

The Shell



Mats Töpel

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UNIX?

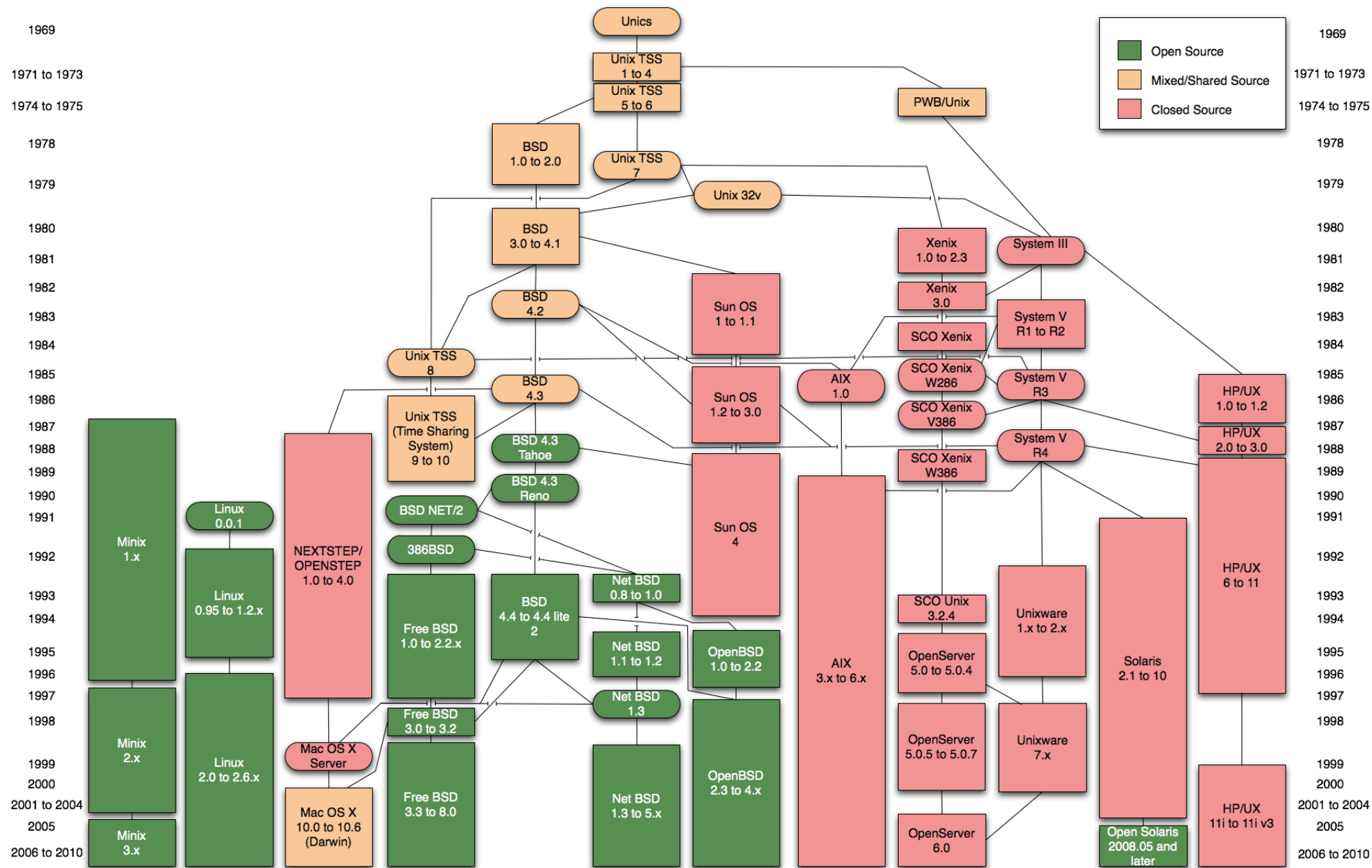


Terminal, shell, GNU/Linux, Mac OSX?

Ken Thompson & Dennis Ritchie



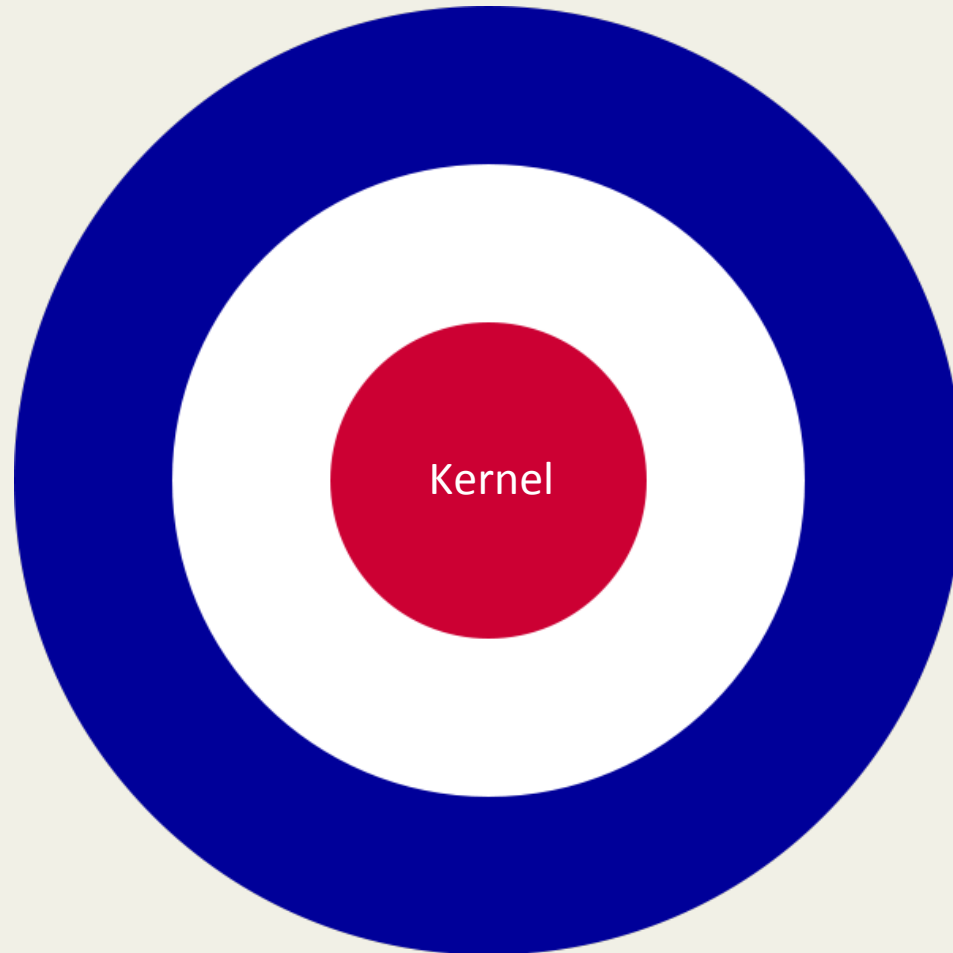
Evolution of UNIX-like systems



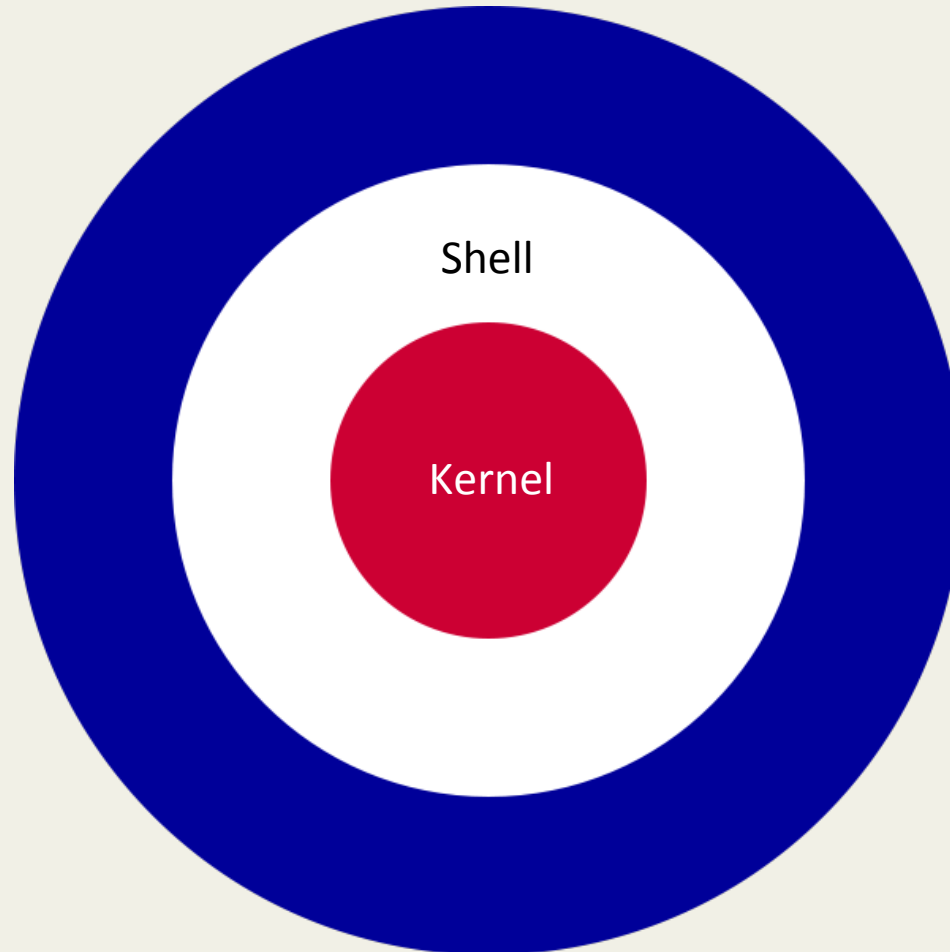
The UNIX system



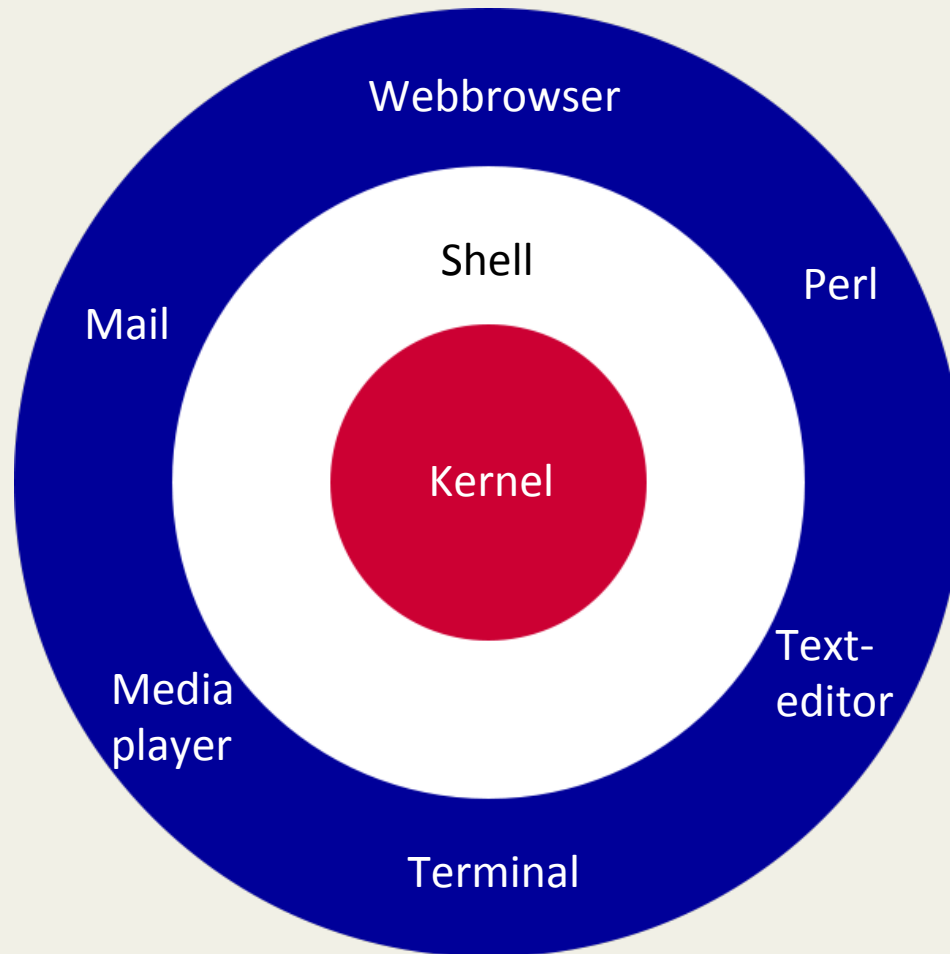
The UNIX system



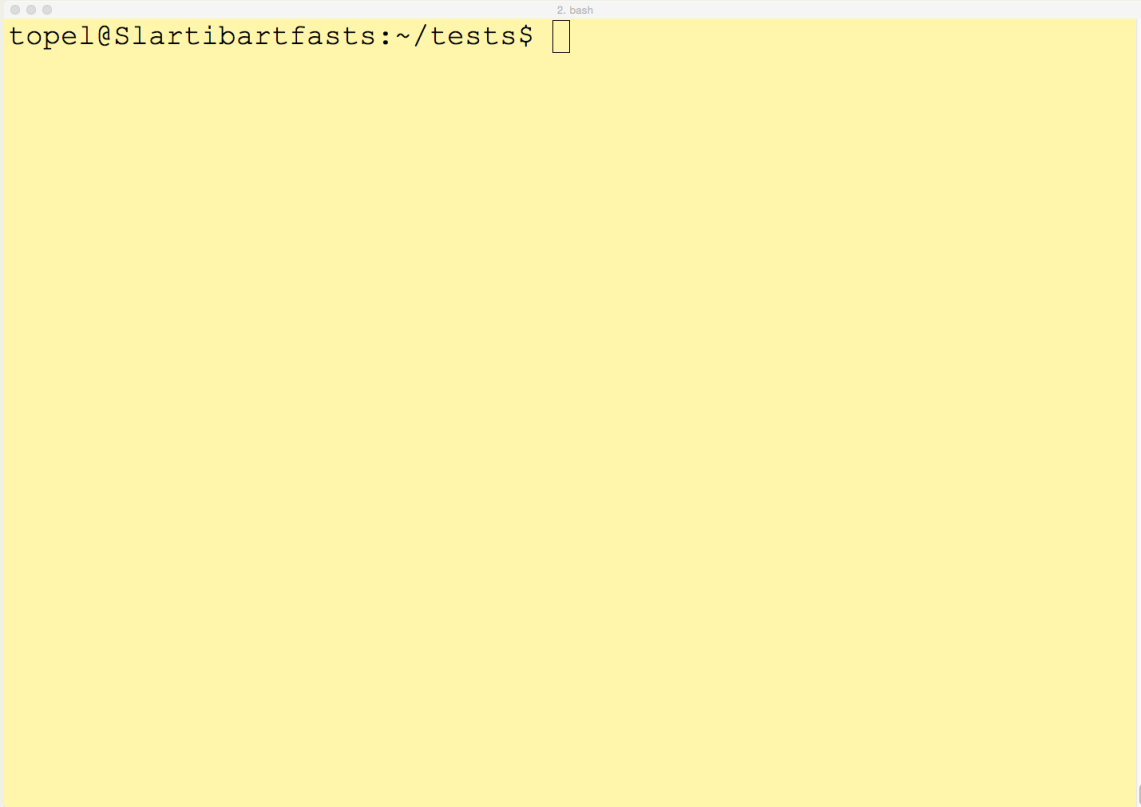
The UNIX system




The UNIX system



(virtual) Terminal vs. shell vs. bash

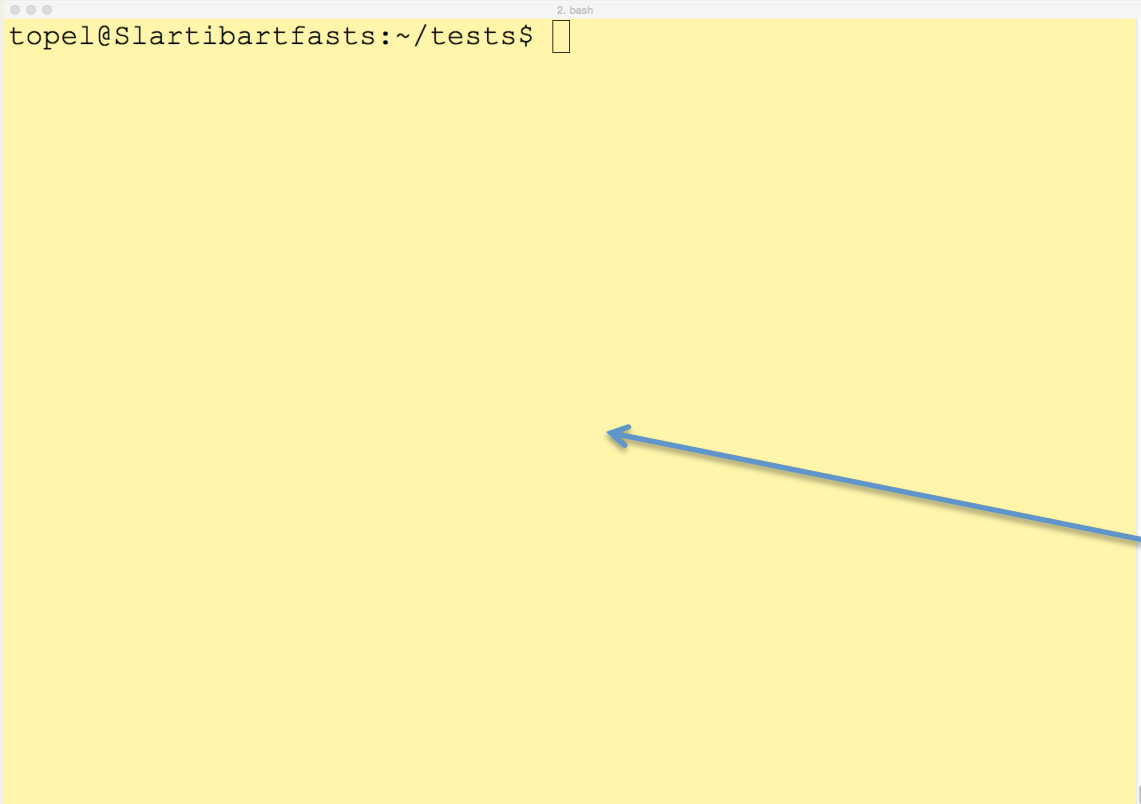


```
topel@Slartibartfasts:~/tests$
```



Terminal window (Graphical
User Interface [GUI] that runs
the shell)
e.g. iTerm, Terminal, Konsole,
gnome-terminal

(virtual) Terminal vs. shell vs. bash

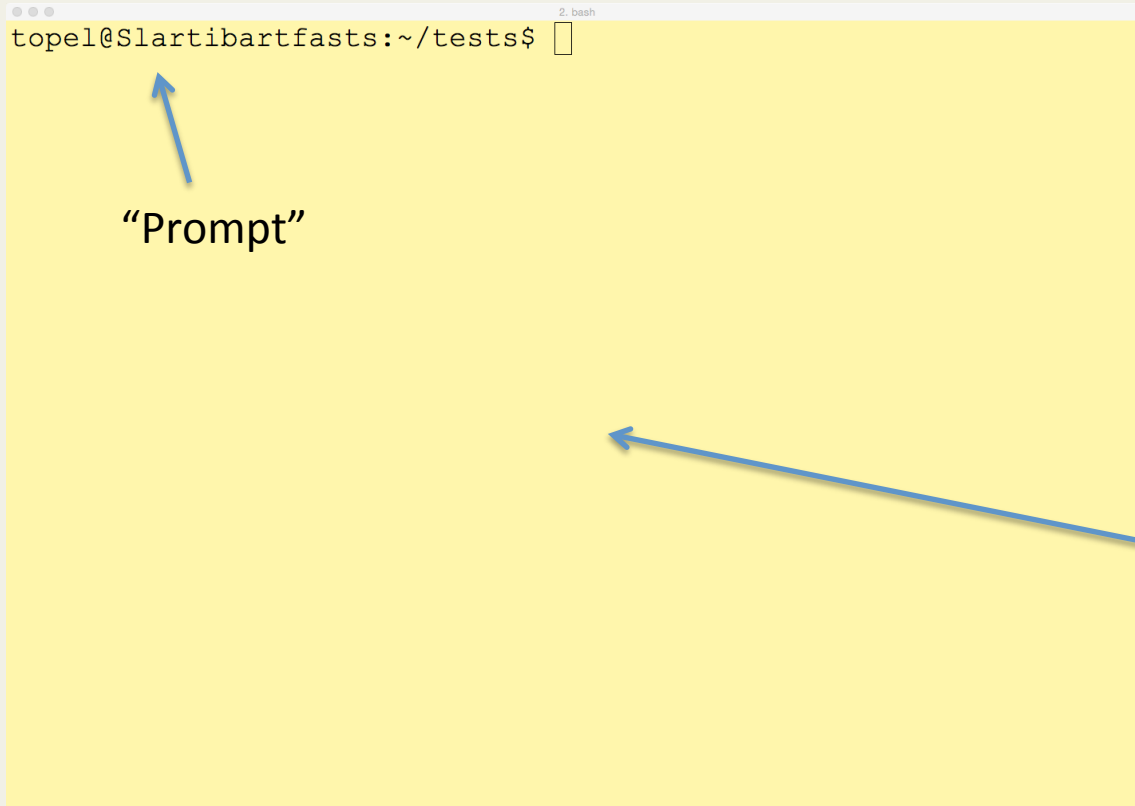


```
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```

Terminal window (Graphical User Interface [GUI] that runs the shell)
e.g. iTerm, Terminal, Konsole, gnome-terminal

The shell (a.k.a Comand Line Interface [CLI]. Program that starts other programs)
e.g. bash, sh, tcsh

(virtual) Terminal vs. shell vs. bash



Terminal window (Graphical User Interface [GUI] that runs the shell)
e.g. iTerm, Terminal, Konsole, gnome-terminal

The shell (a.k.a Comand Line Interface [CLI]. Program that starts other programs)
e.g. bash, sh, tcsh

UNIX.

Why so successful?

UNIX design strategy

- Do one thing and do it good
- Don't be “chatty”

UNIX design strategy

- Do one thing and do it good

ls [List files and directories]

rm [Remove files]

mkdir [Create directories]

wc [Count words, lines and characters]

UNIX design strategy

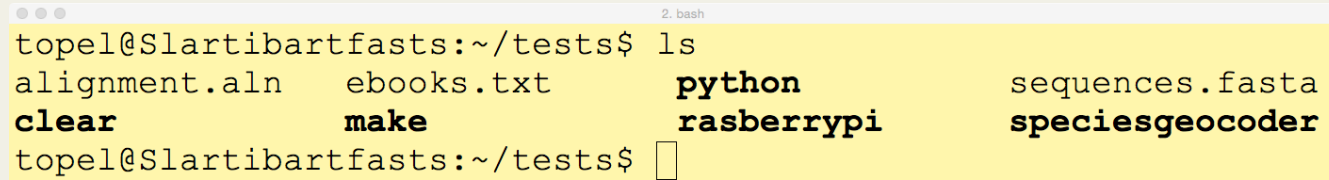
- Do one thing and do it good
- Don't be "chatty"
 - ls [Only outputs the names of files and dir's]
 - rm [Will remove a file without any warning]

UNIX design strategy

- Do one thing and do it good
- Don't be "chatty"
 - ls [Only outputs the names of files and dir's]
 - rm [Will remove a file without any warning]

This behavior can be modified using options a.k.a. "flags"

ls



A terminal window with a yellow background. The title bar shows three window control buttons on the left and the text '2. bash' on the right. The terminal text is as follows:

```
topel@Slartibartfasts:~/tests$ ls
alignment.aln  ebooks.txt      python          sequences.fasta
clear          make            rasperrypi     speciesgeocoder
topel@Slartibartfasts:~/tests$
```

ls -l

```
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drwxr-xr-x  2 topel  staff    68 Aug 31 11:16 clear
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drwxr-xr-x  8 topel  staff   272 May 23  2014 make
drwxr-xr-x  4 topel  staff   136 Jun 12  2014 python
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drwxr-xr-x 24 topel  staff   816 Jul 17  2014 speciesgeocoder
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File permissions (more on this later)

ls -l

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User and group that owns the file

ls -l


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```

File size in bytes

ls -l

```
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Modification date



ls -l

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Filenames



UNIX design strategy

- Do one thing and do it good
- Don't be chatty
- Redirect “>”, append “>>” and pipe “|”

UNIX design strategy

- Do one thing and do it good
- Don't be chatty
- Redirect “>”, append “>>” and pipe “|”
 - > Output from a program can be saved in a new file...

UNIX design strategy

```
ls > my_file.txt
```

UNIX design strategy

- Do one thing and do it good
- Don't be chatty
- Redirect “>”, append “>>” and pipe “|”
 - > Output from a program can be saved in a new file...
 - >> ...or appended to an existing file...

UNIX design strategy

```
ls -la >> my_file.txt
```

UNIX design strategy

```
ls -la >> my_file.txt
```



(append to file)

UNIX design strategy

```
cat my_file.txt
```

(this command will show the content of “my_file.txt”)

UNIX design strategy

- Do one thing and do it good
- Don't be chatty
- Redirect “>”, append “>>” and pipe “|”
 - > Output from a program can be saved in a new file...
 - >> ...or appended to an existing file...
 - | ...or sent to another program.

UNIX design strategy

How many files?

UNIX design strategy

```
ls -a | wc -l
```

UNIX design strategy

How many sequences
in a file?

UNIX design strategy

The fasta file format

>otToc34

MSDEEYSEDEYVSSEGE GAEGRDVEPQAQQAAPVLGPKEWVGLSSMPAATQQALLETLGK
KANAAGEKVVNERPWLTDMVGTMVEMACAKESYEYDHKKAGKKLDPNNKYKIWMLPLFLF
QAFVLRPLMIGQIRRDIRKSDEDKKKKSARPAPKK

>cmToc34

MDSETPTKNEAEQRASPDRTGQVTQRPVSLFRKNGTFAYPLESDVYEEQVLALEDVPEP
TAQAILRLALAAERQGVPRRLFLVVGAPGVGKSSLINTLLNENLCSVSAWERGTKNAQVC
ARQVDSVVIEFIDTPGIAPCRRSGLEASRRQVQRLRKLLDARGADEHPYLRSFHAILYVM
RLDDTRPDLVDYHNWKVLMEFF

UNIX design strategy

The fasta file format

>otToc34

MSDEEYSEDEYVSSEGE GAEGRDVEPQAQQAAPVLGPKEWVGLSSMPAATQQALLETLGK
KANAAGEKVVNERPWLTDMVGTMVEMACAKESYEYDHKKAGKKLDPNNKYKIWMLPLFLF
QAFVLRPLMIGQIRRDIRKSDEDKKKKSARPAPKK

>cmToc34

MDSETPTKNEAEQRASPDRTGQVTQRPVSLFRKNGTFAYPLESDVYEEQVLALEDVPEP
TAQAILRLALAAERQGVPRRLRVVGAPGVGKSSLINTLLNENLCSVSAWERGTKNAQVC
ARQVDSVVIEFIDTPGIAPCRRSGLEASRRQVQRLRKLLDARGADEHPYLRSFHAILYVM
RLDDTRPDLVDYHNWKVLMEFF

UNIX design strategy

```
grep ">" my_seq-file.fst | wc -l
```

UNIX design strategy

grep ">" my_seq-file.fst | wc -l

grep -c ">" my_seq-file.fst

File permissions

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```

File permissions (more on this now)

File permissions

-rwxrwx-r--

File permissions

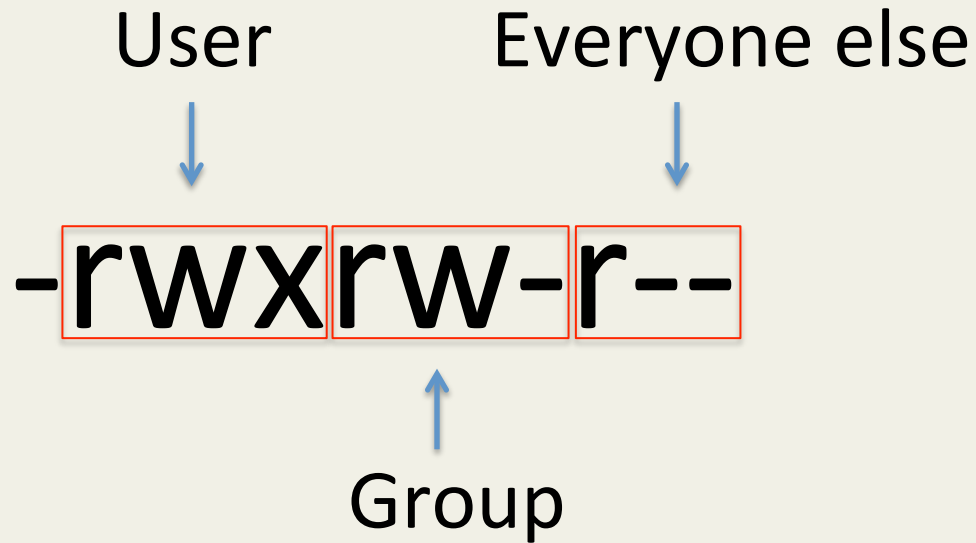
-rwxrwx-r--

r = read

w = write

x = execute

File permissions



r = read

w = write

x = execute

File permissions

**-rwxrwx-r--**

Type (file, link, directory etc.)

r = read

w = write

x = execute

File permissions

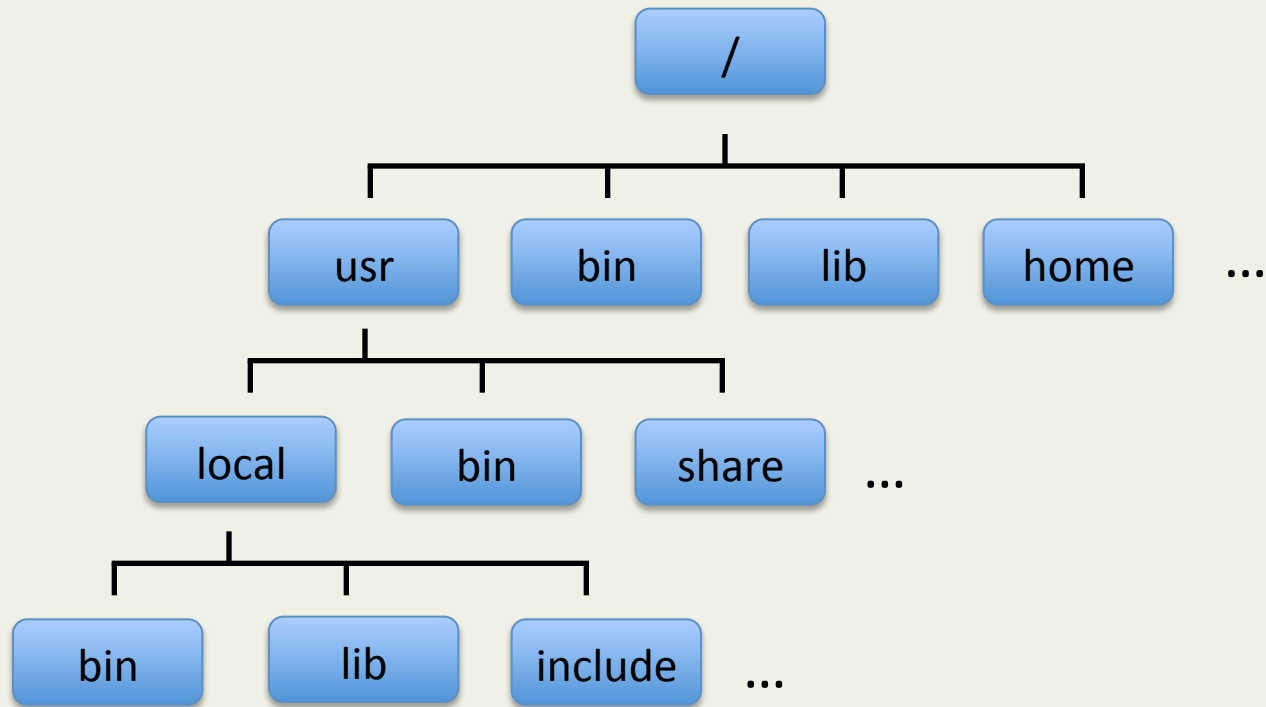
- File permissions can be changed using the command “chmod”

The command...

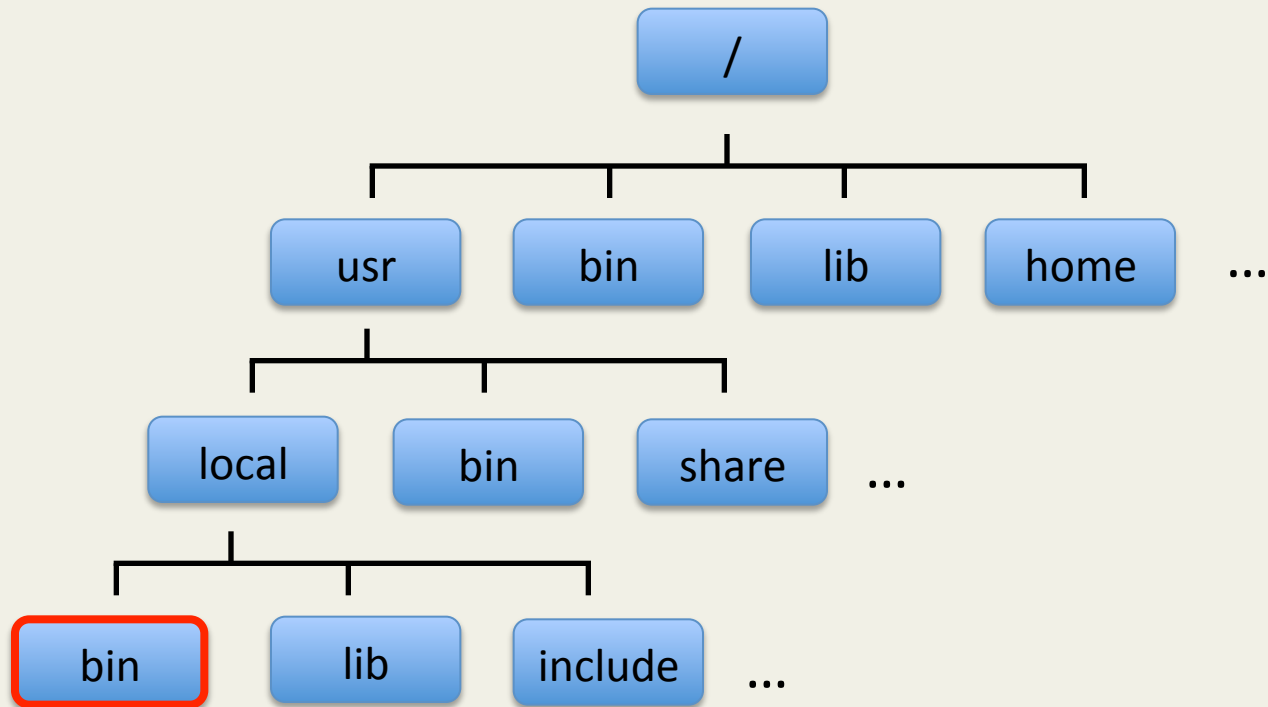
chmod +x my_file.txt

...will make “my_file.txt” executable

UNIX file system

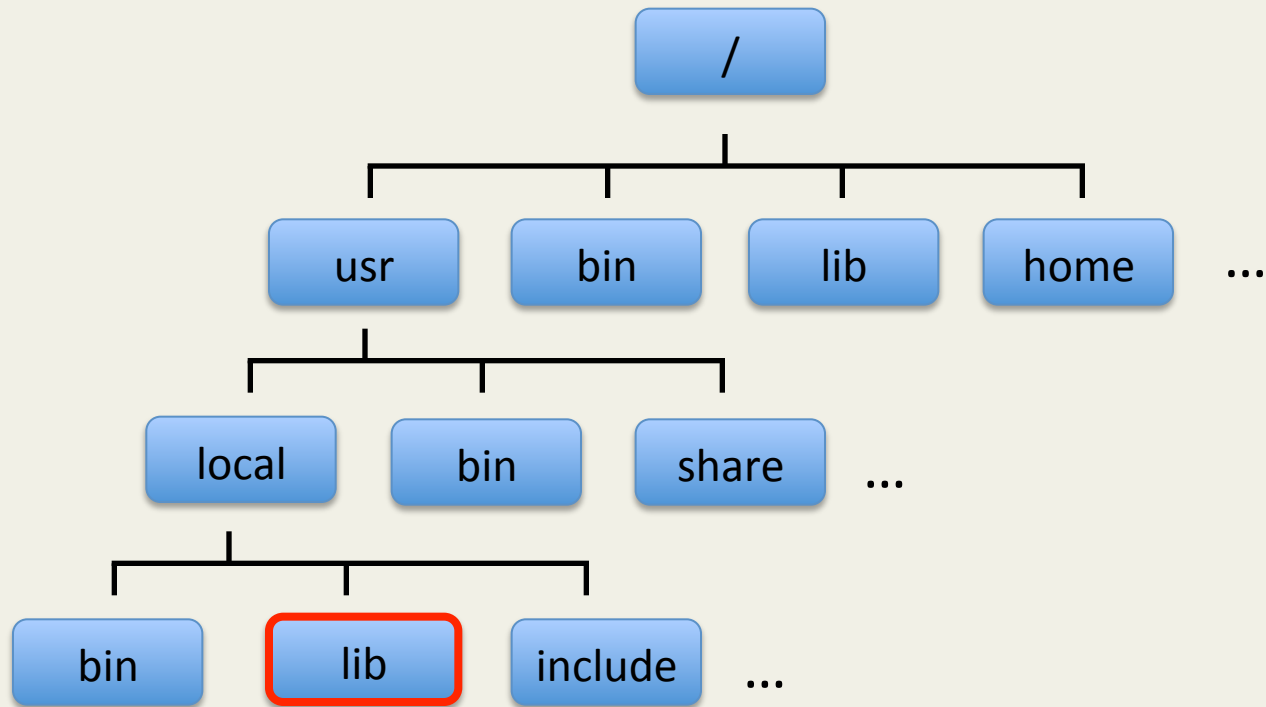


UNIX file system



/usr/local/bin

UNIX file system

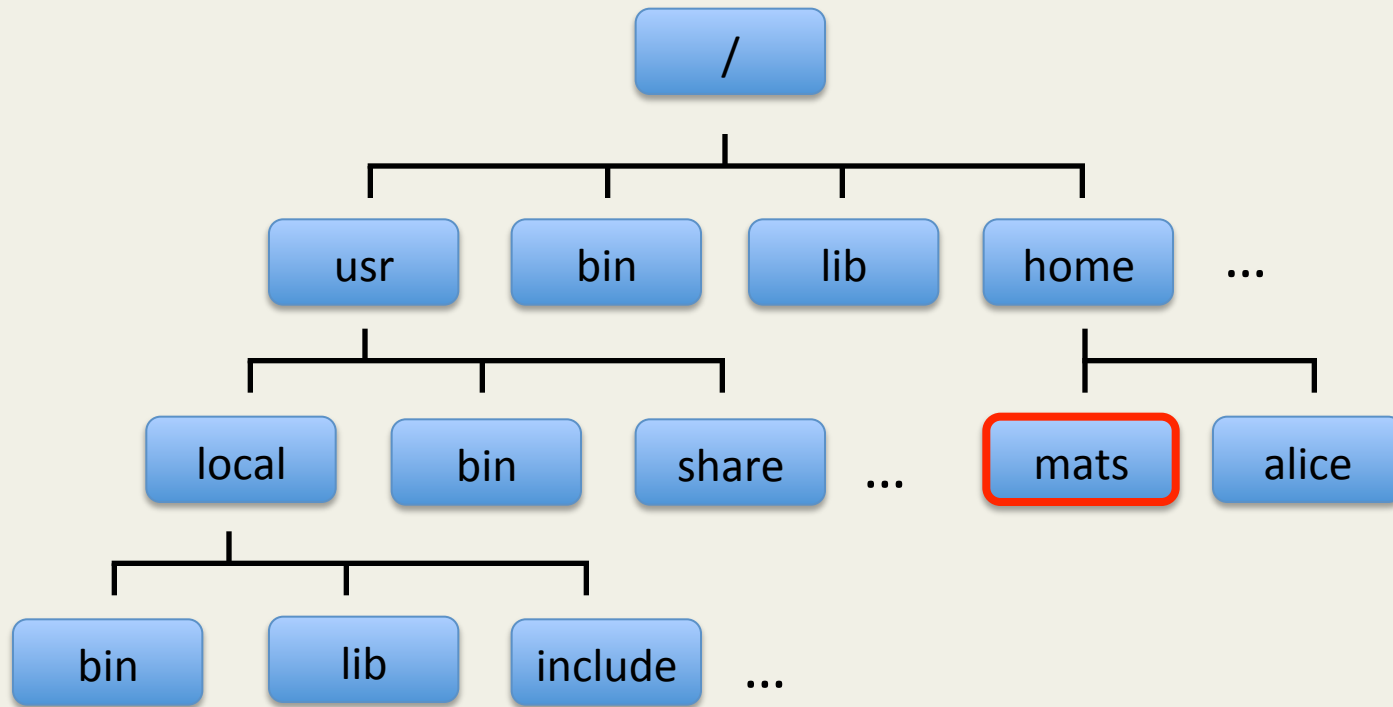


/usr/local/lib

UNIX file system

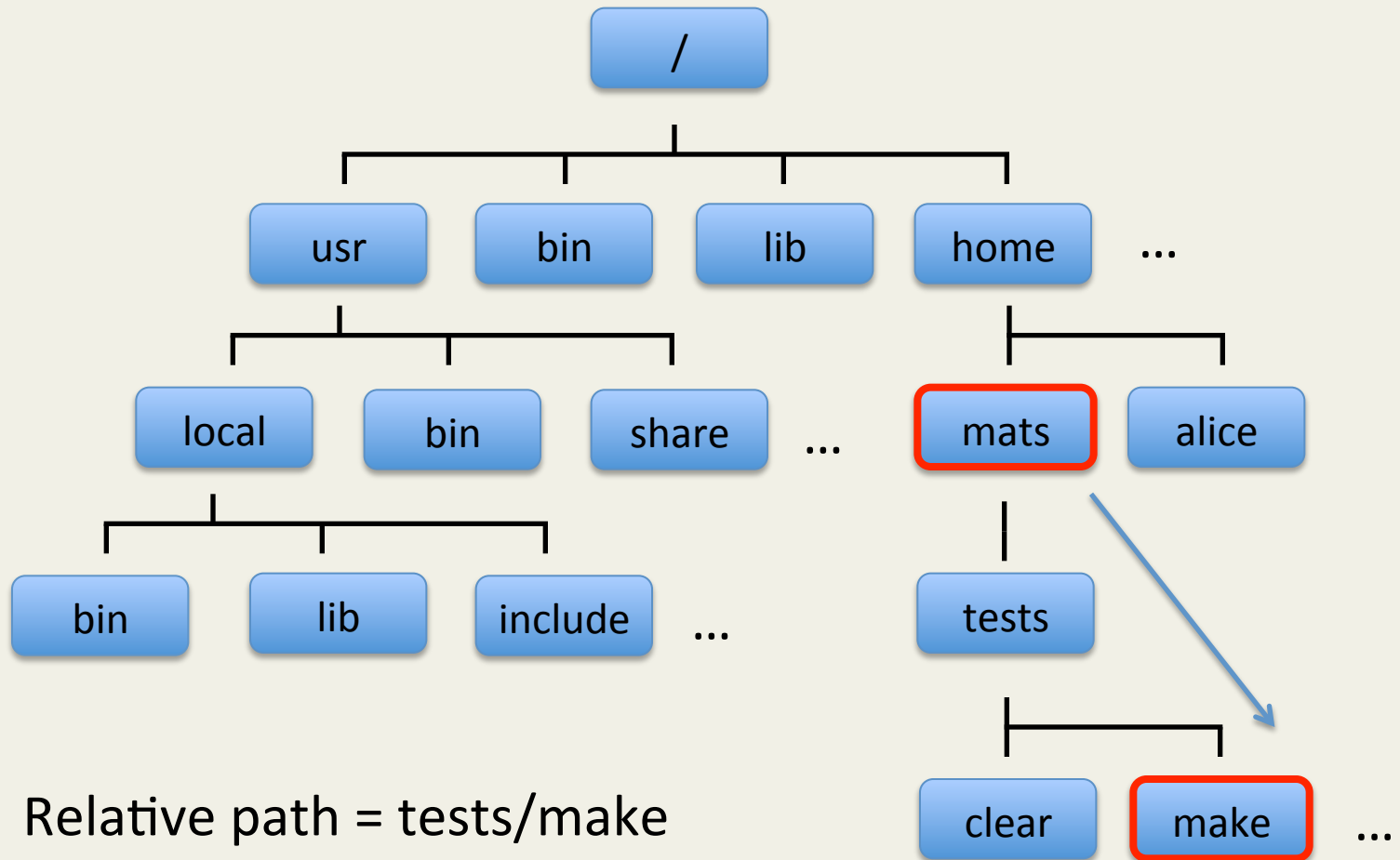
```
cd /usr/local/bin
```


UNIX file system



/home/mats = ~

UNIX file system



UNIX file system

```
cd tests/make
```

cd – Change Directory

Putting it all together!

Writing a program

- A program is a set of instructions collected in a file
- This file is executable
- The file usually contains information about which programming language the instructions are written in (the **shebang**)

how_many_files.sh

1. `#!/bin/bash`
2. `ls -a | wc -l`

covgc_plot.sh

(by Alvar Almstedt)

```
#!/bin/bash
```

```
SMRT_JOB_NUM=$1
```

```
OUT_PREFIX=$2
```

```
echo "Creating symlink and copying assembly..."
```

```
ln -s /data01/smrtanalysis/userdata/jobs/016/$SMRT_JOB_NUM/data/aligned_reads.bam
```

```
cp /data01/smrtanalysis/userdata/jobs/016/$SMRT_JOB_NUM/data/polished_assembly.fasta.gz ./
```

```
echo "Symlink created and assembly copied..."
```

```
gunzip polished_assembly.fasta.gz
```

```
echo "Assembly gunzipped..."
```

```
echo "Commencing generation of coverage file..."
```

```
genomeCoverageBed -ibam aligned_reads.bam -d > $OUT_PREFIX.coverage
```

```
echo "Coverage file generated..."
```

```
echo "Cutting..."
```

```
cut -f 1,3 $OUT_PREFIX.coverage > cut_$OUT_PREFIX.coverage
```

```
echo "Cut made..."
```

```
echo "Launching contig_average_coverage.py..."
```

```
contig_average_coverage.py cut_$OUT_PREFIX.coverage > cut_$OUT_PREFIX.avg.coverage
```

```
echo "Average calculated..."
```

```
echo "Deleting..."
```

```
rm $OUT_PREFIX.coverage
```

```
rm cut_$OUT_PREFIX.coverage
```

```
echo "Intermediary files removed..."
```

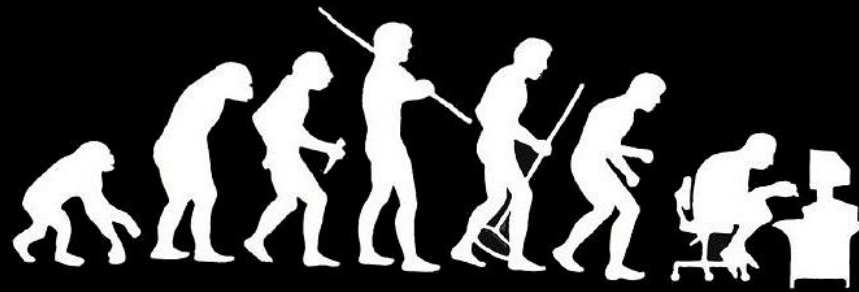
```
echo "Formatting fasta file headers..."
```

```
sed 's/|quiver//g' polished_assembly.fasta > temp && mv temp polished_assembly.fasta
```

```
echo "Headers formatted..."
```

```
echo "Launching fasta_analyzer.py"
```

```
fasta_analyzer.py -cg polished_assembly.fasta cut_$OUT_PREFIX.avg.coverage
```



Something, somewhere went terribly wrong

Thank you for your attention!

Albiorix

- Address: `albiorix.bioenv.gu.se`

Exercises:

https://github.com/The-Bioinformatics-Group/Learning_Unix/wiki/Learn-Unix-with-applications-to-NGS-data

Bash on Windows computers

I suggest you use the mobaxterm program. Go to ...

<http://mobaxterm.mobatek.net/download-home-edition.html>

...and download the portable edition.

Suggested additional tutorials

To start with:

- Do tutorial One, Two, Three, Four, Five [up to 5.2] (and optionally Six) at

<http://www.ee.surrey.ac.uk/Teaching/Unix/>

Codecademy

- <https://www.codecademy.com/en/courses/learn-the-command-line>

For experienced users:

<https://wikis.utexas.edu/display/bioiteam/Shell+Script>

