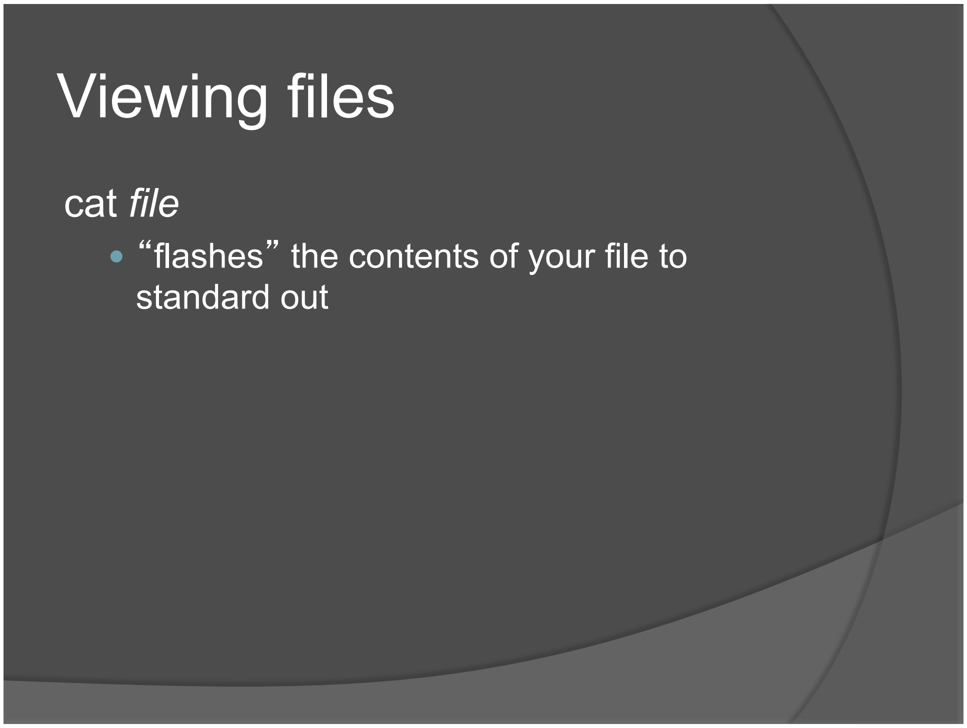
Standard in and standard out

- Standard input is what you tell the computer by typing after the prompt and pressing [return] or [enter]



Standard in and standard out

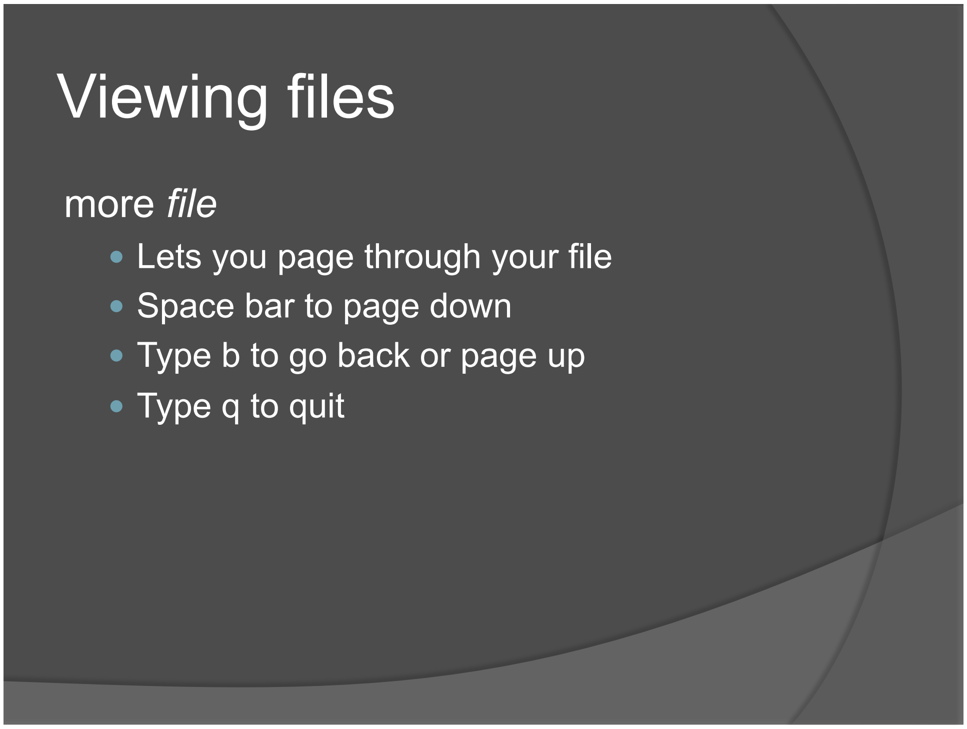
- Standard output is the computer (program) writing results to the screen
  - If you don’t specify where you want the results written, it will print to standard out



Viewing files

cat *file*

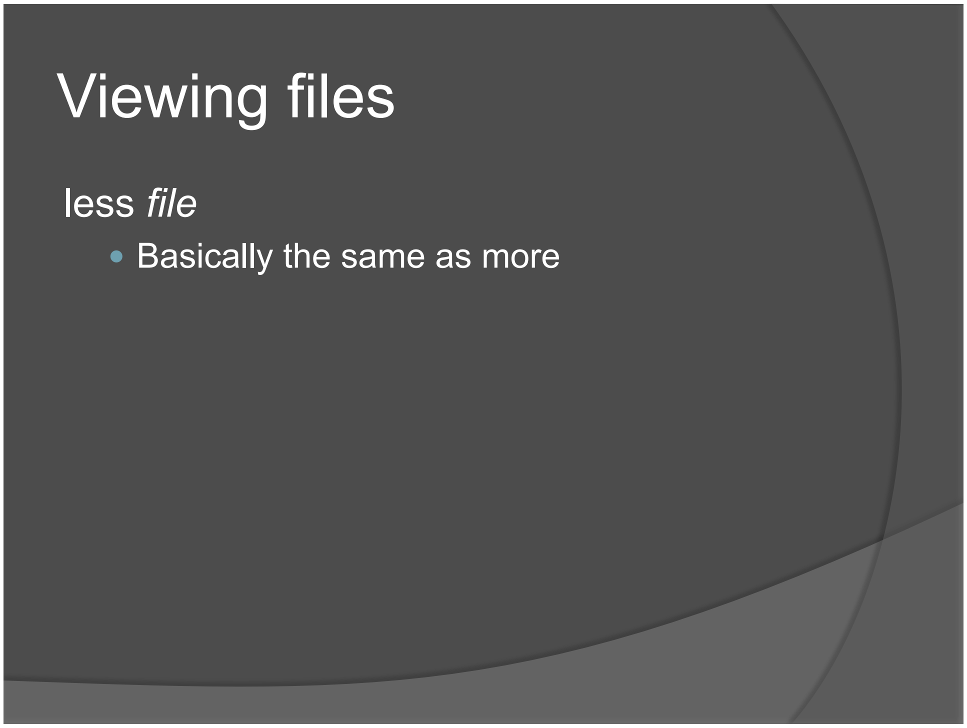
- “flashes” the contents of your file to standard out



Viewing files

more *file*

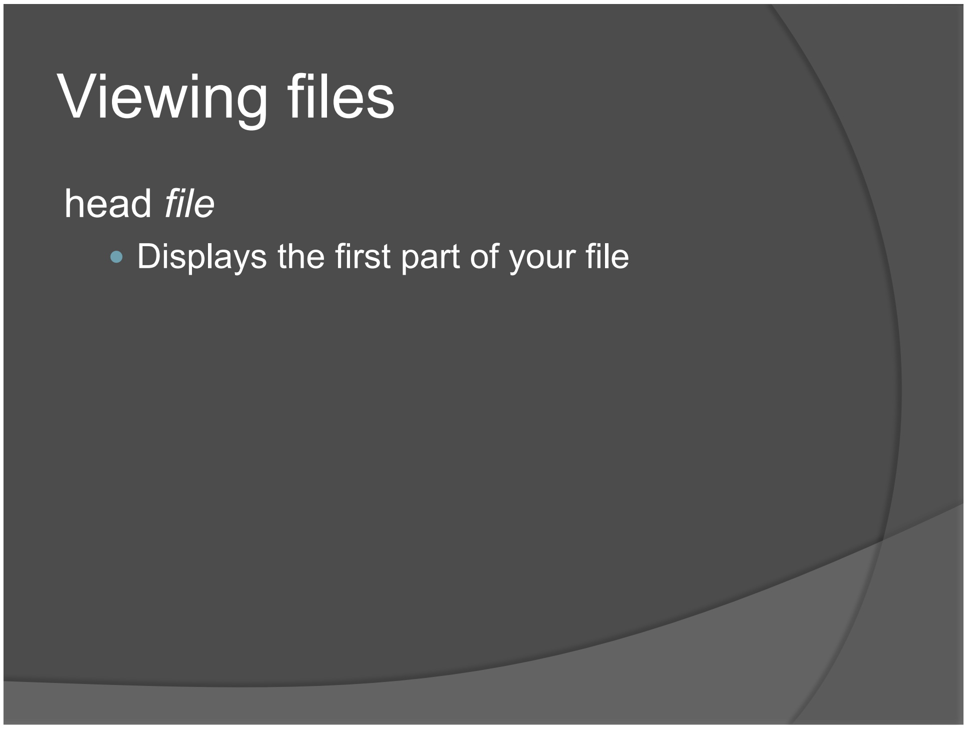
- Lets you page through your file
- Space bar to page down
- Type b to go back or page up
- Type q to quit



Viewing files

less *file*

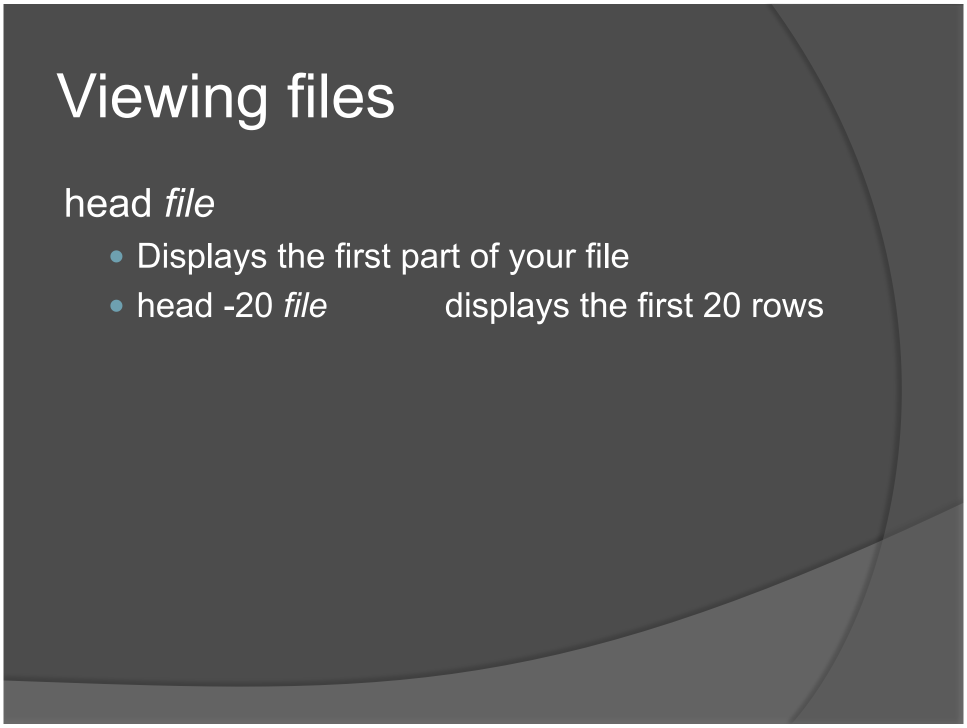
- Basically the same as more



Viewing files

head *file*

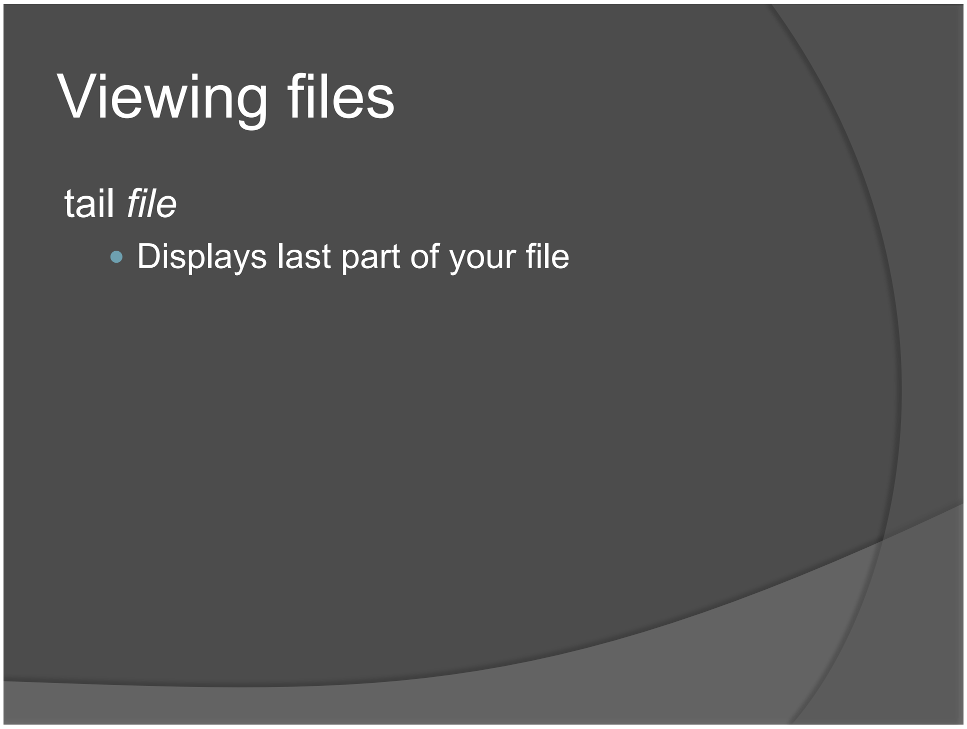
- Displays the first part of your file



Viewing files

head *file*

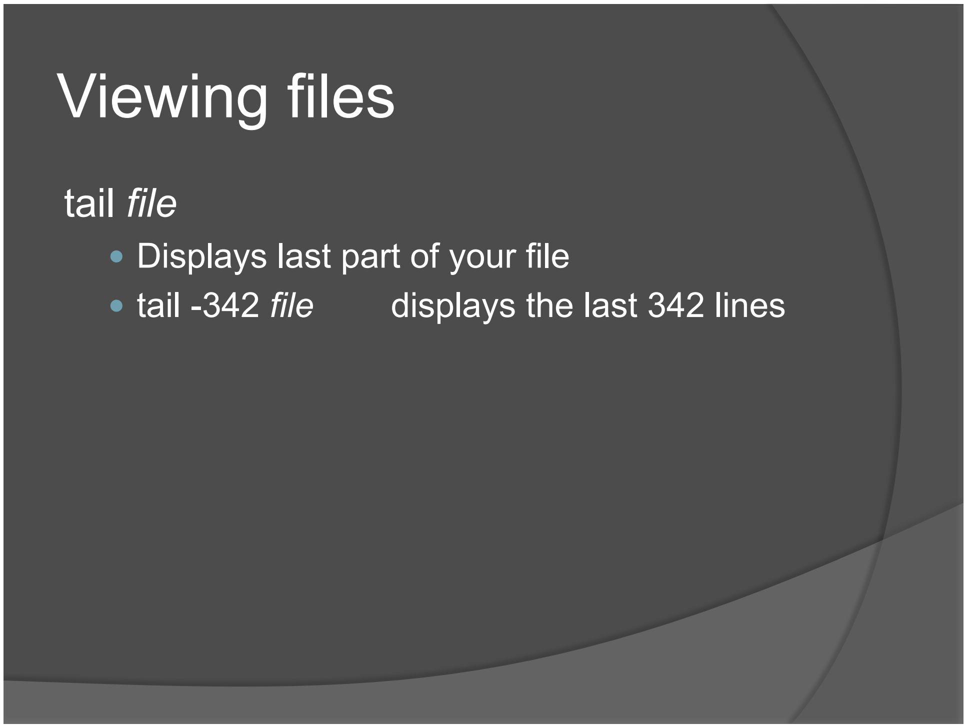
- Displays the first part of your file
- head -20 *file* displays the first 20 rows



Viewing files

tail *file*

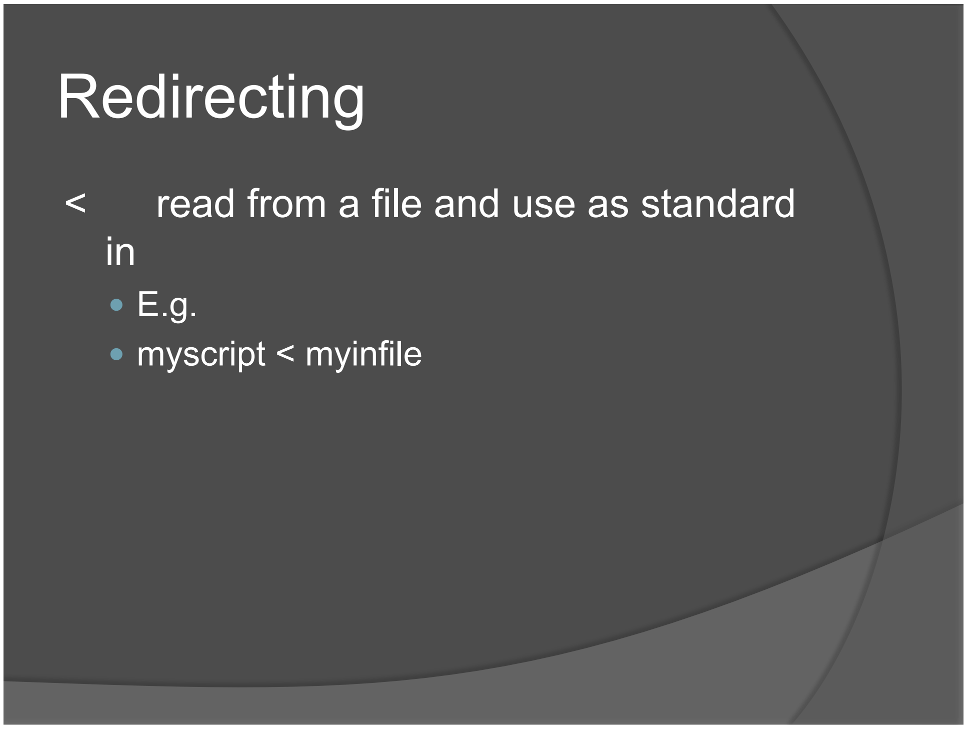
- Displays last part of your file



Viewing files

tail *file*

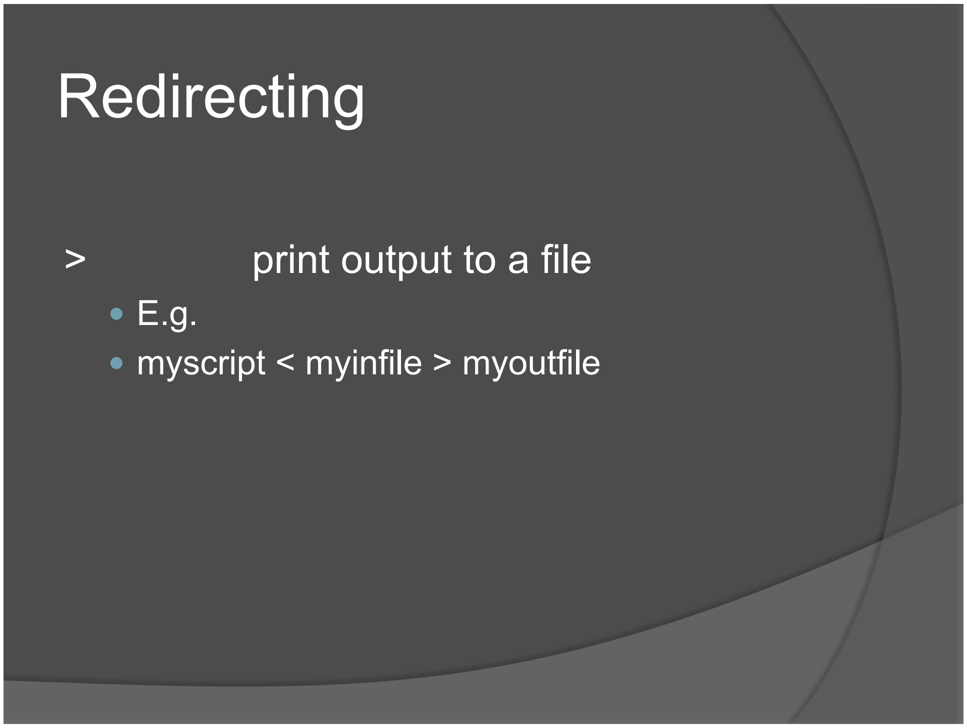
- Displays last part of your file
- tail -342 *file*   displays the last 342 lines



Redirecting

<   read from a file and use as standard in

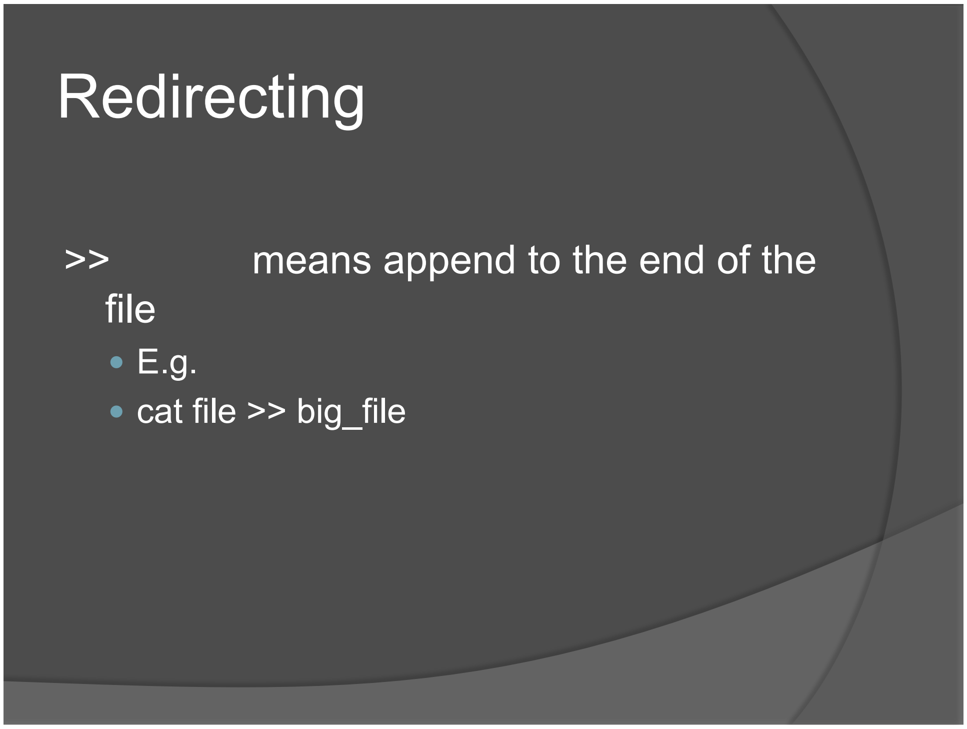
- E.g.
- myscript < myinfile



Redirecting

> print output to a file

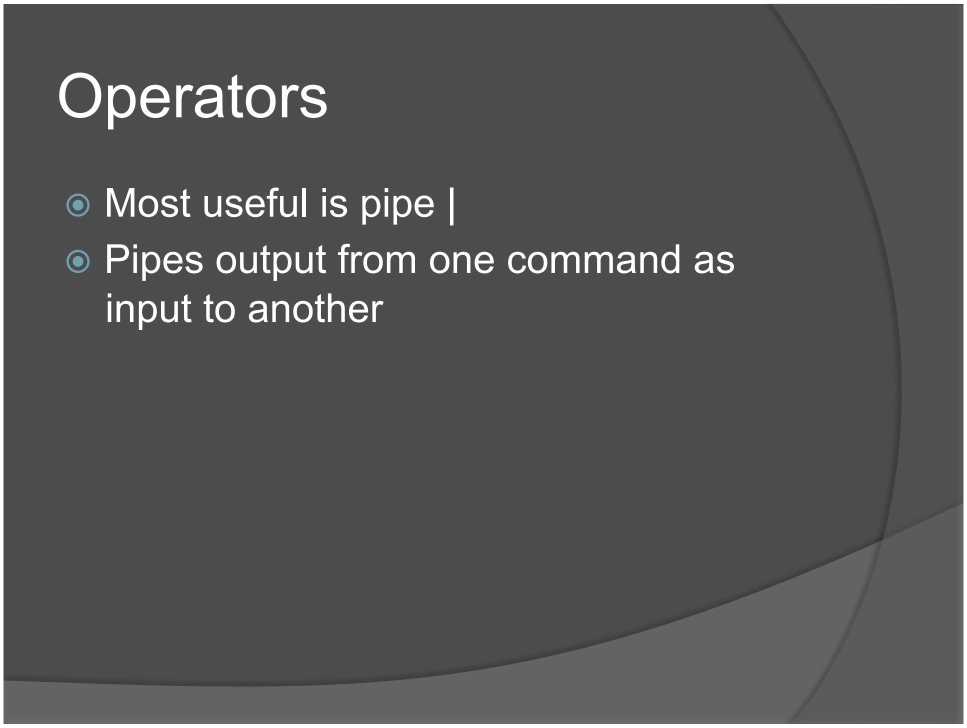
- E.g.
- myscript < myinfile > myoutfile



Redirecting

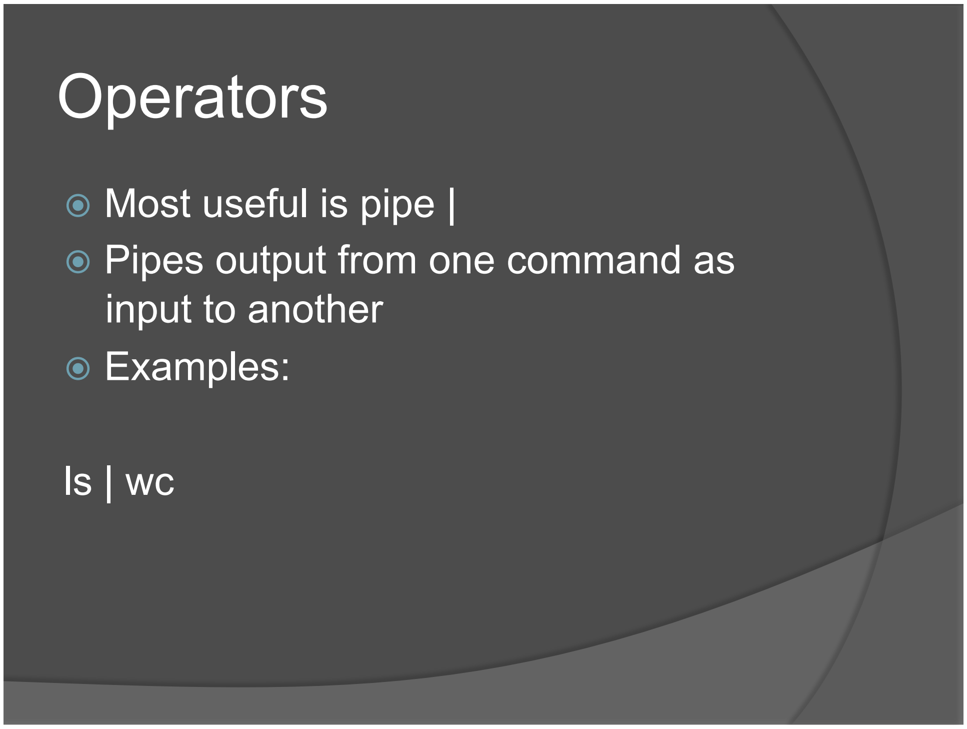
>> means append to the end of the file

- E.g.
- cat file >> big_file



Operators

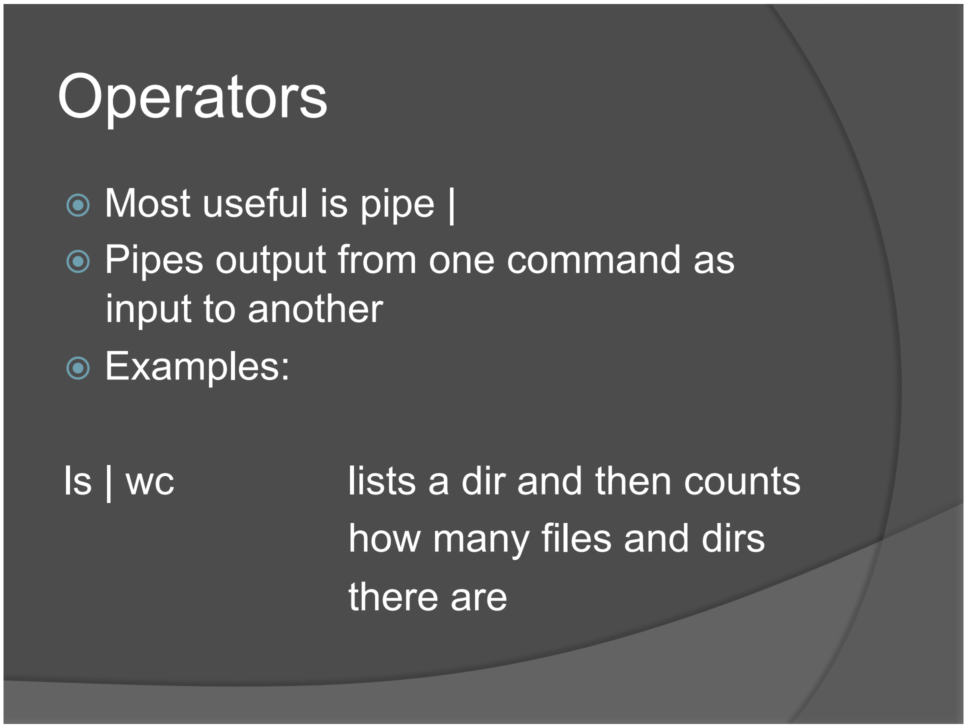
- Most useful is pipe |
- Pipes output from one command as input to another



Operators

- Most useful is pipe |
- Pipes output from one command as input to another
- Examples:

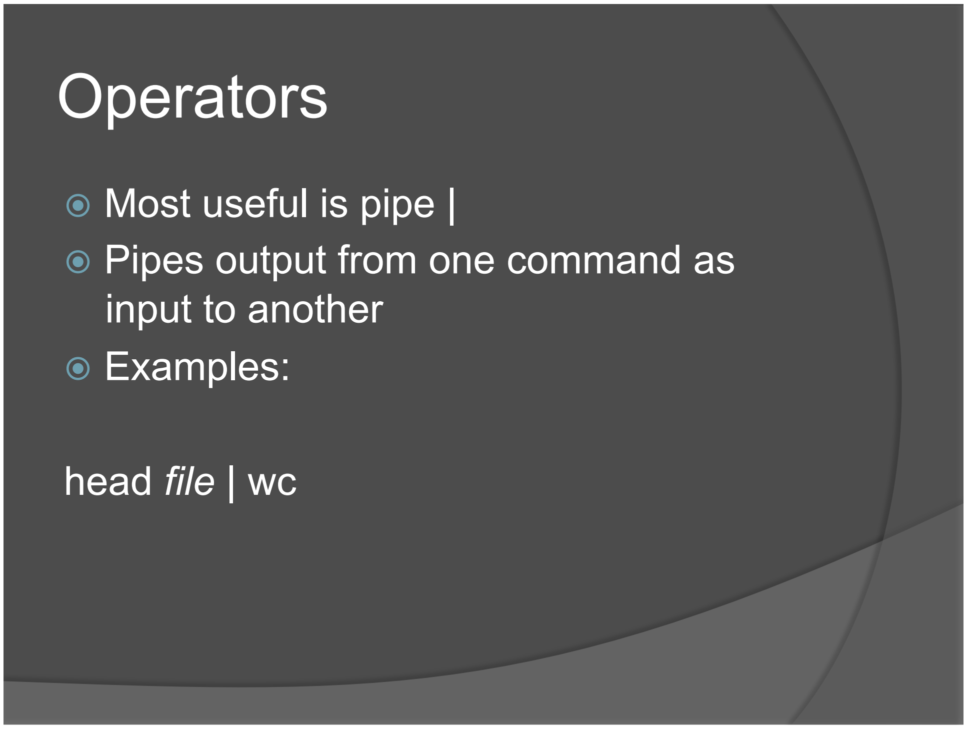
```
ls | wc
```



Operators

- Most useful is pipe |
- Pipes output from one command as input to another
- Examples:

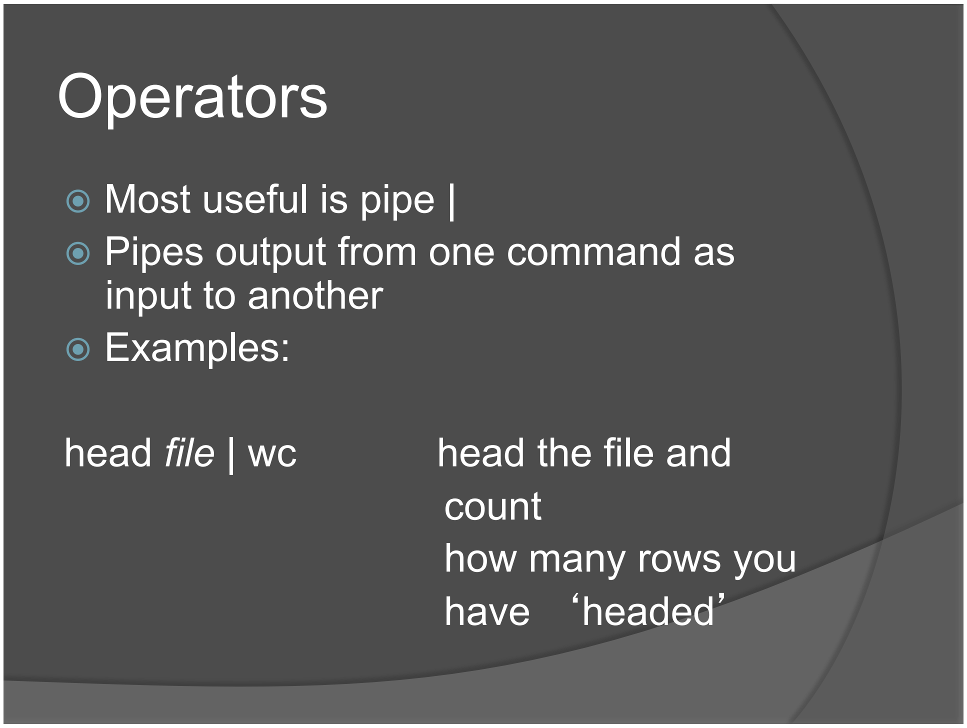
ls | wc	lists a dir and then counts how many files and dirs there are



Operators

- Most useful is pipe |
- Pipes output from one command as input to another
- Examples:

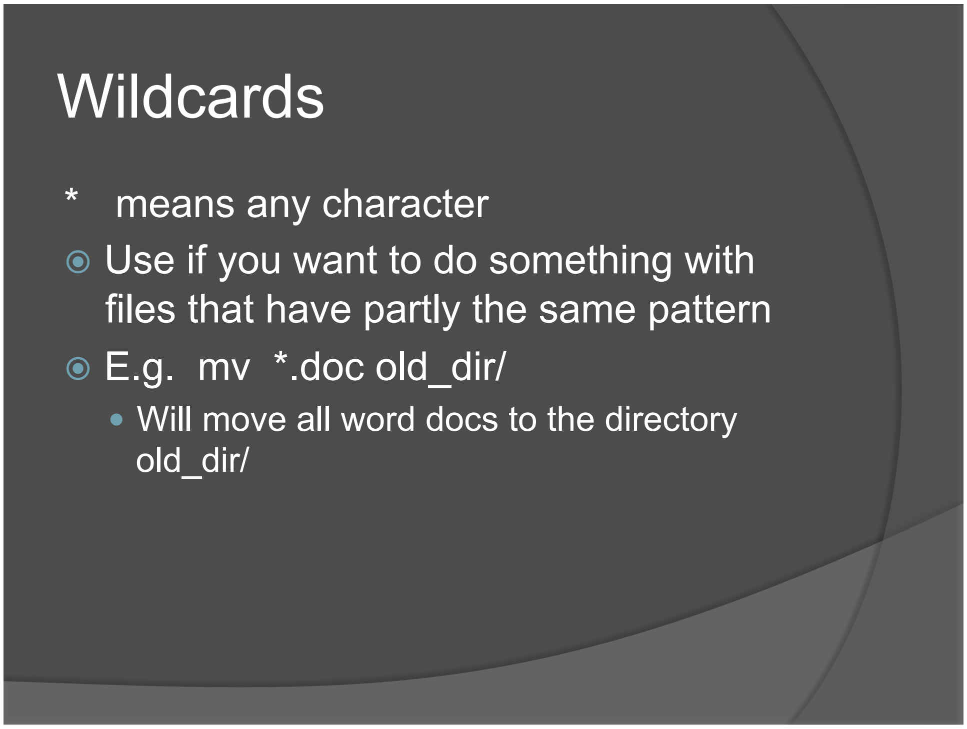
head *file* | wc



Operators

- Most useful is pipe |
- Pipes output from one command as input to another
- Examples:

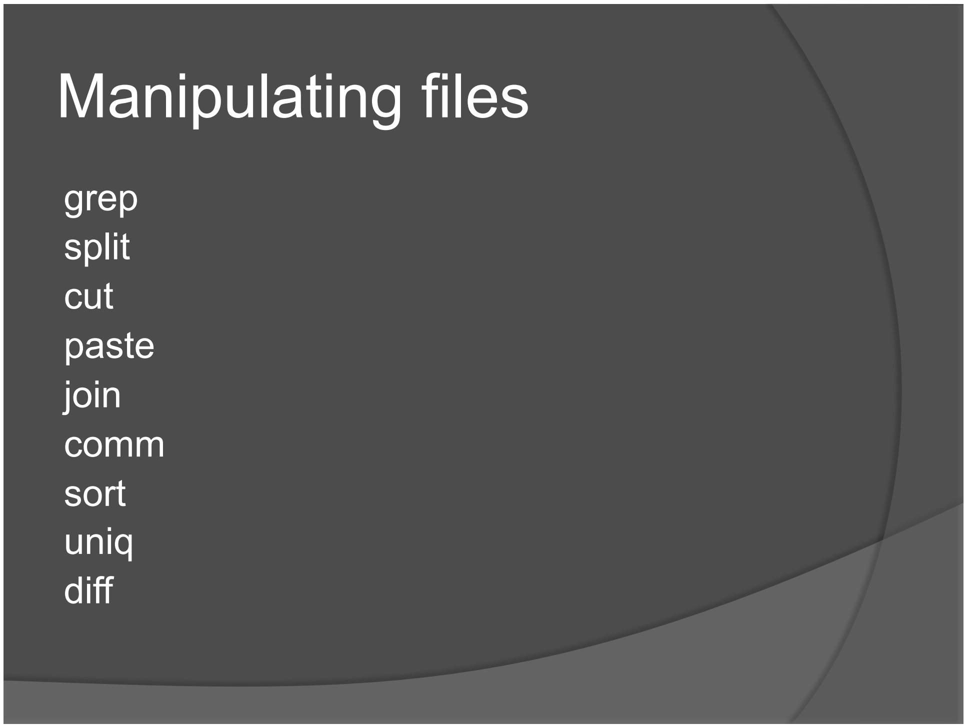
head *file* | wc head the file and count how many rows you have ‘headed’



Wildcards

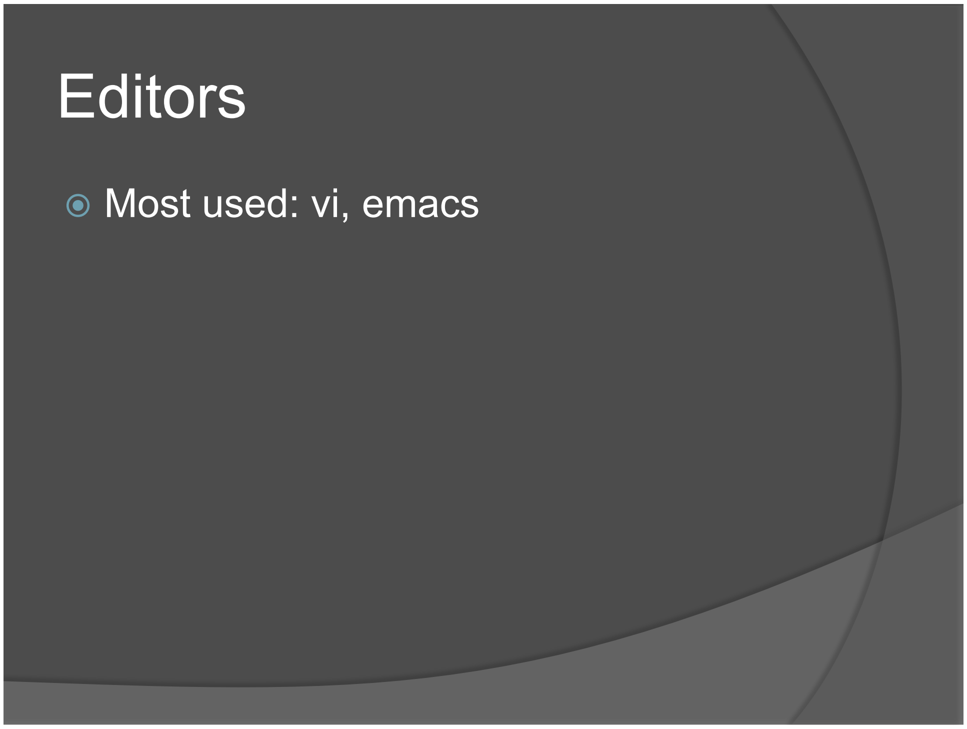
* means any character

- Use if you want to do something with files that have partly the same pattern
- E.g. mv *.doc old_dir/
  - Will move all word docs to the directory old_dir/



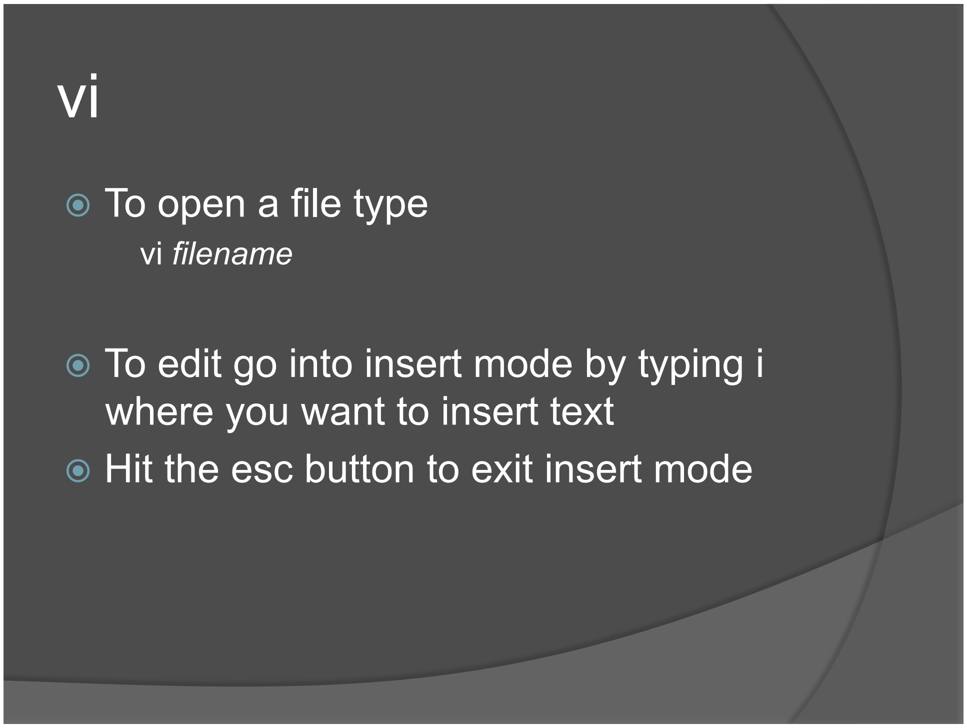
Manipulating files

grep
split
cut
paste
join
comm
sort
uniq
diff



Editors

- Most used: vi, emacs

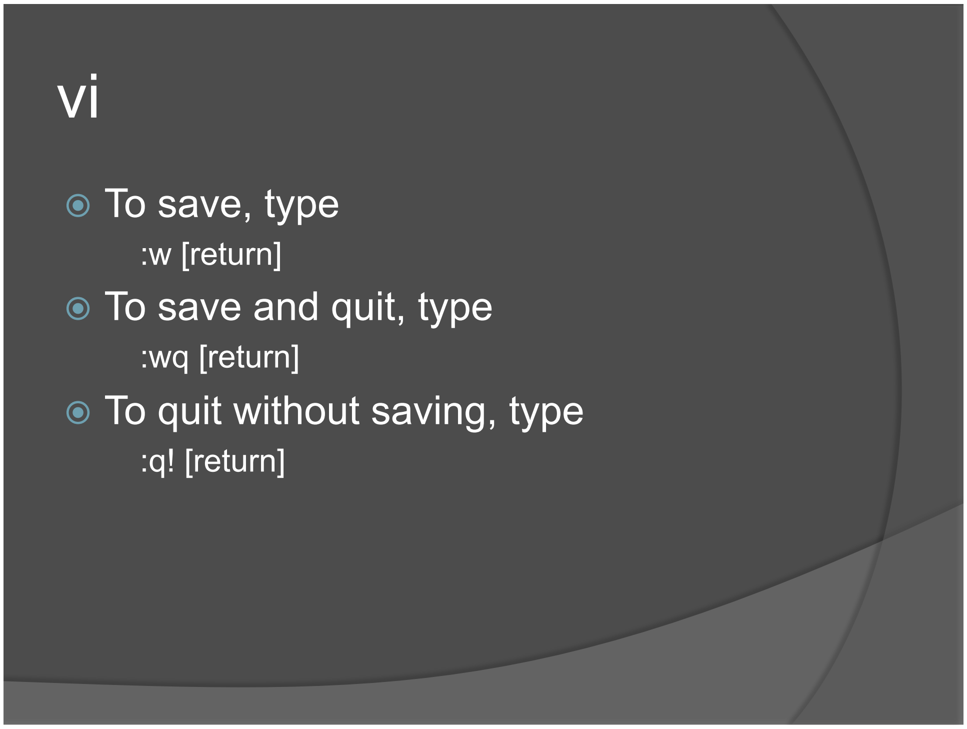


vi

- To open a file type

  vi *filename*

- To edit go into insert mode by typing i where you want to insert text
- Hit the esc button to exit insert mode



vi

- To save, type

  :w [return]

- To save and quit, type

  :wq [return]

- To quit without saving, type

  :q! [return]

tar archives

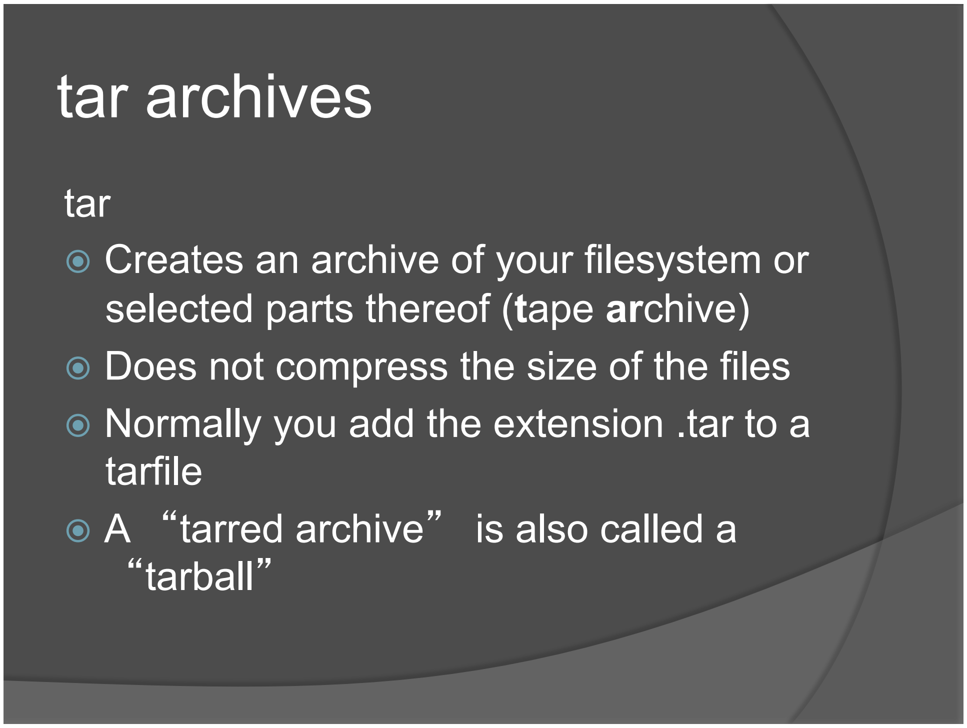
tar

- Creates an archive of your filesystem or selected parts thereof (**t**ape **ar**chive)

tar archives

tar

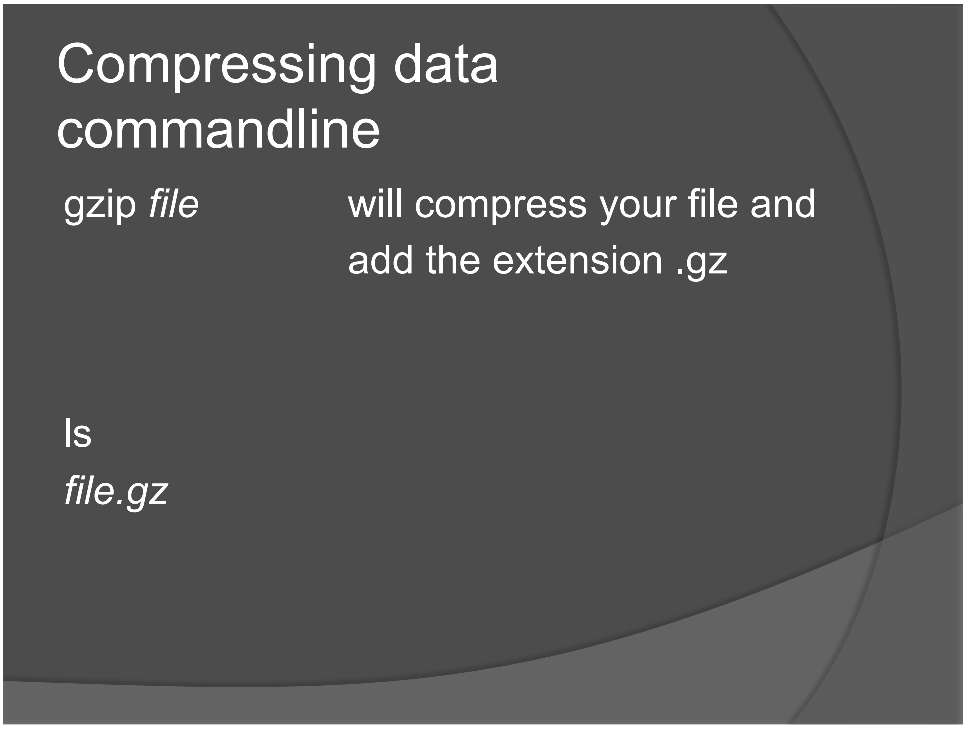
- Creates an archive of your filesystem or selected parts thereof (**t**ape **ar**chive)
- Does not compress the size of the files



tar archives

tar

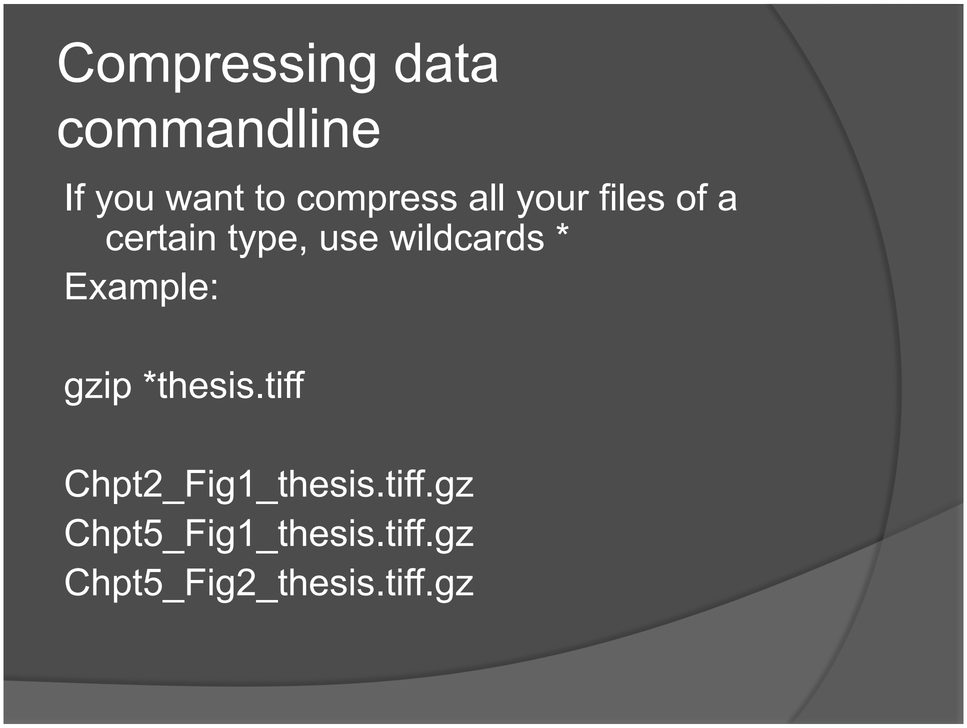
- Creates an archive of your filesystem or selected parts thereof (**t**ape **ar**chive)
- Does not compress the size of the files
- Normally you add the extension .tar to a tarfile
- A "tarred archive" is also called a "tarball"



Compressing data commandline

gzip *file* will compress your file and add the extension .gz

```
ls
file.gz
```



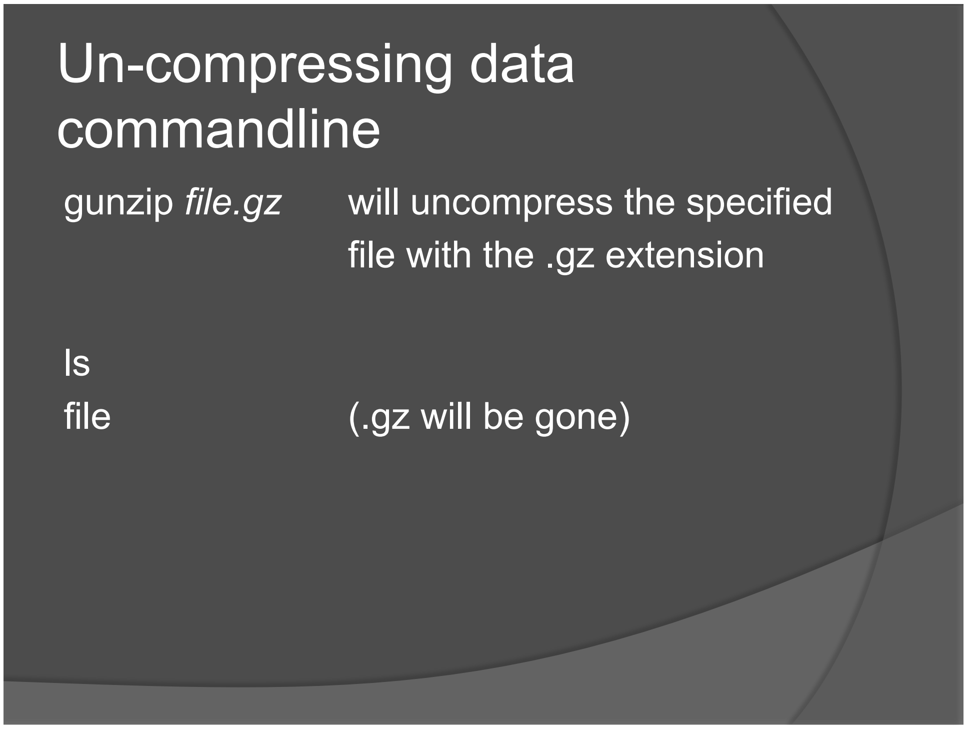
Compressing data commandline

If you want to compress all your files of a certain type, use wildcards *

Example:

```
gzip *thesis.tiff
```

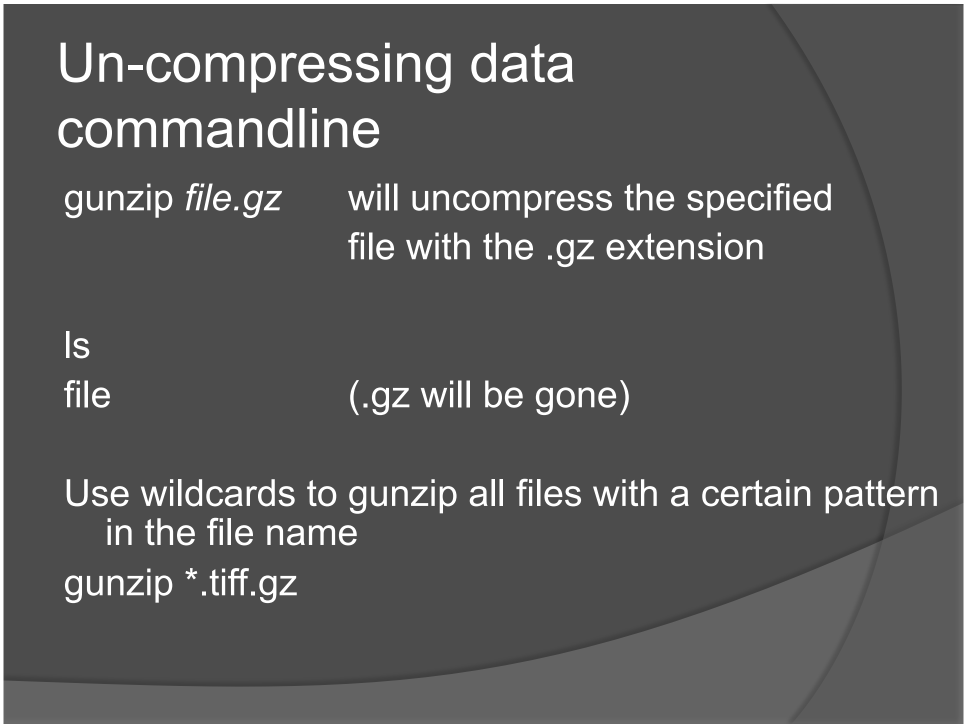
```
Chpt2_Fig1_thesis.tiff.gz
Chpt5_Fig1_thesis.tiff.gz
Chpt5_Fig2_thesis.tiff.gz
```



Un-compressing data commandline

gunzip *file.gz*   will uncompress the specified file with the .gz extension

```
ls
file                    (.gz will be gone)
```



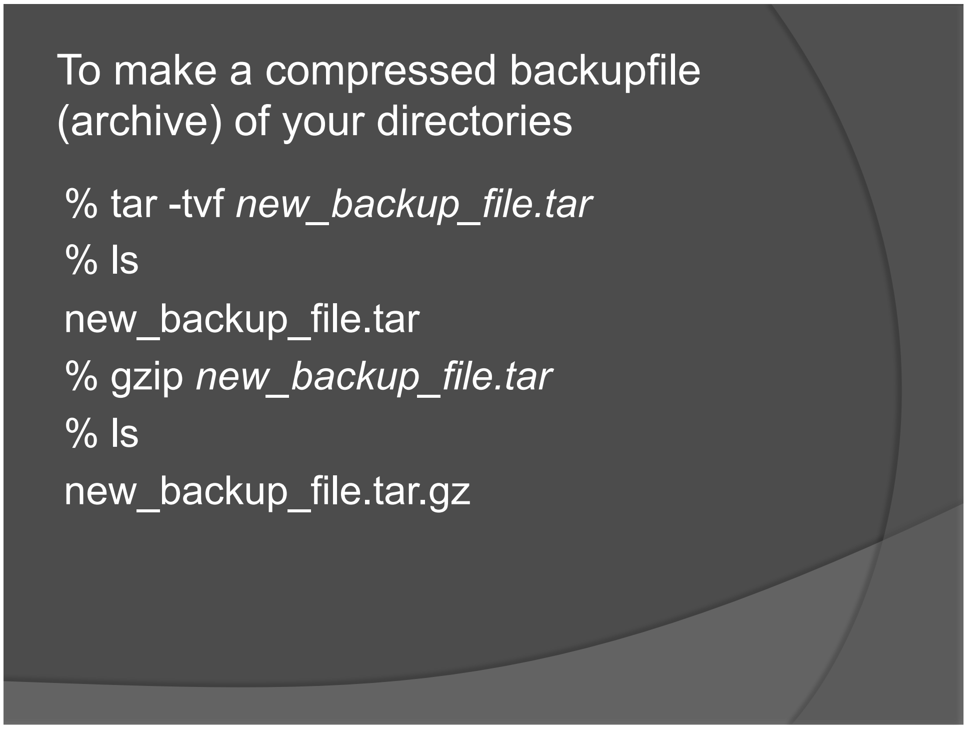
Un-compressing data commandline

gunzip *file.gz* will uncompress the specified file with the .gz extension

```
ls
file                 (.gz will be gone)
```

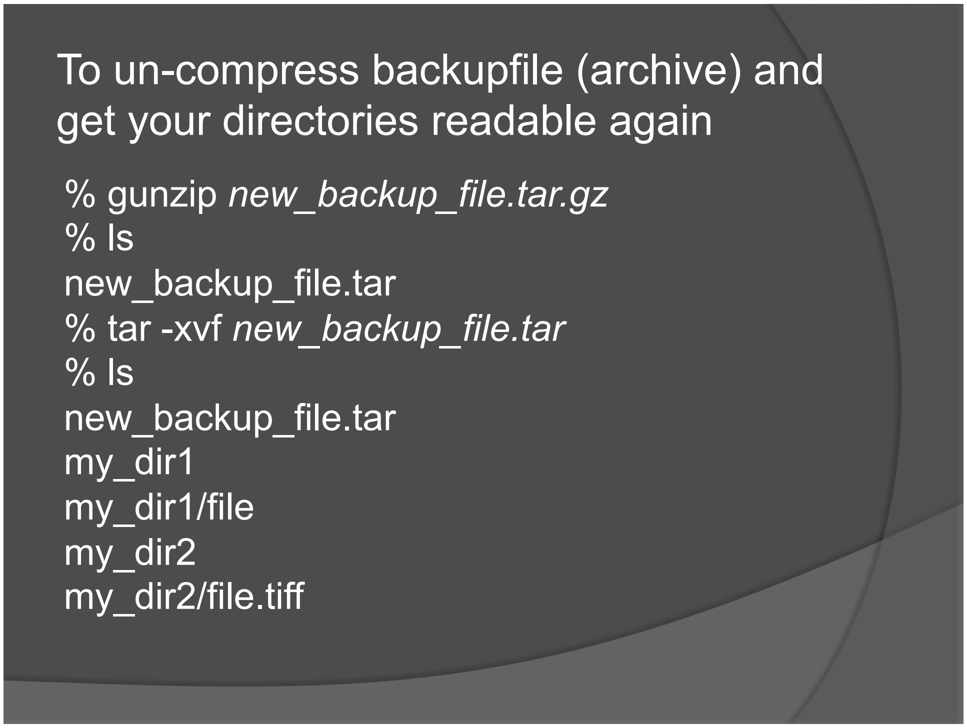
Use wildcards to gunzip all files with a certain pattern in the file name

```
gunzip *.tiff.gz
```



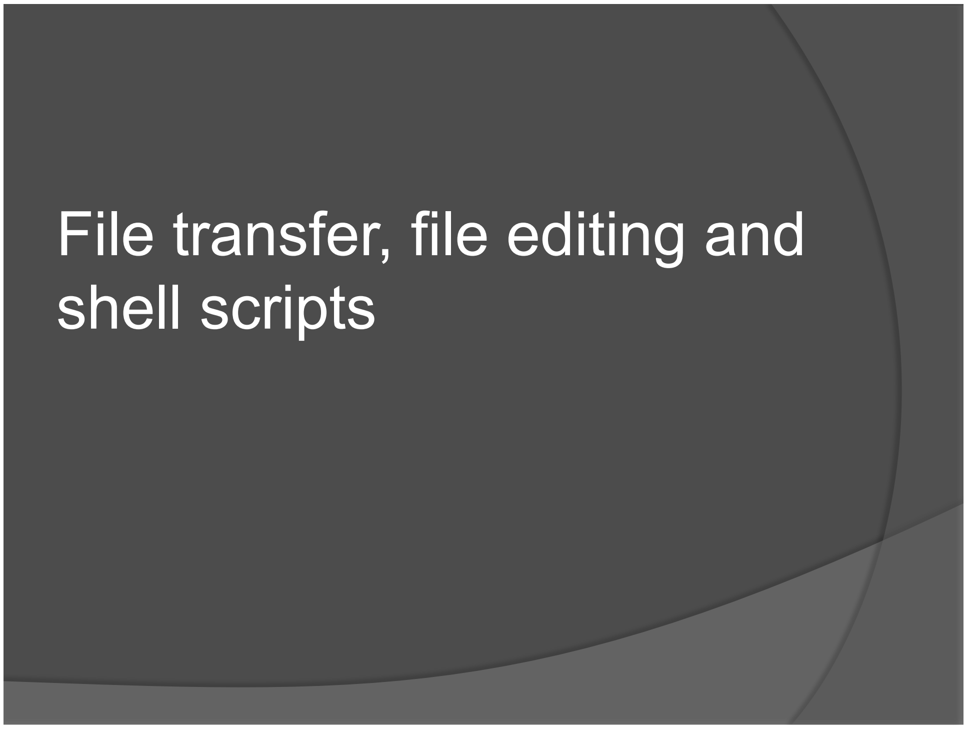
To make a compressed backupfile (archive) of your directories

```
% tar -tvf new_backup_file.tar
% ls
new_backup_file.tar
% gzip new_backup_file.tar
% ls
new_backup_file.tar.gz
```

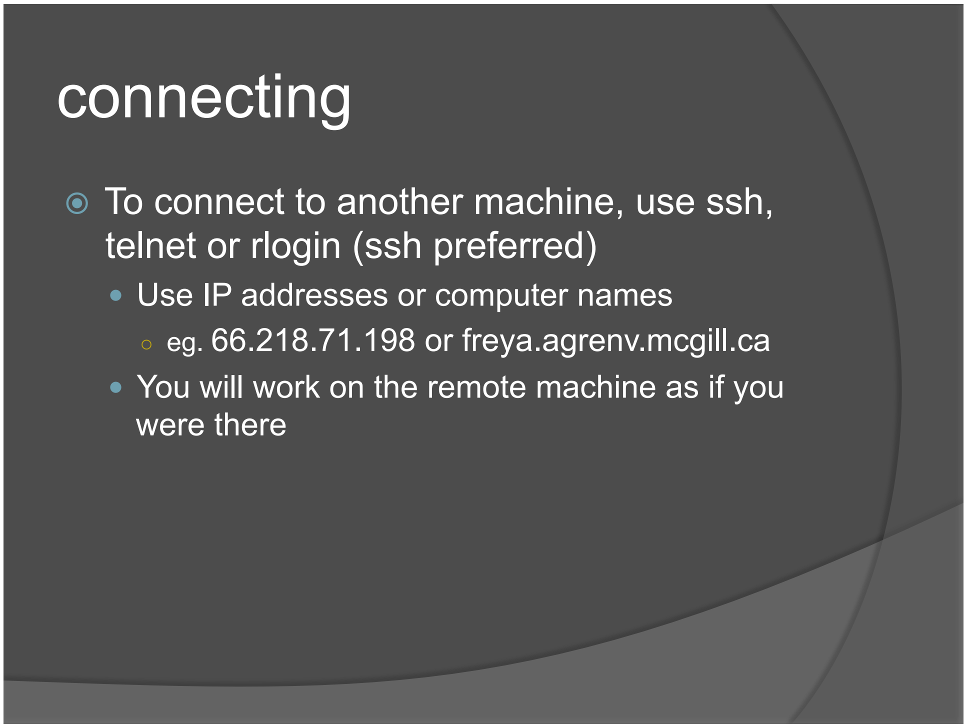


To un-compress backupfile (archive) and get your directories readable again

```
% gunzip new_backup_file.tar.gz
% ls
new_backup_file.tar
% tar -xvf new_backup_file.tar
% ls
new_backup_file.tar
my_dir1
my_dir1/file
my_dir2
my_dir2/file.tiff
```

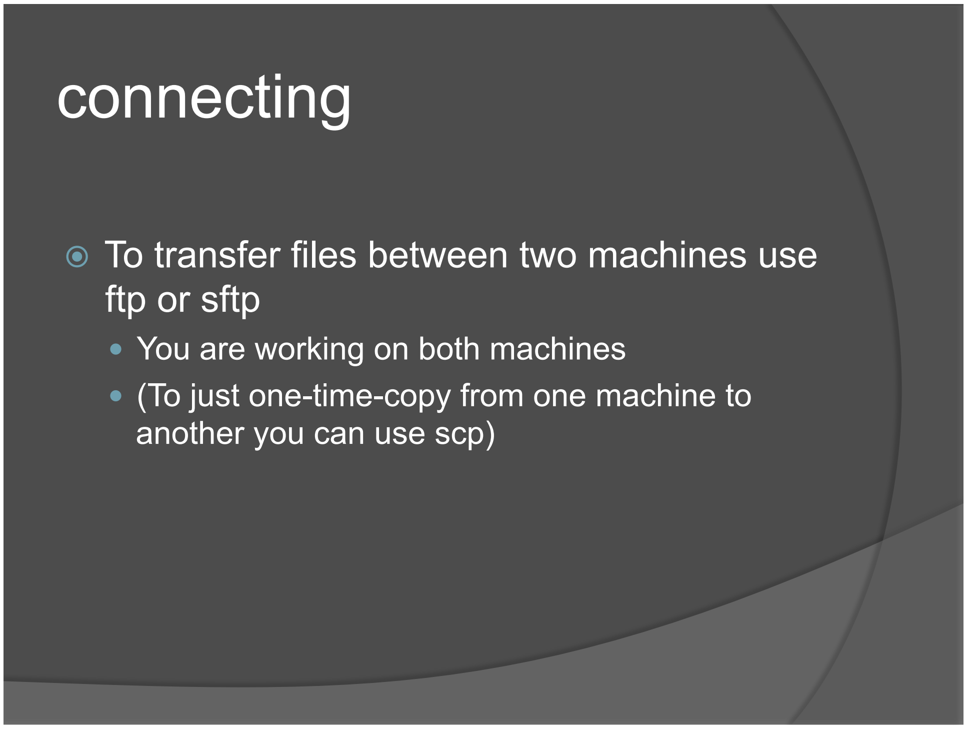


File transfer, file editing and shell scripts



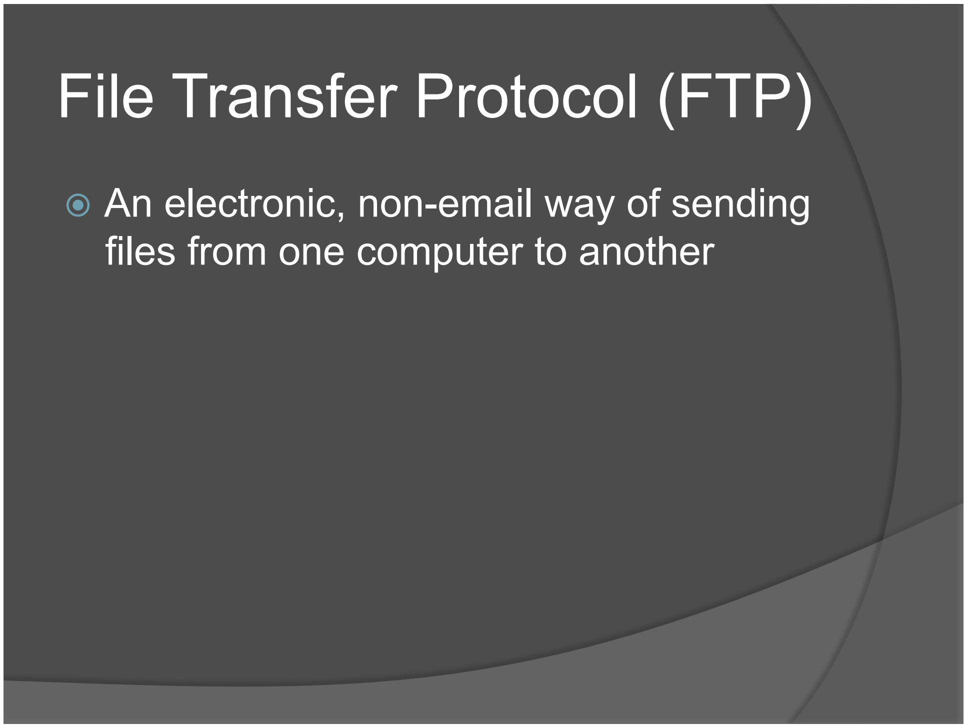
connecting

- To connect to another machine, use ssh, telnet or rlogin (ssh preferred)
  - Use IP addresses or computer names
    - eg. 66.218.71.198 or freya.agrenv.mcgill.ca
  - You will work on the remote machine as if you were there



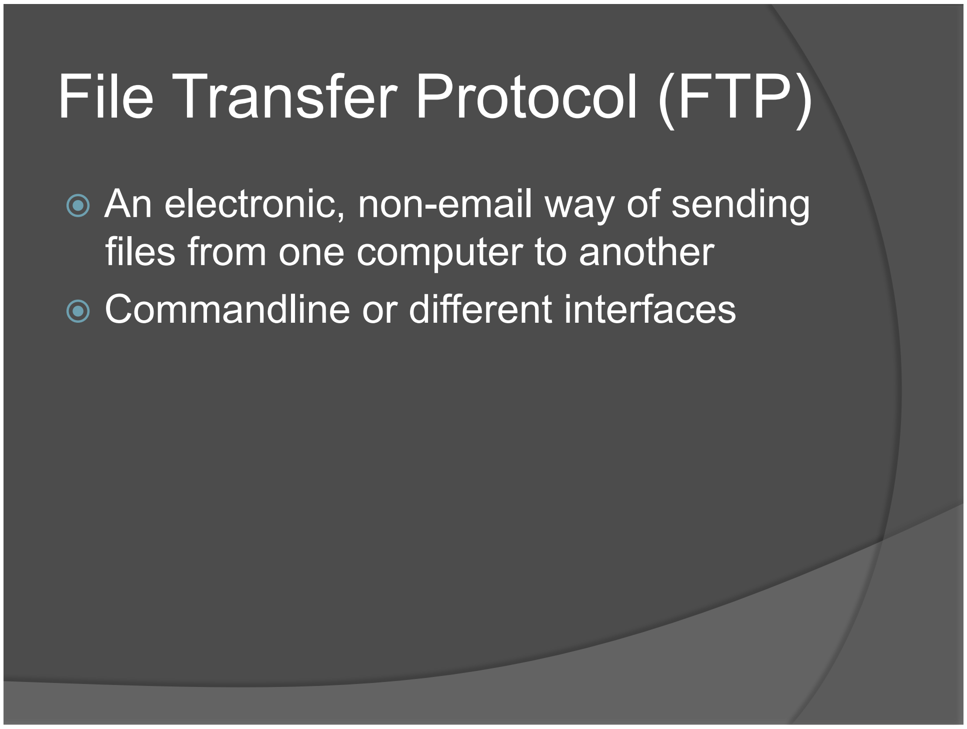
connecting

- To transfer files between two machines use ftp or sftp
  - You are working on both machines
  - (To just one-time-copy from one machine to another you can use scp)



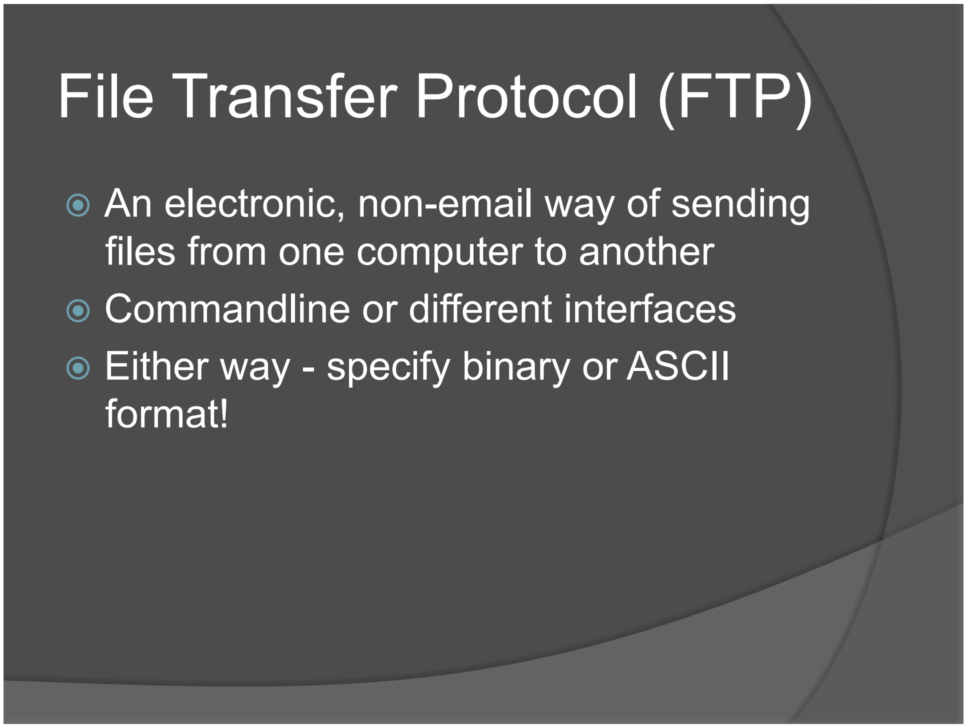
File Transfer Protocol (FTP)

- An electronic, non-email way of sending files from one computer to another



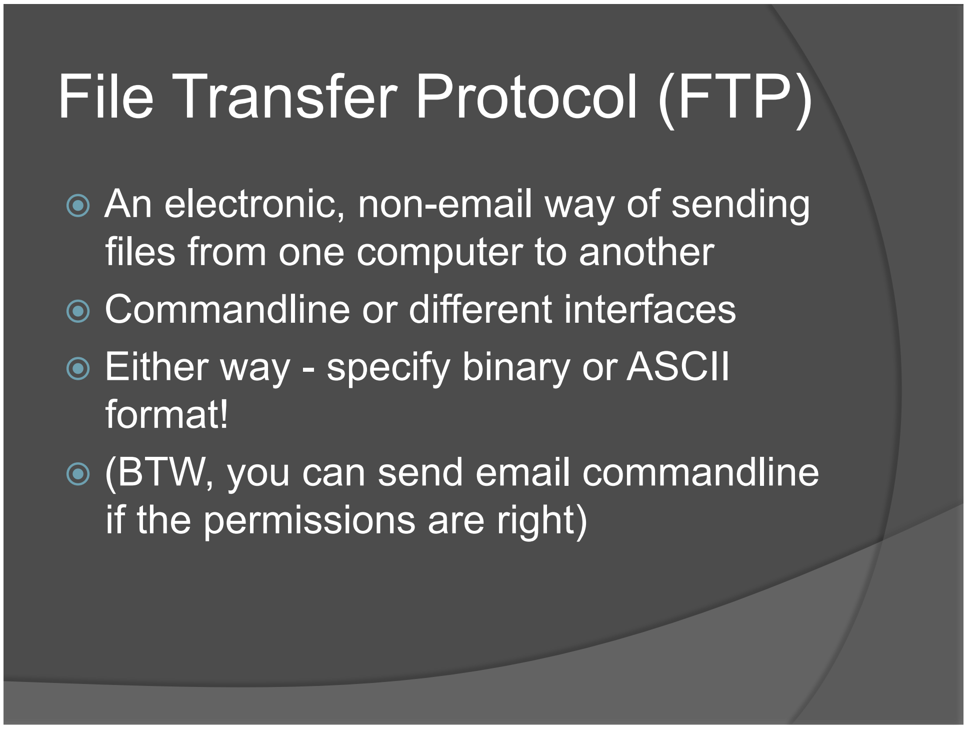
File Transfer Protocol (FTP)

- An electronic, non-email way of sending files from one computer to another
- Commandline or different interfaces



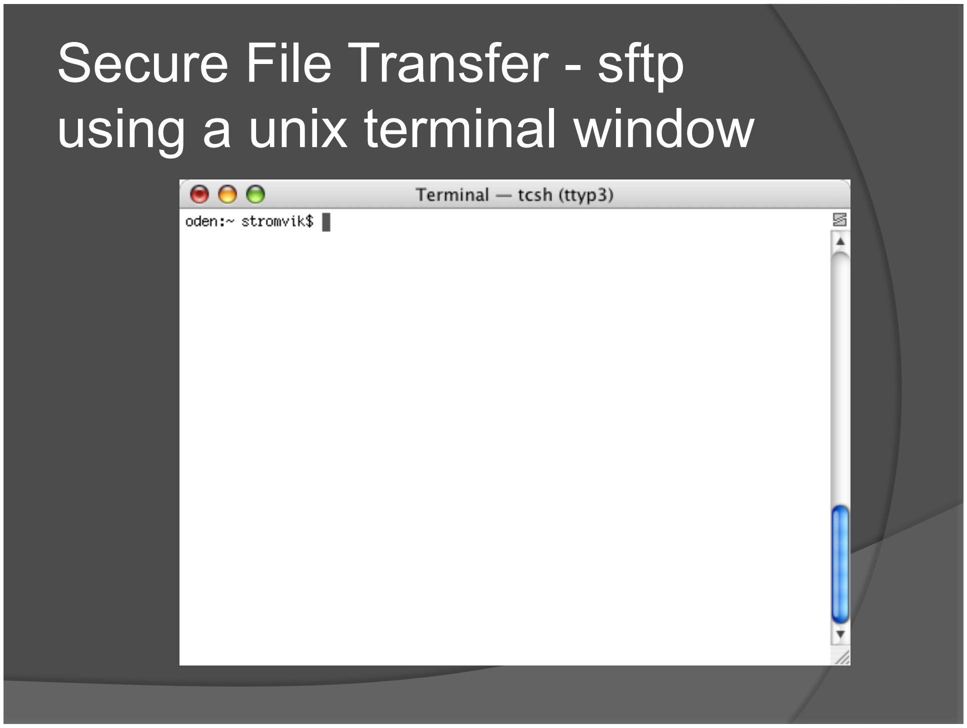
File Transfer Protocol (FTP)

- An electronic, non-email way of sending files from one computer to another
- Commandline or different interfaces
- Either way - specify binary or ASCII format!



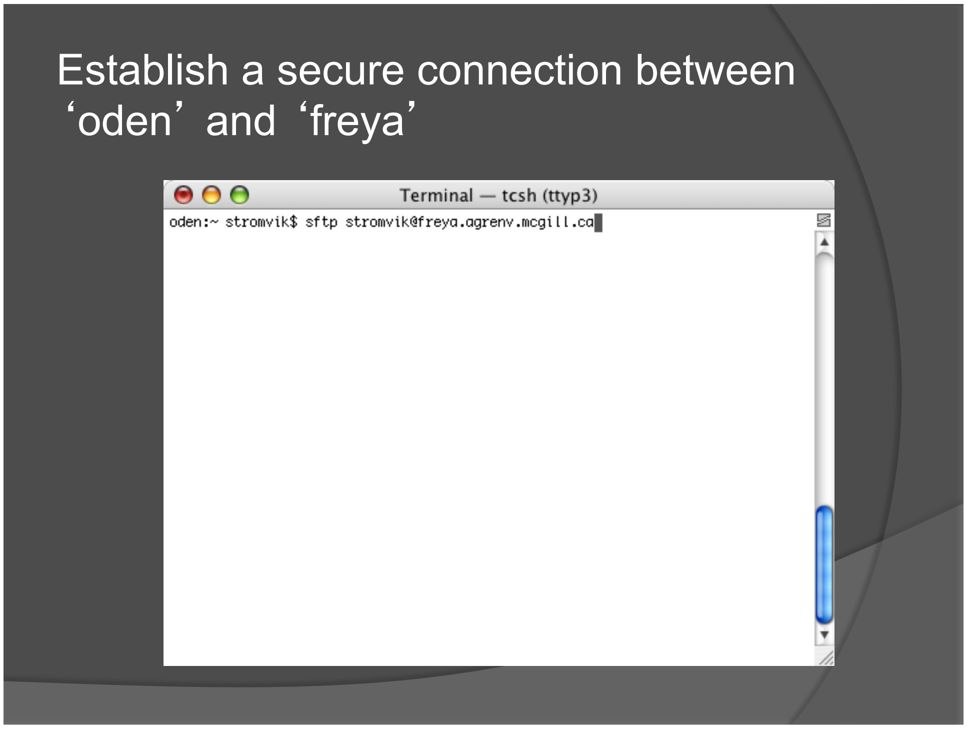
File Transfer Protocol (FTP)

- An electronic, non-email way of sending files from one computer to another
- Commandline or different interfaces
- Either way - specify binary or ASCII format!
- (BTW, you can send email commandline if the permissions are right)



Secure File Transfer - sftp using a unix terminal window

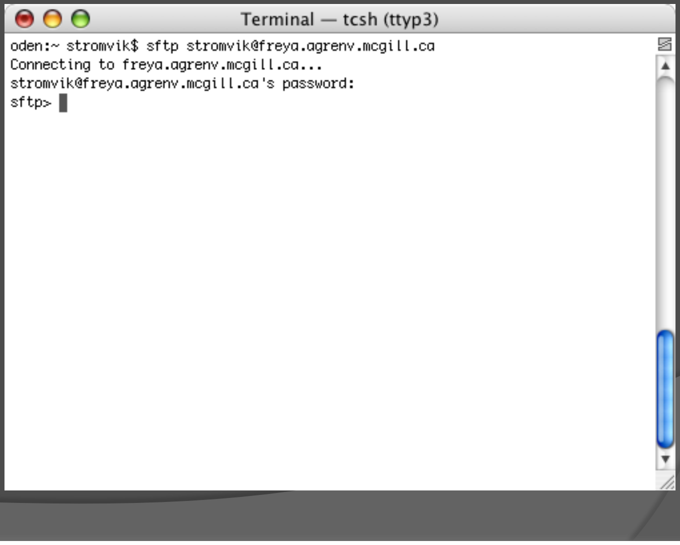
```
oden:~ stromvik$
```



Establish a secure connection between ‘oden’ and ‘freya’

```
oden:~ stromvik$ sftp stromvik@freya.agrenv.mcgill.ca
```

You now talk with Both machines using the program sftp



```
oden:~ stromvik$ sftp stromvik@freya.agrenv.mcgill.ca
Connecting to freya.agrenv.mcgill.ca...
stromvik@freya.agrenv.mcgill.ca's password:
sftp> █
```

Some commands in common between sftp and unix shell

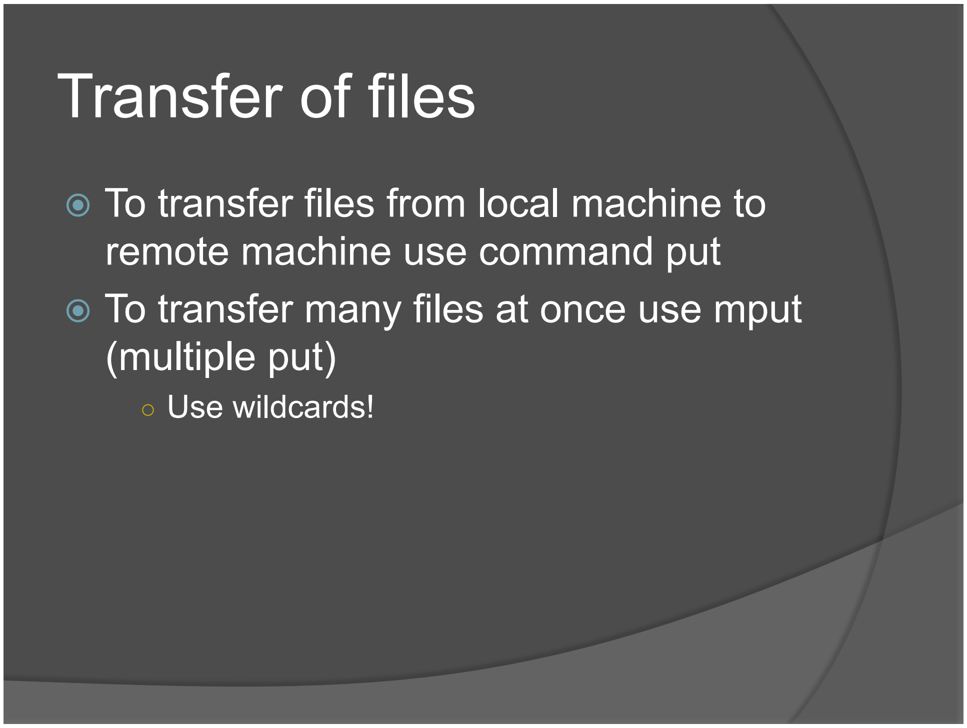
- To list the working dir on remote machine = ls
- To list the working dir on the local machine = lls

Some commands in common with unix

- To print remote working dir = pwd
- To print local working dir = lpwd

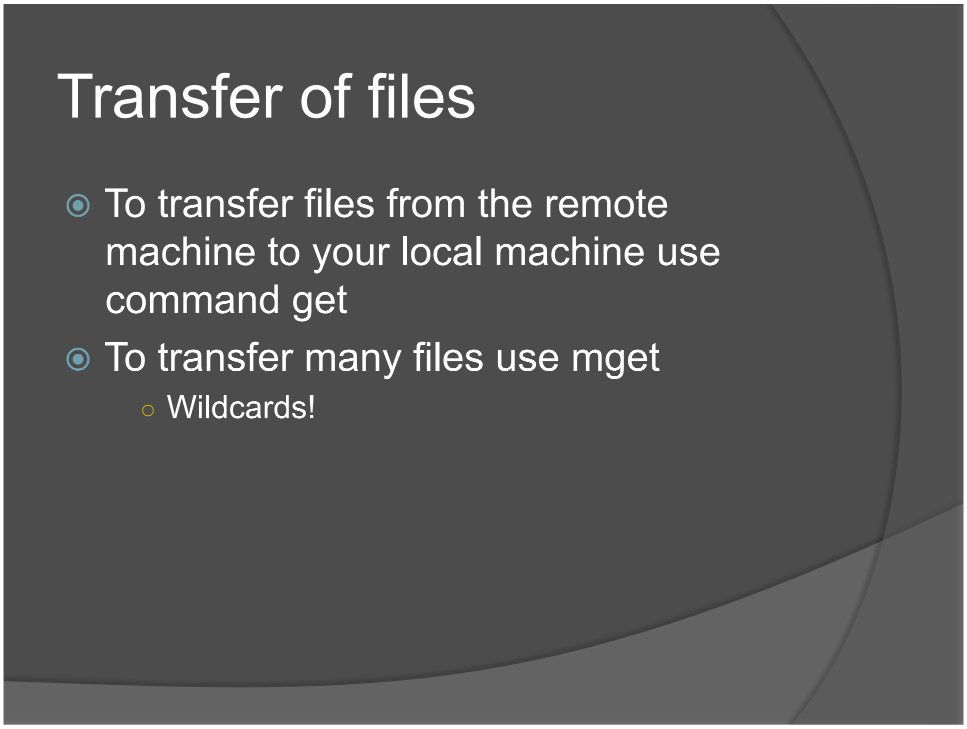
Some commands in common with unix

- To change dir remotely = cd
- To change dir locally = lcd



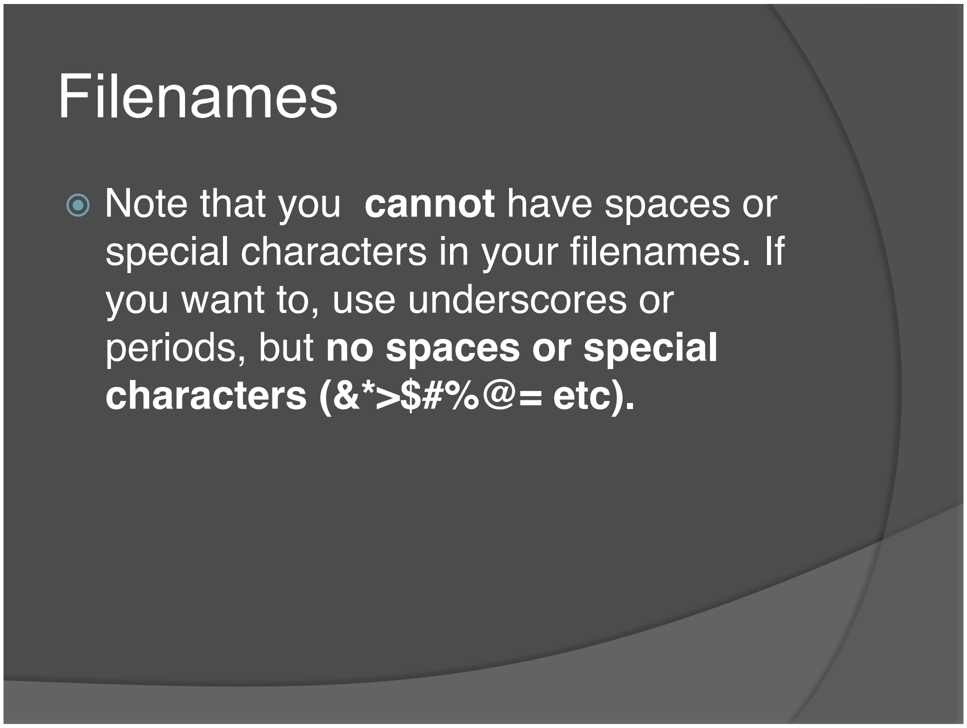
Transfer of files

- To transfer files from local machine to remote machine use command put
- To transfer many files at once use mput (multiple put)
  - Use wildcards!



Transfer of files

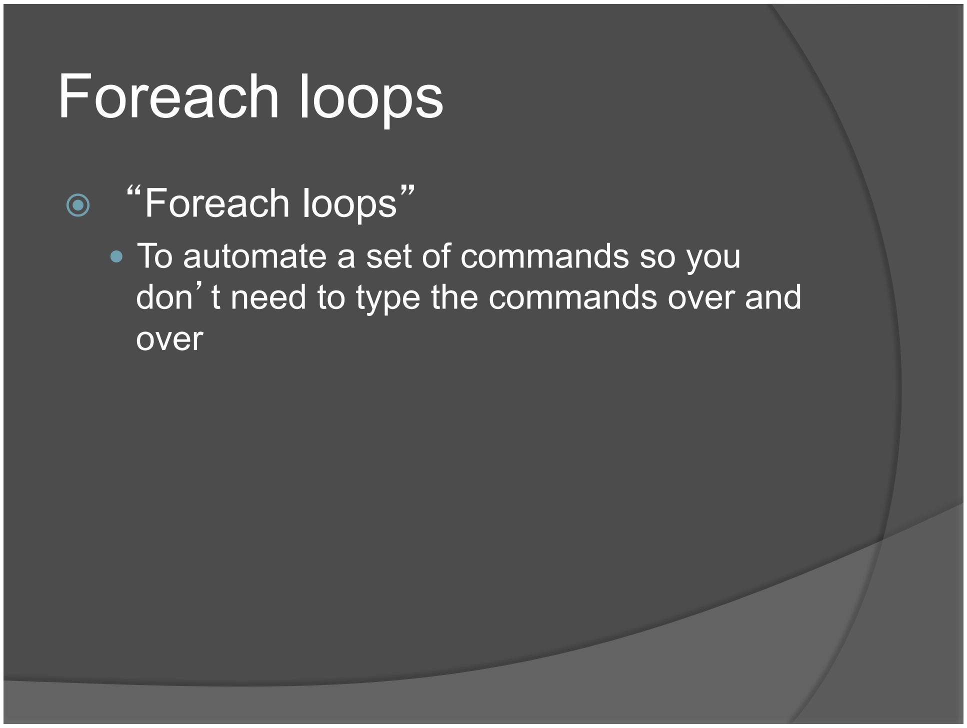
- To transfer files from the remote machine to your local machine use command get
- To transfer many files use mget
  - Wildcards!



Filenames

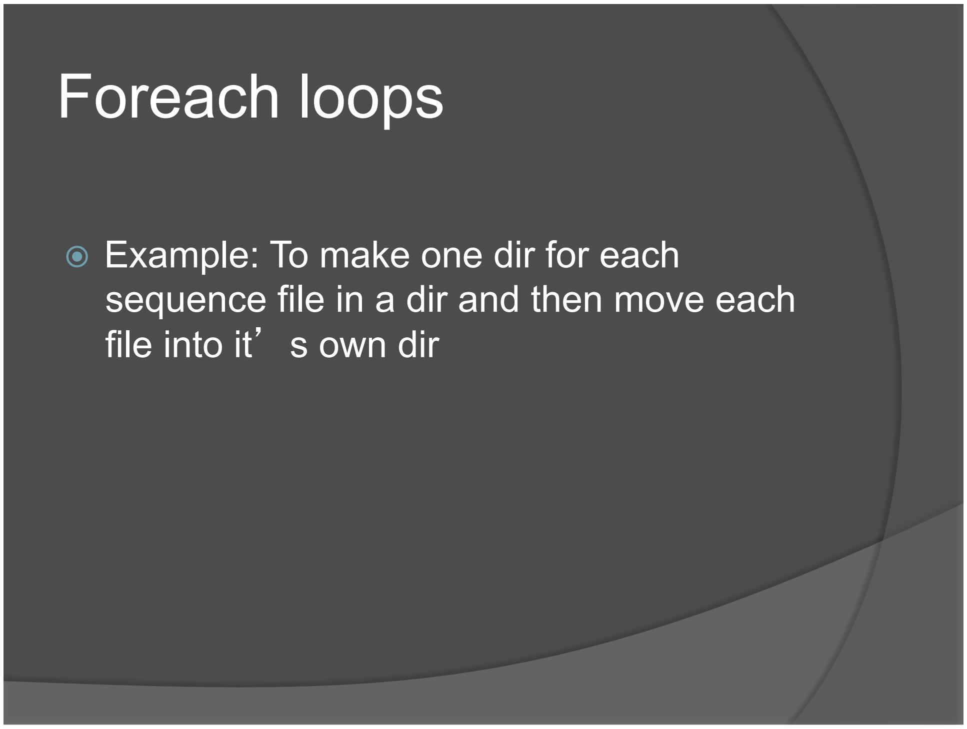
- Note that you **cannot** have spaces or special characters in your filenames. If you want to, use underscores or periods, but **no spaces or special characters (&*>$#%@= etc).**

SHELL SCRIPTS



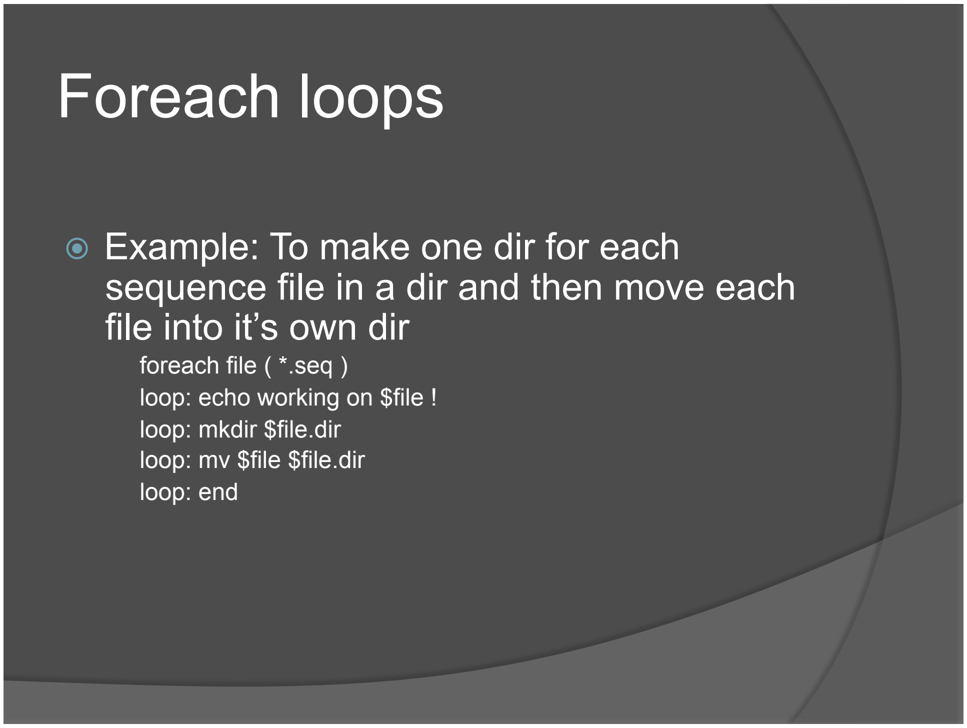
Foreach loops

- "Foreach loops"
  - To automate a set of commands so you don' t need to type the commands over and over



Foreach loops

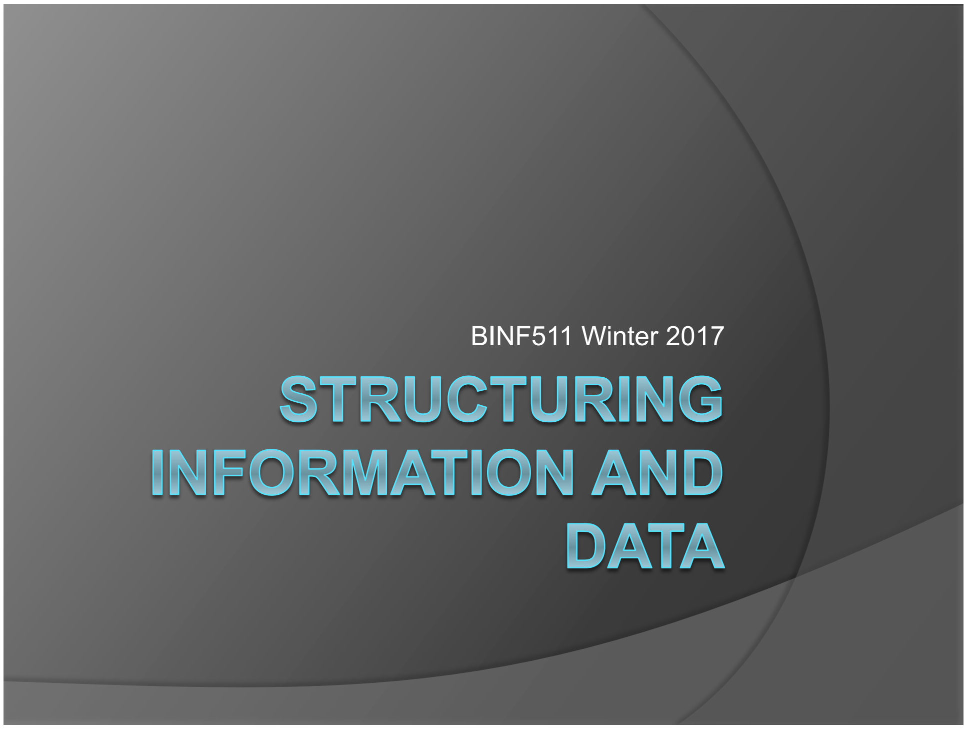
- Example: To make one dir for each sequence file in a dir and then move each file into it' s own dir



Foreach loops

- Example: To make one dir for each sequence file in a dir and then move each file into it’s own dir

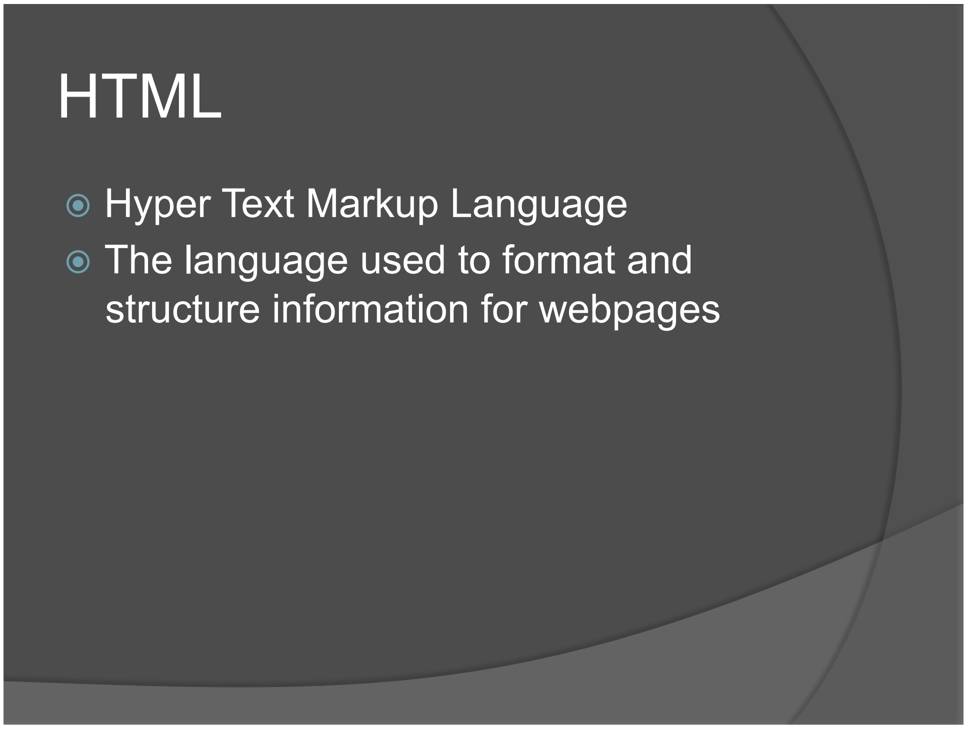
```
foreach file ( *.seq )
loop: echo working on $file !
loop: mkdir $file.dir
loop: mv $file $file.dir
loop: end
```



BINF511 Winter 2017

STRUCTURING INFORMATION AND DATA

HTML



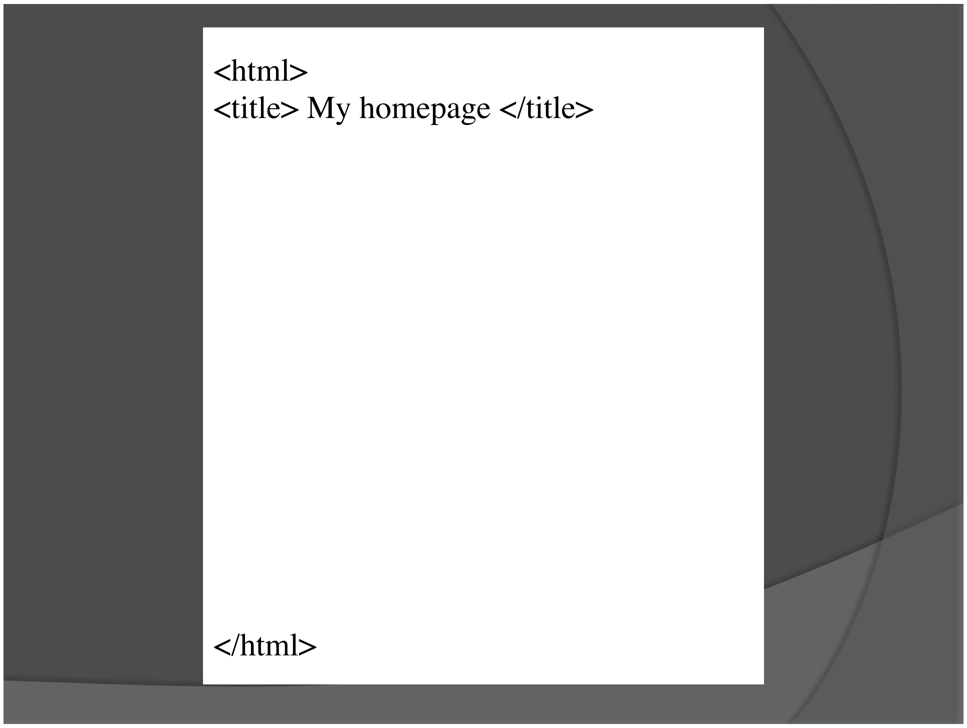
HTML

- Hyper Text Markup Language
- The language used to format and structure information for webpages

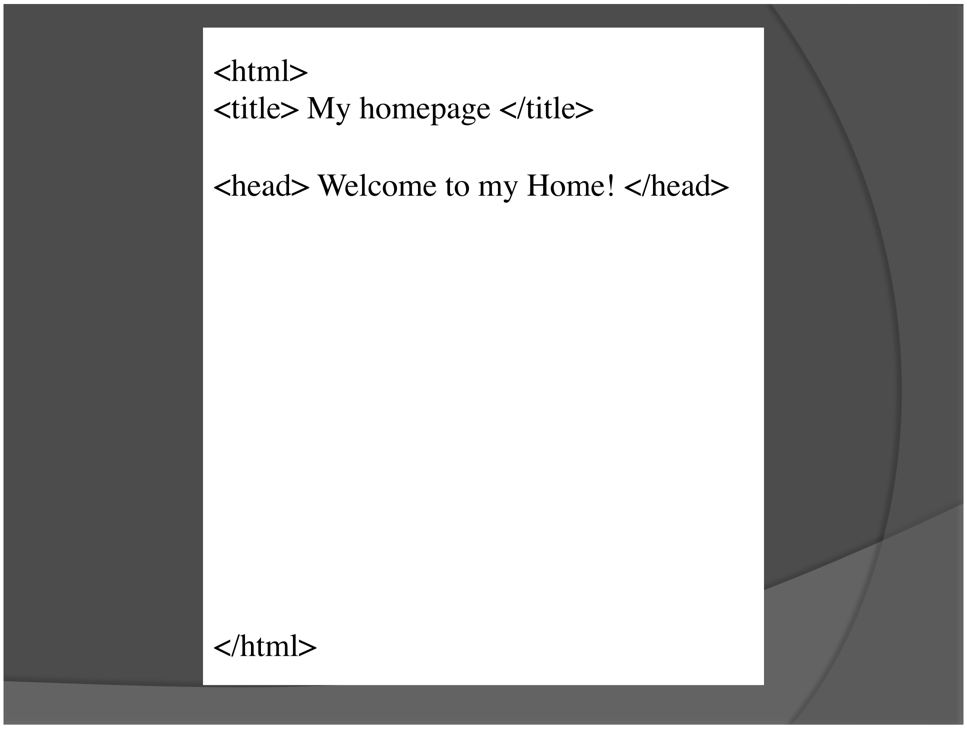
HTML

- Hyper Text Markup Language
- The language used to format and structure information for webpages
- HTML tags - everything is ordered within tags
- Use file suffix .html or .htm
- To interpret, you use a browser
  - Internet Explorer, Netscape, Mozilla, Safari

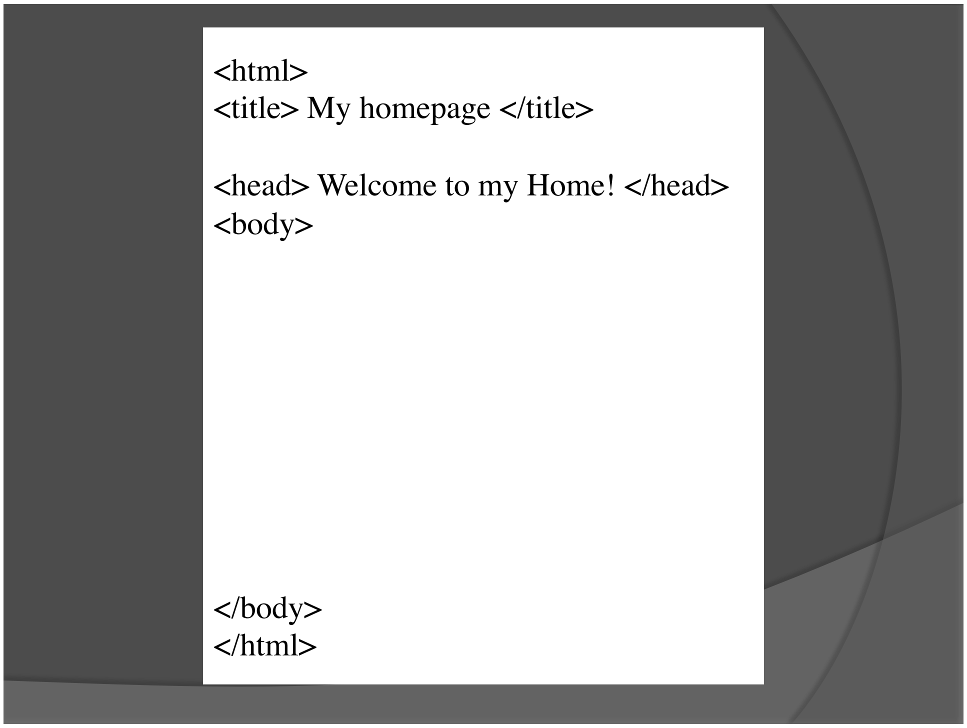
```
<html>



</html>
```



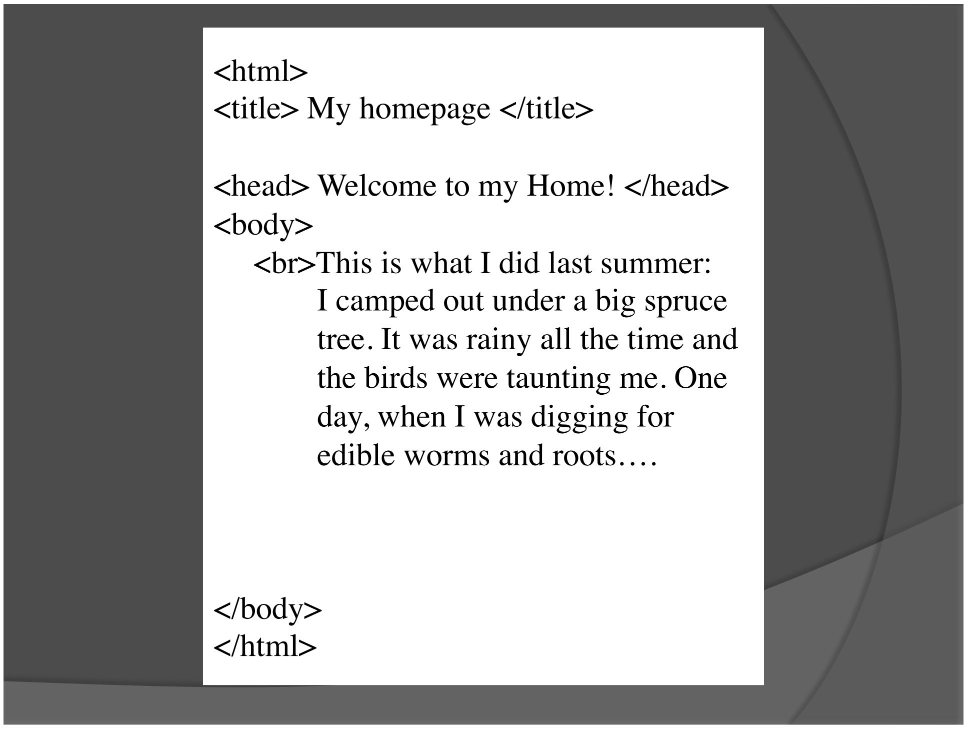
```
<html>
<title> My homepage </title>







</html>
```



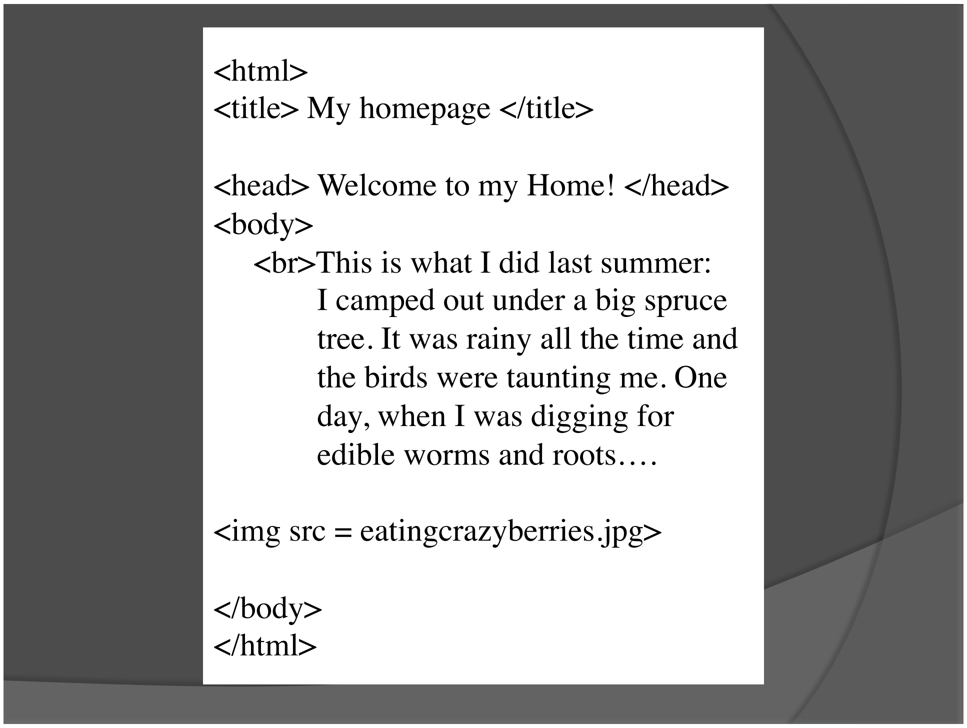
```
<html>
<title> My homepage </title>

<head> Welcome to my Home! </head>






</html>
```



```
<html>
<title> My homepage </title>

<head> Welcome to my Home! </head>
<body>









</body>
</html>
```

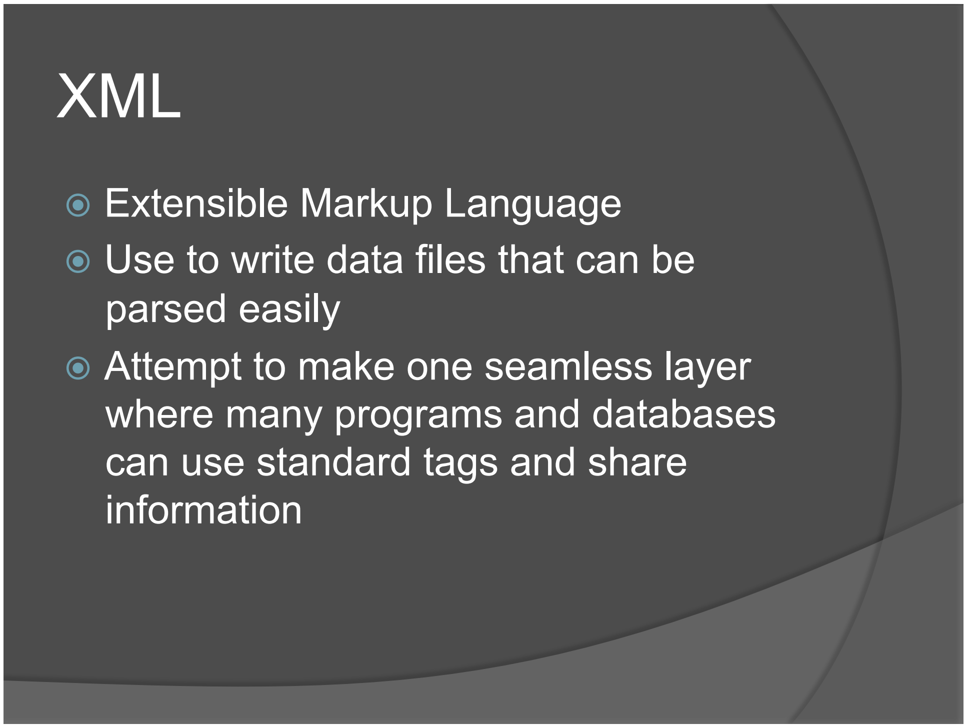


```
<html>
<title> My homepage </title>

<head> Welcome to my Home! </head>
<body>
   <br>This is what I did last summer:
        I camped out under a big spruce
        tree. It was rainy all the time and
        the birds were taunting me. One
        day, when I was digging for
        edible worms and roots….



</body>
</html>
```



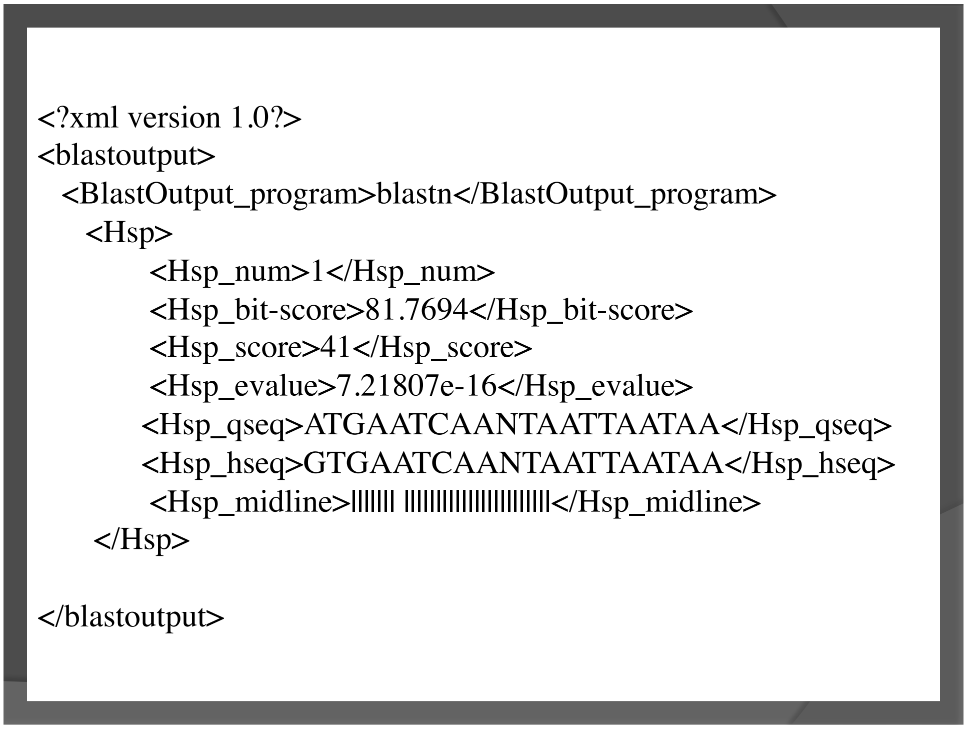
```
<html>
<title> My homepage </title>

<head> Welcome to my Home! </head>
<body>
    <br>This is what I did last summer:
          I camped out under a big spruce
          tree. It was rainy all the time and
          the birds were taunting me. One
          day, when I was digging for
          edible worms and roots….

<img src = eatingcrazyberries.jpg>

</body>
</html>
```

XML

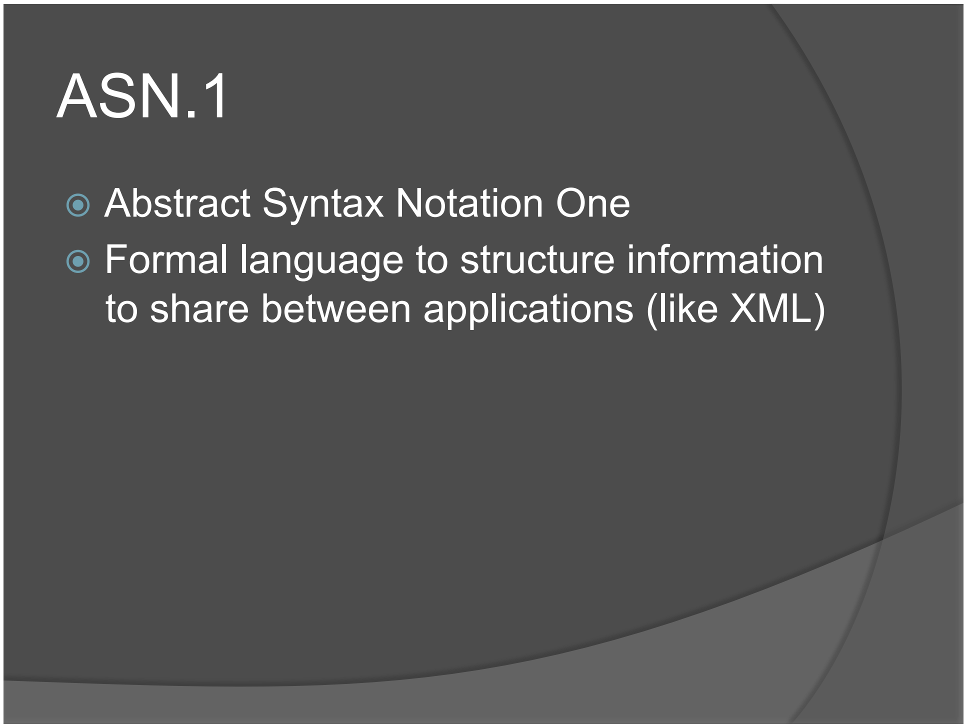


XML

- Extensible Markup Language
- Use to write data files that can be parsed easily
- Attempt to make one seamless layer where many programs and databases can use standard tags and share information

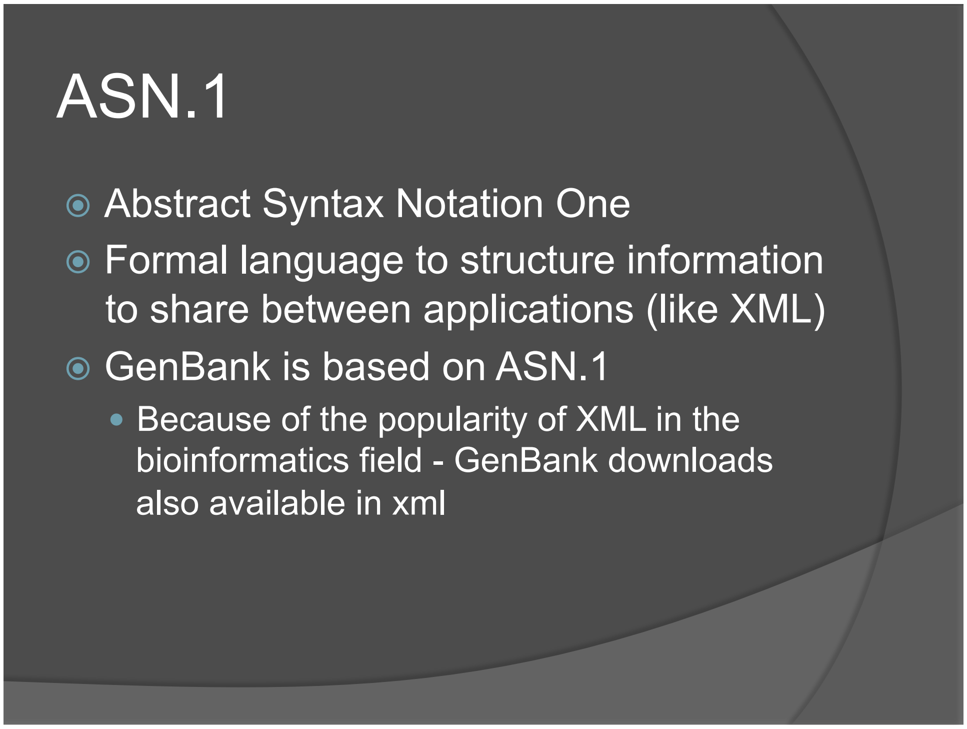


```
<?xml version 1.0?>
<blastoutput>
  <BlastOutput_program>blastn</BlastOutput_program>
    <Hsp>
          <Hsp_num>1</Hsp_num>
          <Hsp_bit-score>81.7694</Hsp_bit-score>
          <Hsp_score>41</Hsp_score>
          <Hsp_evalue>7.21807e-16</Hsp_evalue>
         <Hsp_qseq>ATGAATCAANTAATTAATAA</Hsp_qseq>
         <Hsp_hseq>GTGAATCAANTAATTAATAA</Hsp_hseq>
          <Hsp_midline>||||||| |||||||||||||||||||||||</Hsp_midline>
     </Hsp>

</blastoutput>
```



ASN.1

- Abstract Syntax Notation One
- Formal language to structure information to share between applications (like XML)



ASN.1

- Abstract Syntax Notation One
- Formal language to structure information to share between applications (like XML)
- GenBank is based on ASN.1
  - Because of the popularity of XML in the bioinformatics field - GenBank downloads also available in xml