Workshop 1: **Introduction to UNIX command-line**

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Swiss Army knife" set of tools

Day 1

pwd - report your current directory

cd *<to where>* - change your current directory

ls *<directory>* -list contents of directory

cp *<old file> <new file>* - copy file

cp –r *<old dir> <new dir>* - copy a directory and its contents

mv *<old file/dir> <new file/dir>* - move (or rename)

rm *<file>* -delete a file

rm –r <dir> - remove a directory and its contents

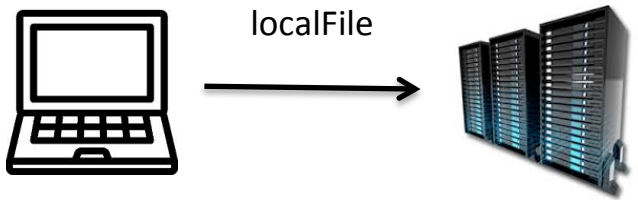
mkdir *<new directory name>* -make a directory

W1-files

- W-files are on the workshop page
- Please download w1-files on your laptop
- Copy the w1-files.zip to hoffman2

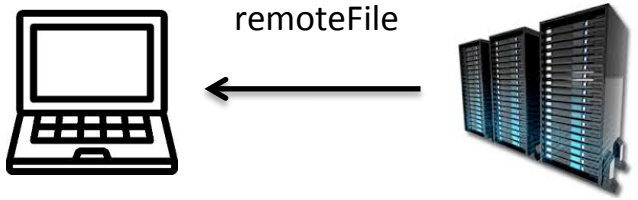
Remote copying : scp

File located on the laptop, in the current directory




```
scp <localFile>  user@hoffman2.idre.ucla.edu:<path>
```

Where on the cluster <localFile> will be copied




```
scp user@hoffman2.idre.ucla.edu:<path>/<remoteFile> ./
```

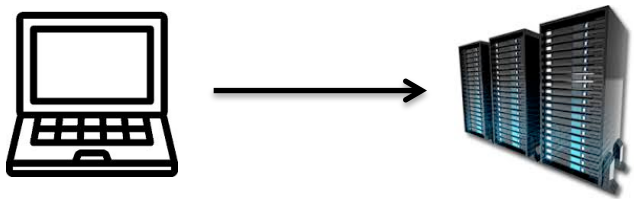
File located on the cluster, in the <path> directory

Run scp from the local session of the terminal. To open a local session :

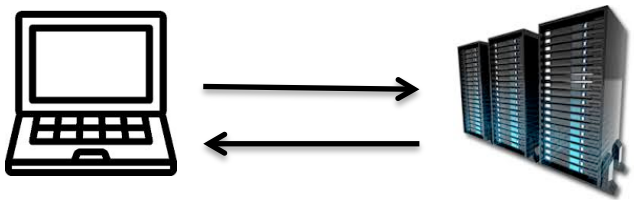
- Control-T to open a new tab
- New tab be default corresponds to a local session

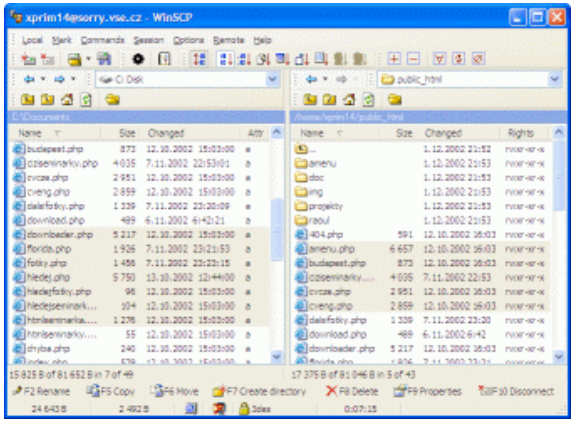
Copy the working files

- `[Sergheis-MacBook-Air]$ scp` **`w1-files.zip`** `serghei@hoffman2.idre.ucla.edu:~`
- `serghei@hoffman2.idre.ucla.edu's password:`



Microsoft Windows





Winscp

Alias

- Go to home directory : `cd`
- Open file .bash_profile: `vi .bash_profile`
- Add in the end of the file:

- `alias hoffman2='ssh serghei@hoffman2.idre.ucla.edu'`

- Restart the session

Run from the local session of the terminal. To open a local session : **Control-T**

Relative vs. absolute path

- A file or a directory can be referred to by
  - Relative path
    - `../test.txt` **if you are at** `/u/home/s/serghei/test/new/`
  - Absolute path
    - `/u/home/s/serghei/test/test.txt`

```
[serghei@login2 test]$ less ./test.txt
[serghei@login2 test]$ ls -l ../
[serghei@login2 test]$ ls -l ~/
```

Relative

Absolute

245 Highland Ave, Manhattan Beach, California 90266

File permissions

- Each file in Unix has an associated permission level
- This allows the user to prevent others from reading/writing/executing their files or directories
- Use "ls -l *filename*" to find the permission level of that file
- There are 3 kinds of people in the world: you (user), your friends (group) and
  the world (others).

Permission levels

- “**r**” means “read only” permission
- “**w**” means “write” permission
- “**x**” means “execute” permission
  - In case of directory, “**x**” grants permission to list directory contents

File Permissions

```
-rw-r--r-- 1 serghei eeskin   72 Mar 11 14:22 large.txt
-rw-r--r-- 1 serghei eeskin  263 Mar 11 15:18 new.tar
-rw-r--r-- 1 serghei eeskin   13 Mar 11 15:27 test.txt
drwxr-xr-x 2 serghei eeskin 4096 Mar 11 15:36
dfgdfgdfgdfgdfgdfgdfgdf
```

Type

User (you)

File Permissions

```
-rw-r--r-- 1 serghei eeskin   72 Mar 11 14:22 large.txt
-rw-r--r-- 1 serghei eeskin  263 Mar 11 15:18 new.tar
-rw-r--r-- 1 serghei eeskin   13 Mar 11 15:27 test.txt
drwxr-xr-x 2 serghei eeskin 4096 Mar 11 15:36
dfgdfgdfgdfgdfgdfgdfgdf
```

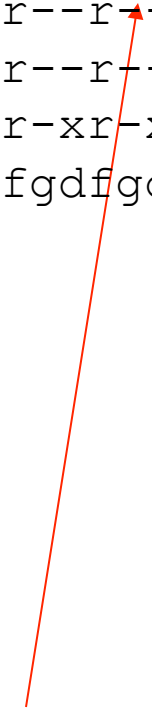
Type

Group

File Permissions

```
-rw-r--r-- 1 serghei eeskin   72 Mar 11 14:22 large.txt
-rw-r--r-- 1 serghei eeskin  263 Mar 11 15:18 new.tar
-rw-r--r-- 1 serghei eeskin   13 Mar 11 15:27 test.txt
drwxr-xr-x 2 serghei eeskin 4096 Mar 11 15:36
dfgdfgdfgdfgdfgdfgdfgdf
```

Type



“The World”

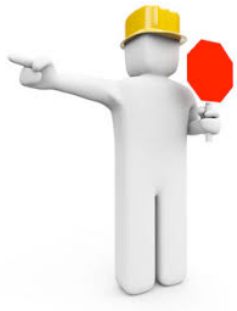
Command: chmod

- If you own the file, you can change it's permissions with "chmod"
  - Syntax:

```
chmod [user/group/others/all]+-[permission] [file(s)]
```

```
[serghei@login2 test]$ ls -l
drwxr-xr-x 3 serghei eeskin 4096 Mar 11 15:23 archive
-rw-r--r-- 1 serghei eeskin   72 Mar 11 14:22 large.txt
-rw-r--r-- 1 serghei eeskin  263 Mar 11 15:18 new.tar
-rw-r--r-- 1 serghei eeskin   13 Mar 11 15:27 test.txt
[serghei@login2 test]$ chmod g+w large.txt
[serghei@login2 test]$ ls -l
drwxr-xr-x 3 serghei eeskin 4096 Mar 11 15:23 archive
-rw-rw-r-- 1 serghei eeskin   72 Mar 11 14:22 large.txt
-rw-r--r-- 1 serghei eeskin  263 Mar 11 15:18 new.tar
-rw-r--r-- 1 serghei eeskin   13 Mar 11 15:27 test.txt
```

Redirection



- `program_a`
  - display program_a's output at the terminal
- `program_a > file.txt`
  - program_a's output is written to file.txt
  - "`>`" will **overwrite** any existing data in file.txt
- `program_a < input.txt`
  - program_a gets its input from a file called "input.txt"
- `program_a >> file.txt`
  - program_a's output is **appended** to the end of file.txt

Let's practice!

```
[serghei@login4 test]$ wc -l large.txt
25 large.txt
[serghei@login4 test]$ wc -l large.txt >f_ls.txt
[serghei@login4 test]$ ls >f_ls.txt
[serghei@login4 test]$ head large.txt  >>f_ls.txt
```

Pipeline

pipe character

- `program_a | program_b`
  - program_a's output becomes program_b's input
  - Analogous to

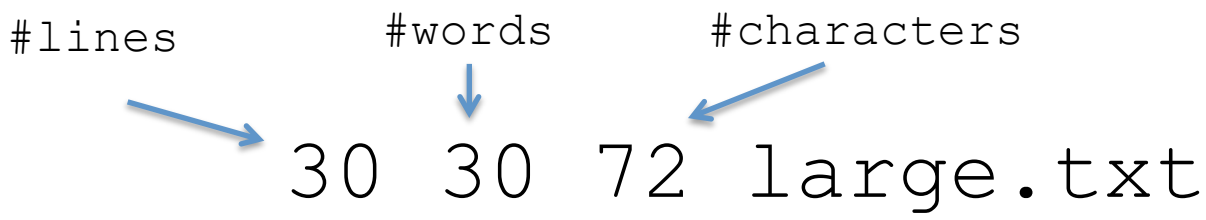
```
program_a > temp.txt
program_b < temp.txt
```

Command: **wc**

- To count the characters, words, and lines in a file use **wc**

```
wc <filename>
```

  - The first column in the output is lines, the second is words, and the last is characters
  - **-l** to count the lines



Let's practice!

```
[serghei@login2 ~]$ wc test.log
1  3 15 test.log
[serghei@login2 ~]$ wc -l test.log
1 test.log
[serghei@login2 ~]$ ls | wc -l
5
```

Command : **cat**

- Concatenate files together and displayed in the terminal.

```
cat <file1> <file2> …
```

```
[serghei@login2 test]$ cat large.txt test.log | wc -l
21
[serghei@login2 test]$ cat large.txt test.log >all.txt
```

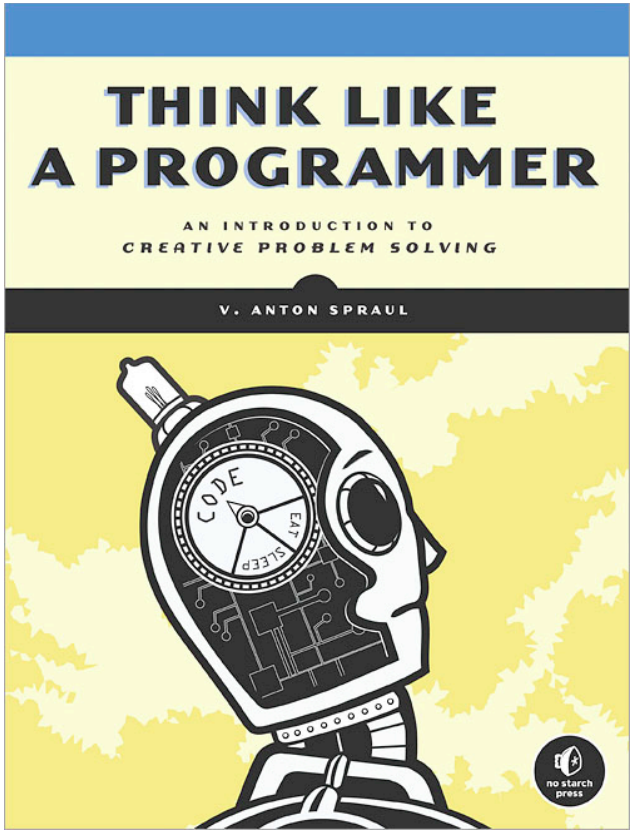
Directory

Find

- find new -name test.txt -type f –print

File

Tools for processing text files



Command : **grep**

- allows to search one file or multiple files for lines that contain a certain string
- **grep** options
  - lines not containing the selected string (-v)
  - line numbers where the string occurs (-n)
  - number of lines containing the string (-c)
  - filenames where the string occurs (-l)
  - makes the match case-insensitive (-i)

Grep syntax treats the first argument as the pattern and the rest as filenames

Let's practice!

```
[serghei@login4 test]$ grep "1" large.txt
1
10
…
19
[serghei@login4 test]$ grep -n "1" large.txt
1:1
10:10
…
19:19
[serghei@login4 test]$ grep -c "1" large.txt
13
[serghei@login4 test]$ grep -l "1" large.txt test.txt
large.txt
[serghei@login4 test]$ grep "1" large.txt test.txt
large.txt:1
large.txt:10
…
```

Alternative?

Grep syntax treats the first argument as the pattern and the rest as filenames

Lines corresponding to chr2

```
[serghei@login4 test]$ grep "chr2" hg19.gtf > chr2.txt
[serghei@login4 test]$ tail –n 1 chr2.txt
chr21  hg19_knownGene   CDS 33066517  33066602  0.000000
    gene_id "uc002ypd.2"; transcript_id "uc002ypd.2";
```

Regular Expression

- A **regular expression** is a string that can be used to describe several sequences of characters.

regular expression → **c k s**

UNIX Tools rocks.

match

UNIX Tools sucks.

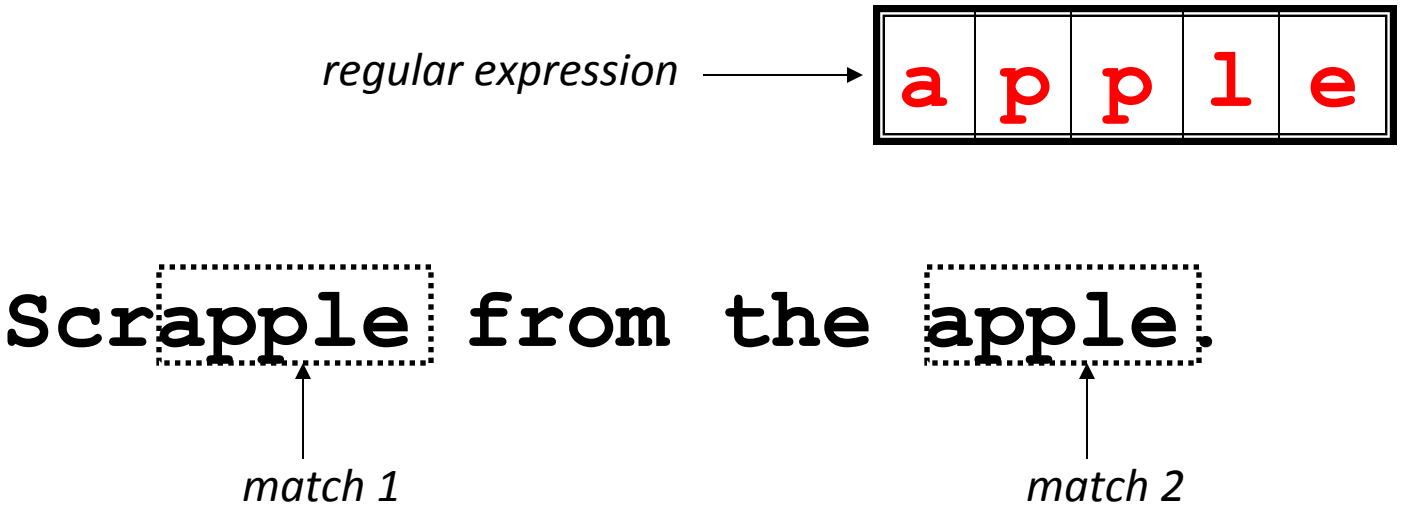
match

UNIX Tools is okay.

no match

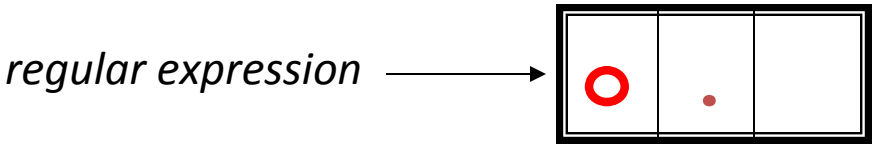
Regular Expressions

- A regular expression can match a string in more than one place.



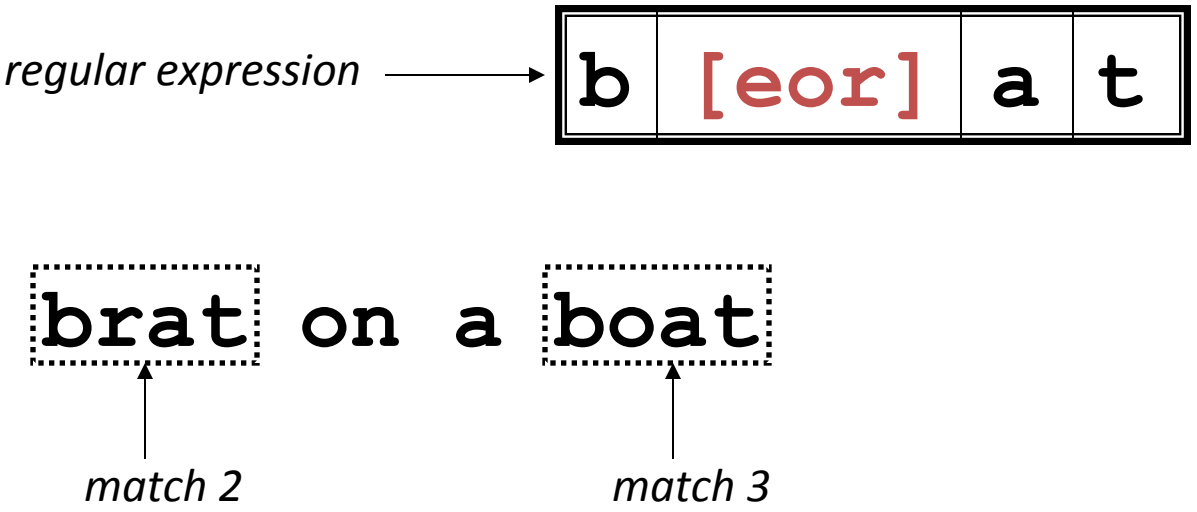
Regular Expressions

- The . regular expression can be used to match any character.



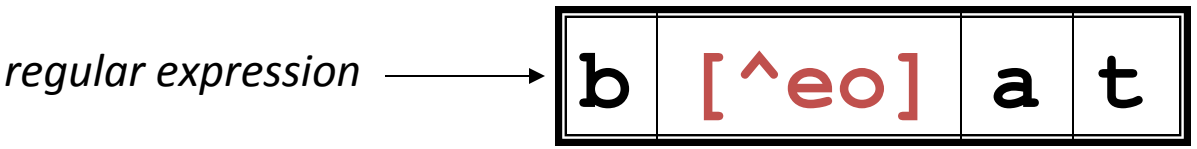
Character Classes

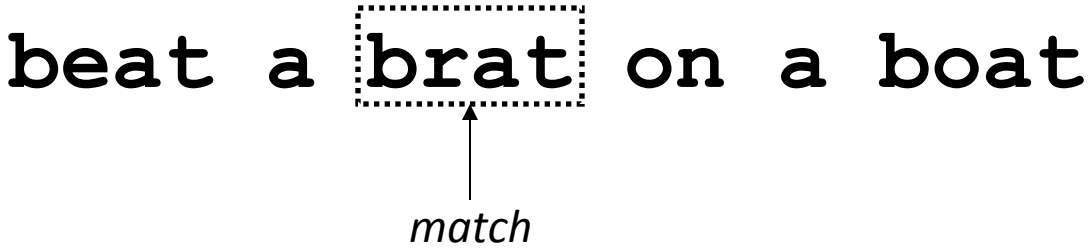
- Character classes [] can be used to match any specific set of characters.



Negated Character Classes

- Character classes can be negated with the [^] syntax.





Let's practice!

```
[serghei@login4 test]$ grep "b[eor]at" regex.txt
[serghei@login4 test]$ grep "b.at” regex.txt
[serghei@login4 test]$ grep "b[^eor]at" regex.txt
[serghei@login4 test]$ grep "b[^eor]" regex.txt
```

More About Character Classes

  - **[aeiou]** will match any of the characters **a**, **e**, **i**, **o**, or **u**
  - **[kK]orn** will match **korn** or **Korn**
- Ranges can also be specified in character classes
  - **[1-9]** is the same as **[123456789]**
  - **[abcde]** is equivalent to **[a-e]**
  - You can also combine multiple ranges
    - **[abcde123456789]** is equivalent to **[a-e1-9]**
  - Note that the **-** character has a special meaning in a character class ***but only*** if it is used within a range, **[-123]** would match the characters **-**, **1**, **2**, or **3**

Alphanumeric characters

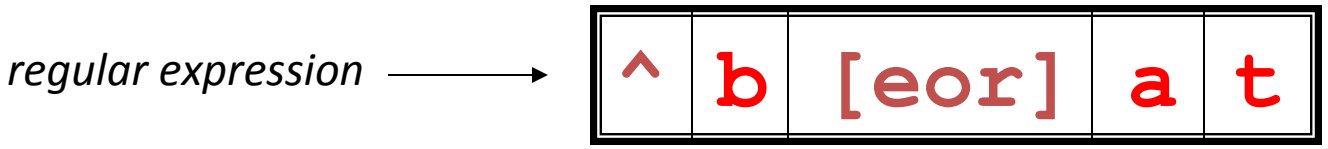
- Alphabetic characters
  - [a-zA-Z]
  - **[[:alpha:]]**
- Digits
  - **[0-9]**
  - [[:digit:]]
- Alphanumeric characters
  - [a-zA-Z0-9]
  - **[[:alnum:]]**

Anchors

- Anchors are used to match at the beginning or end of a line (or both).

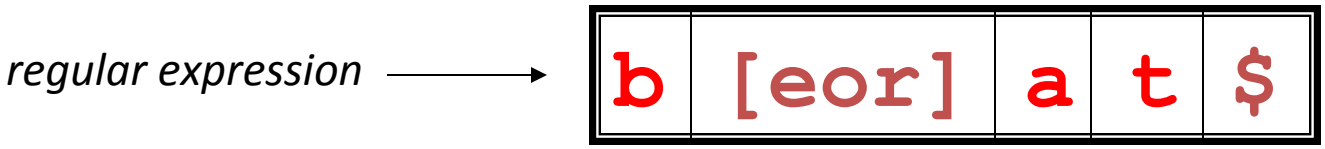
^ means beginning of the line

$ means end of the line



beat a brat on a boat

match



beat a brat on a boat

match

---

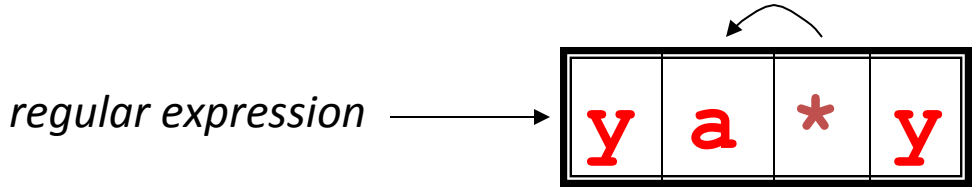
^word$ ^$

Let's practice!

```
grep "[Aa]1" regex2.txt
grep "^[Aa]1" regex2.txt
grep "[Aa][0-9]$" regex2.txt
grep  "[0-9]" regex2.txt
grep "[[:alnum:]]" regex2.txt
grep  "[[:alpha:]]" regex2.txt
grep  "[[:alpha:]]" regex2.txt
```

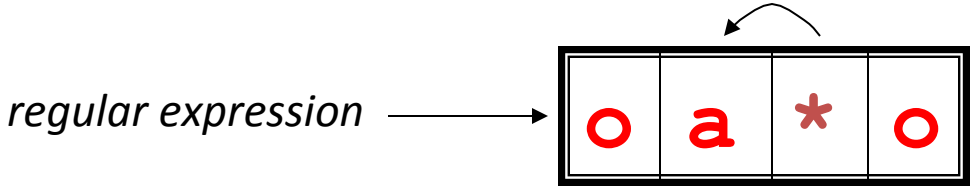
Repetition operators

- The * (asterisk) matches the zero or more occurrences of the **preceding** character



I got mail, yaaaaaaaaaay!

match



For me to poop on.

match

.*

Repetition operators

*****	Zero or more...
?	Zero or one... (i.e. optional element)
+	One or more...
{x}	x instance of...
{x,y}	between x and y instances of...
{x,}	at least x instances of...
r1|r2	regular expressions r1 or r2

-E

```
grep -E <pattern> <filename>
```

Special characters

- **\s** space
- **\t** tab
- **\s+** many spaces
- **\t\t** two adjacent tabs

Let's practice!

```
grep -E "a1|b1" regex2.txt
grep  "[ab]1" regex2.txt
```

Alternative

Lines corresponding to chr2

```
grep "chr2\s" hg19.gtf > chr2.gtf
```

Repetition operators

- If you want to group part of an expression so that * or { } applies to more than just the previous character, use ( ) notation
- Subexpresssions are treated like a single character
  - **a*** matches 0 or more occurrences of **a**
  - **abc*** matches **ab**, **abc**, **abcc**, **abccc**, …
  - **(abc)*** matches **abc**, **abcabc**, **abcabcabc**, …
  - **(abc){2,3}** matches **abcabc** or **abcabcabc**

Let's practice!

```
grep -E "a+" regex2.txt
grep -E "a{3}" regex2.txt
grep -E "a{2,3}" regex2.txt
grep -E "a{2}" regex2.txt
grep -E "(abc)*" regex2.txt
grep -E "(abc)+" regex2.txt
grep -E "(abc){2}" regex2.txt
grep -E "[[:alpha:]]{3}" regex2.txt
grep -E "[[:alpha:]][0-9]{2}" regex2.txt
grep -E "([[:alpha:]][0-9]){2}" regex2.txt
grep -E "[[:alpha:]][0-9]\sa" regex2.txt
```

?

- `grep -E "[0-9]{3}[\s\-]{0,1}[0-9]{3}[\s\-]{0,1}[0-9]{4}" f.txt`

sed : a “**s**tream **ed**itor”

- A non-interactive text editor
- Routine editing tasks
  - find, replace, delete, append, insert
- Input text flows through the program, is modified, and is directed to standard output.

```
sed [options] commands [file-to-edit]
```

Why use **sed**?

- Sed is designed to be especially useful in three cases:
  - files are too large for interactive editing
  - editing is too complicated for regular text editors
  - multiple editing in one pass

sed : Substitute command **s**

```
sed 's/old_word/new_word/’ [file-to-edit]
```

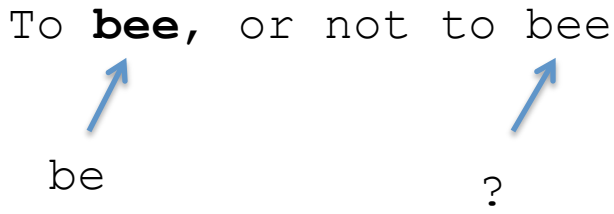
```
To bee, or not to bee
```

```
sed 's/bee/be/‘ file_sed.txt
```

To be, or not to **bee**

sed : **g** - Global replacement

- Normally, substitutions apply to only the first match in the string.



- To apply the substitution to **all** matches in the string use "**g**" options

```
sed 's/bee/be/g' file_sed.txt
```

Edit matched text

- Put parentheses around the matched text:

```
sed 's/<pattern>/(&)/' annoying.txt
```

Let's practice!

To bee, or not to bee

```
vi tobe.txt
sed 's/bee/be/' tobe.txt
To be, or not to bee
sed 's/bee/be/g' tobe.txt
To be, or not to be
```

```
sed  's/seven/nine/g' file_sed.txt | sed 's/nine/two/g'
sed 's/a/o/g' file_sed.txt
sed 's/^and/or/' file_sed.txt
sed 's/s..../xxxxx/g' file_sed.txt
sed 's/ago$/!/' file_sed.txt

sed 's/[12]/3/g' regex2.txt
sed 's/[[:alpha:]]/B/g' regex2.txt
sed -E 's/[[:alnum:]]{2}/(&)/g' regex2.txt
```

Delete lines with sed

- Remove the 3rd line:
  - `sed '3d' fileName.txt`
- Remove the line containing the string "awk":
  - `sed '/awk/d' filename.txt`
- Remove the last line:
  - `sed '$d' filename.txt`

Let’s practice!

```
sed '3d’ regex2.txt
sed '/a/d' regex2.txt
sed '/[0-9]/d' regex2.txt
sed '$d' regex2.txt
```

Summary

file permissions
cat
wc
>, >>, <
pipeline
ln –s
grep
regex