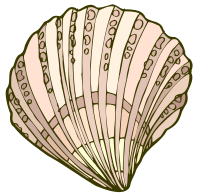
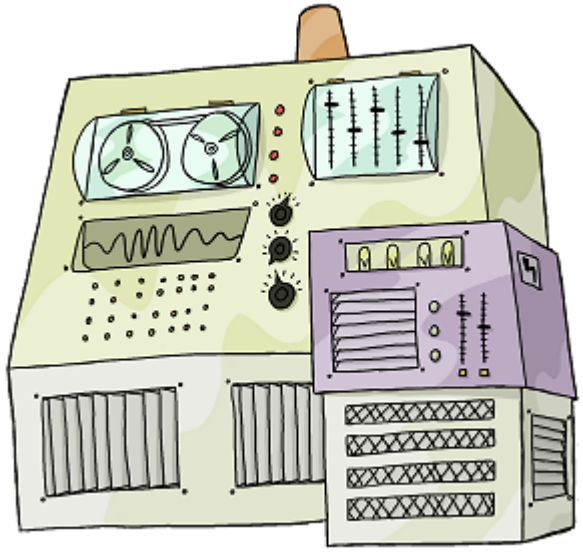
Science & Technology Facilities Council | UK Research and Innovation | NERC SCIENCE OF THE ENVIRONMENT

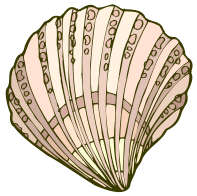
The Unix Shell

Pipes and Filters

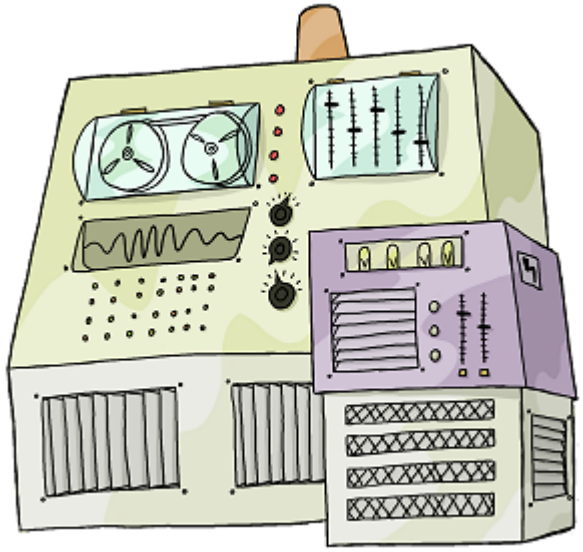


shell

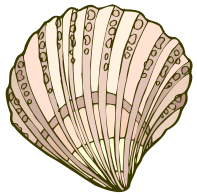




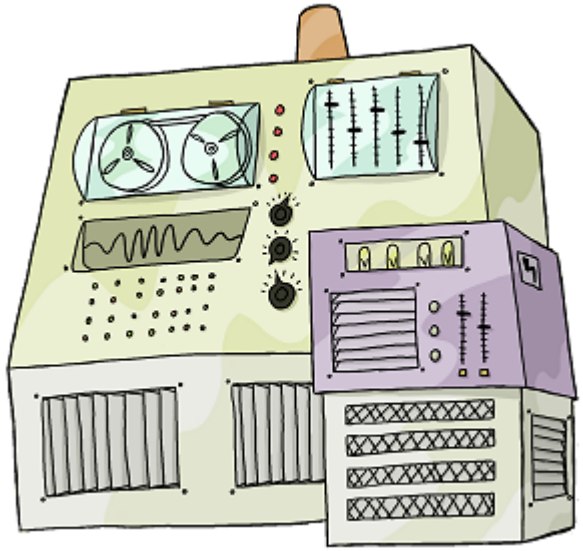
shell



`pwd`	`mkdir`
`cd`	`nano`
`ls`	`rm`
`.`	`rmdir`
`..`	`mv`
	`cp`



shell



`pwd`	`mkdir`
`cd`	`nano`
`ls`	`rm`
`.`	`rmdir`
`..`	`mv`
	`cp`

More powerful

when combined

```
$ ls molecules
cubane.pdb     ethane.pdb     methane.pdb
octane.pdb     pentane.pdb    propane.pdb
$
```

```
$ ls molecules
cubane.pdb     ethane.pdb     methane.pdb
octane.pdb     pentane.pdb    propane.pdb
$ cd molecules
$
```

```
$ ls molecules
cubane.pdb    ethane.pdb    methane.pdb
octane.pdb    pentane.pdb   propane.pdb
$ cd molecules
$ wc *.pdb
```

```
$ ls molecules
cubane.pdb     ethane.pdb     methane.pdb
octane.pdb     pentane.pdb    propane.pdb
$ cd molecules
$ wc *.pdb
```

* is a *wild card*

```
$ ls molecules
cubane.pdb    ethane.pdb    methane.pdb
octane.pdb    pentane.pdb   propane.pdb
$ cd molecules
$ wc *.pdb
```

* is a *wild card*

matches zero or more characters

```
$ ls molecules
cubane.pdb    ethane.pdb    methane.pdb
octane.pdb    pentane.pdb   propane.pdb
$ cd molecules
$ wc *.pdb
```

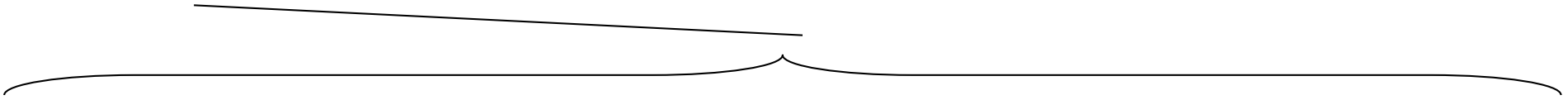
`*` is a *wild card*

matches zero or more characters

so `*.pdb` matches all filenames

ending in `.pdb`

```
$ ls molecules
cubane.pdb    ethane.pdb    methane.pdb
octane.pdb    pentane.pdb   propane.pdb
$ cd molecules
$ wc *.pdb
```



```
wc cubane.pdb ethane.pdb methane.pdb octane.pdb pentane.pdb propane.pdb
```

```
$ ls molecules
cubane.pdb     ethane.pdb     methane.pdb
octane.pdb     pentane.pdb    propane.pdb
$ cd molecules
$ wc *.pdb
```

word count

```
$ ls molecules
cubane.pdb     ethane.pdb     methane.pdb
octane.pdb     pentane.pdb    propane.pdb
$ cd molecules
$ wc *.pdb
```

word count

counts lines, words, and characters in files

```
$ ls molecules
cubane.pdb    ethane.pdb    methane.pdb
octane.pdb    pentane.pdb   propane.pdb
$ cd molecules
$ wc *.pdb
  20  156 1158 cubane.pdb
  12   84  622 ethane.pdb
   9   57  422 methane.pdb
  30  246 1828 octane.pdb
  21  165 1226 pentane.pdb
  15  111  825 propane.pdb
 107  819 6081 total
$
```

```
$ wc -l *.pdb
   20  cubane.pdb
   12  ethane.pdb
    9  methane.pdb
   30  octane.pdb
   21  pentane.pdb
   15  propane.pdb
  107  total
$
```

report only lines

```
$ wc -l *.pdb
  20  cubane.pdb
  12  ethane.pdb
   9  methane.pdb
  30  octane.pdb
  21  pentane.pdb
  15  propane.pdb
 107  total
$
```

report only lines

use -w for words or

-c for characters

```
 20  cubane.pdb
 12  ethane.pdb
  9  methane.pdb
 30  octane.pdb
 21  pentane.pdb
 15  propane.pdb
107  total
```

Which file is shortest?

```
 20  cubane.pdb
 12  ethane.pdb
  9  methane.pdb
 30  octane.pdb
 21  pentane.pdb
 15  propane.pdb
107  total
```

Which file is shortest?

Easy to see when there are six…

```
 20  cubane.pdb
 12  ethane.pdb
  9  methane.pdb
 30  octane.pdb
 21  pentane.pdb
 15  propane.pdb
107  total
```

Which file is shortest?

Easy to see when there are six…

…but what if there were 6000?

```
$ wc -l *.pdb > lengths
$
```

```
$ wc -l *.pdb > lengths
$
```

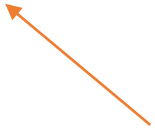
redirect output to a file

```
$ wc -l *.pdb > lengths
$
```

redirect output to a file

create file if it doesn't exist

```
$ wc -l *.pdb > lengths
$
```

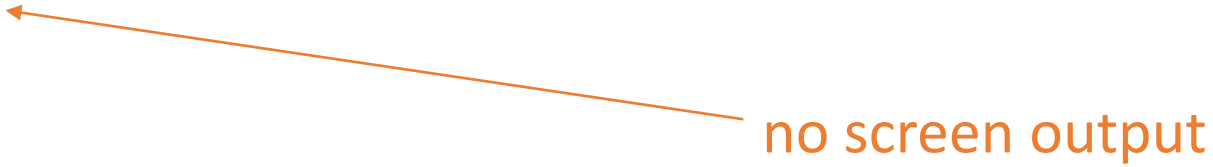


redirect output to a file

create file if it doesn't exist

overwrite it if it does

```
$ wc -l *.pdb > lengths
$
```



```
$ wc -l *.pdb > lengths
$ ls lengths
lengths
$
```

```
$ wc -l *.pdb > lengths
$ ls lengths
lengths
$ cat lengths
  20  cubane.pdb
  12  ethane.pdb
   9  methane.pdb
  30  octane.pdb
  21  pentane.pdb
  15  propane.pdb
 107  total
$
```

```
$ wc -l *.pdb > lengths
$ ls lengths
lengths
$ cat lengths
  20  cubane.pdb
  12  ethane.pdb
   9  methane.pdb
  30  octane.pdb
  21  pentane.pdb
  15  propane.pdb
 107  total
$
```

concatenate files

```
$ wc -l *.pdb > lengths
$ ls lengths
lengths
$ cat lengths
  20  cubane.pdb
  12  ethane.pdb
   9  methane.pdb
  30  octane.pdb
  21  pentane.pdb
  15  propane.pdb
 107  total
$
```

concatenate files

in this case, only one

so file contents printed to screen

```
$ sort -n lengths
   9  methane.pdb
  12  ethane.pdb
  15  propane.pdb
  20  cubane.pdb
  21  pentane.pdb
  30  octane.pdb
 107  total
$
```

```
$ sort -n lengths > sorted-lengths
$
```

```
$ sort -n lengths > sorted-lengths
$ head -1 sorted-lengths
  9  methane.pdb
$
```

```
$ sort -n lengths > sorted-lengths
$ head -1 sorted-lengths
  9  methane.pdb
$
```

get the first line of the file

```
$ sort -n lengths > sorted-lengths
$ head -1 sorted-lengths
   9  methane.pdb
$
```

get the first line of the file
this must be the PDB file
with the fewest lines,
since `sorted-lengths` holds
files and line counts in
order from least to greatest

```
$ sort -n lengths > sorted-lengths
$ head -1 sorted-lengths
   9  methane.pdb
$
```

get the first line of the file

this must be the PDB file

with the fewest lines,

since sorted-lengths holds

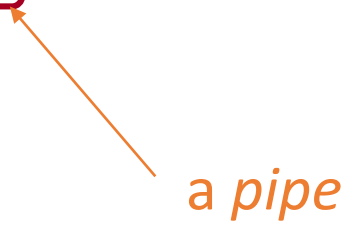
files and line counts in

order from least to greatest

not particularly obvious

```
$ sort -n lengths | head -1
   9  methane.pdb
$
```

```
$ sort -n lengths | head -1
   9  methane.pdb
$
```



```
$ sort -n lengths | head -1
   9  methane.pdb
$
```

a *pipe*

use output of left side

```
$ sort -n lengths | head -1
   9  methane.pdb
$
```

a *pipe*

use output of left side

as input to right side

```
$ sort -n lengths | head -1
   9  methane.pdb
$
```

a *pipe*

use output of left side

as input to right side

without creating temporary file

```
$ wc -l *.pdb | sort -n | head -1
   9  methane.pdb
$
```

don't need to create `lengths` file

```
$ wc -l *.pdb | sort -n | head -1
   9  methane.pdb
$
```

This simple idea is why Unix has been so successful

```
$ wc -l *.pdb | sort -n | head -1
  9  methane.pdb
$
```

This simple idea is why Unix has been so successful

Create simple tools that:

```
$ wc -l *.pdb | sort -n | head -1
   9  methane.pdb
$
```

This simple idea is why Unix has been so successful

Create simple tools that:

– do one job well

```
$ wc -l *.pdb | sort -n | head -1
   9  methane.pdb
$
```

This simple idea is why Unix has been so successful

Create simple tools that:

– do one job well

– work well with each other

```
$ wc -l *.pdb | sort -n | head -1
  9  methane.pdb
$
```

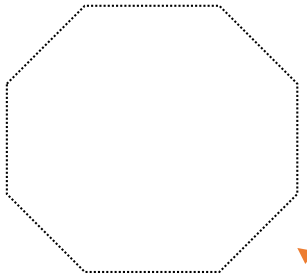
This simple idea is why Unix has been so successful

Create simple tools that:

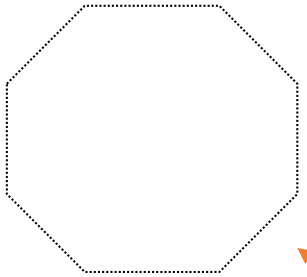
– do one job well

– work well with each other

10 tools can be combined in 100 ways

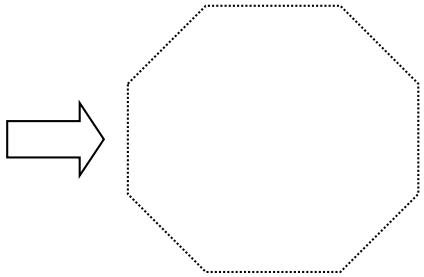


running program

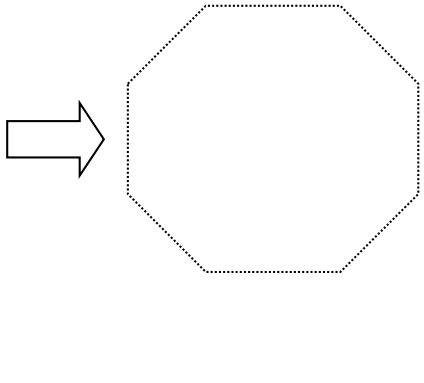


running program

process

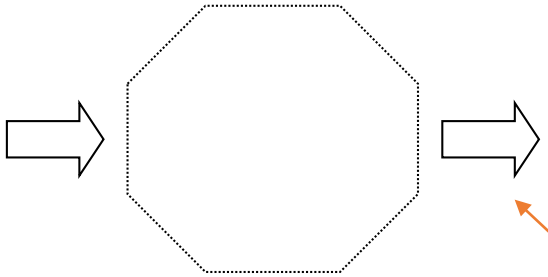


standard input



standard input

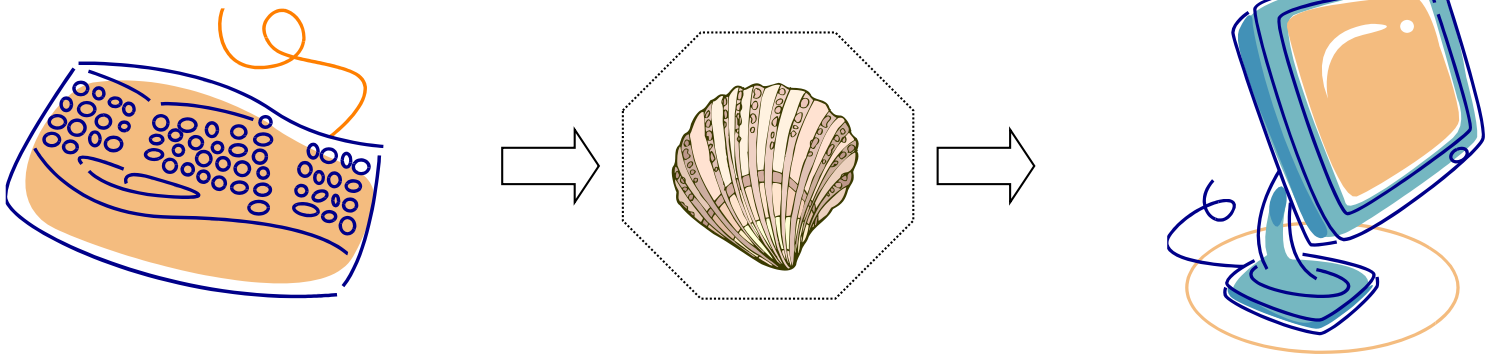
stdin

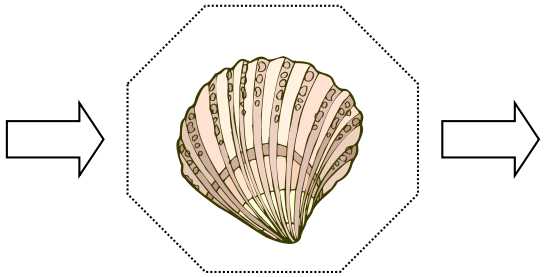


standard output

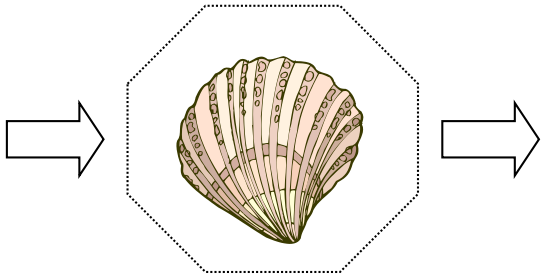
stdout

shell

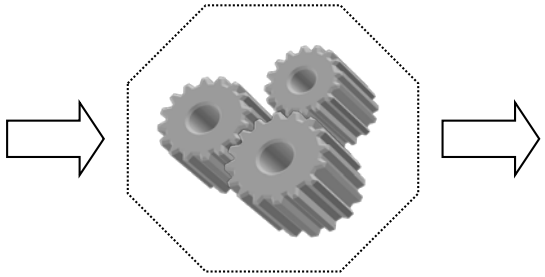




```
$ wc -l *.pdb > lengths
```



wc



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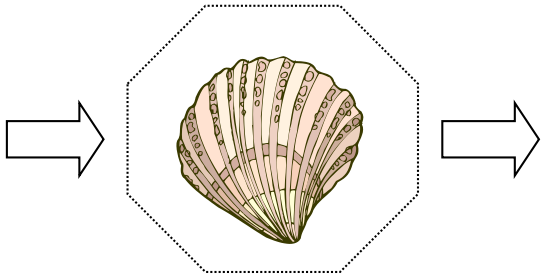
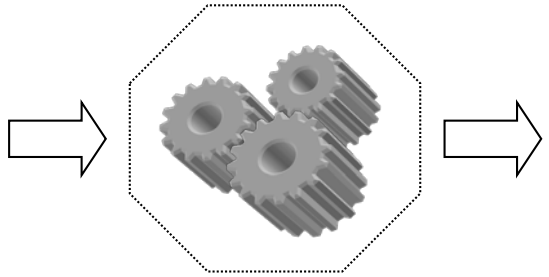


wc



```
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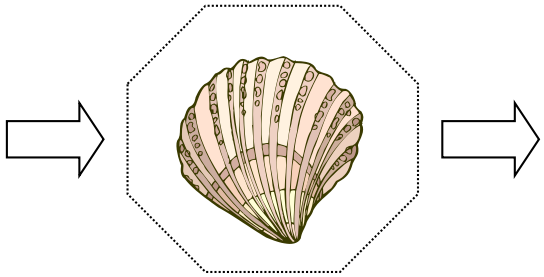


```
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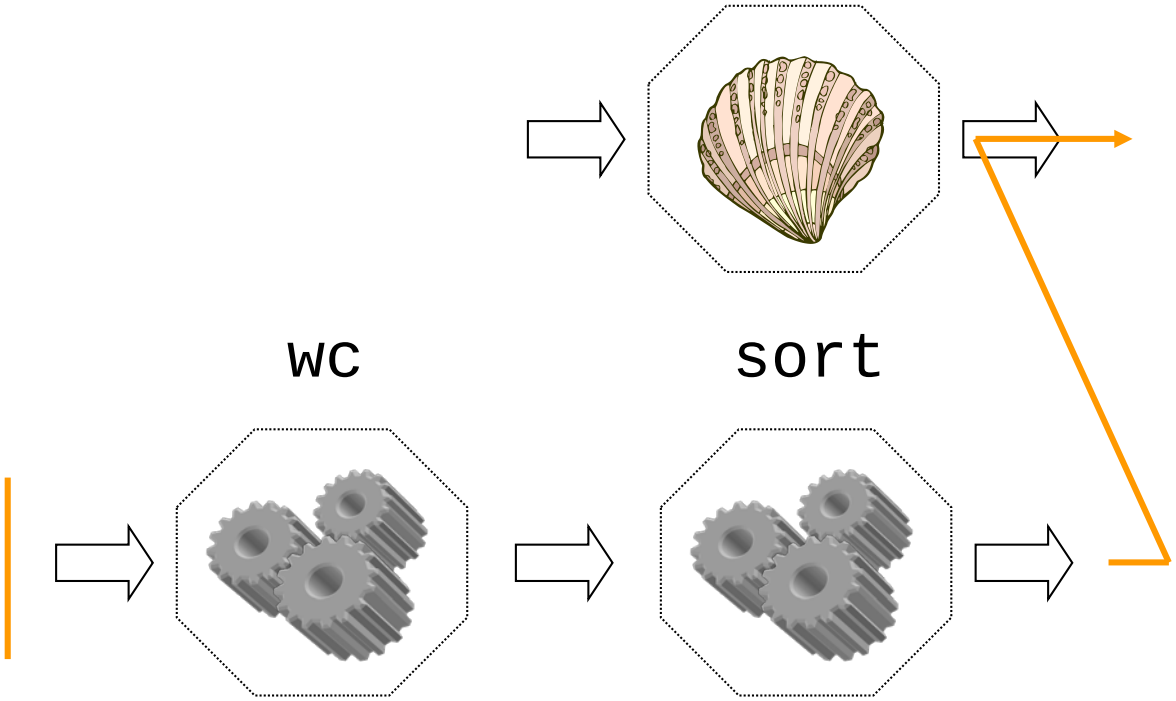
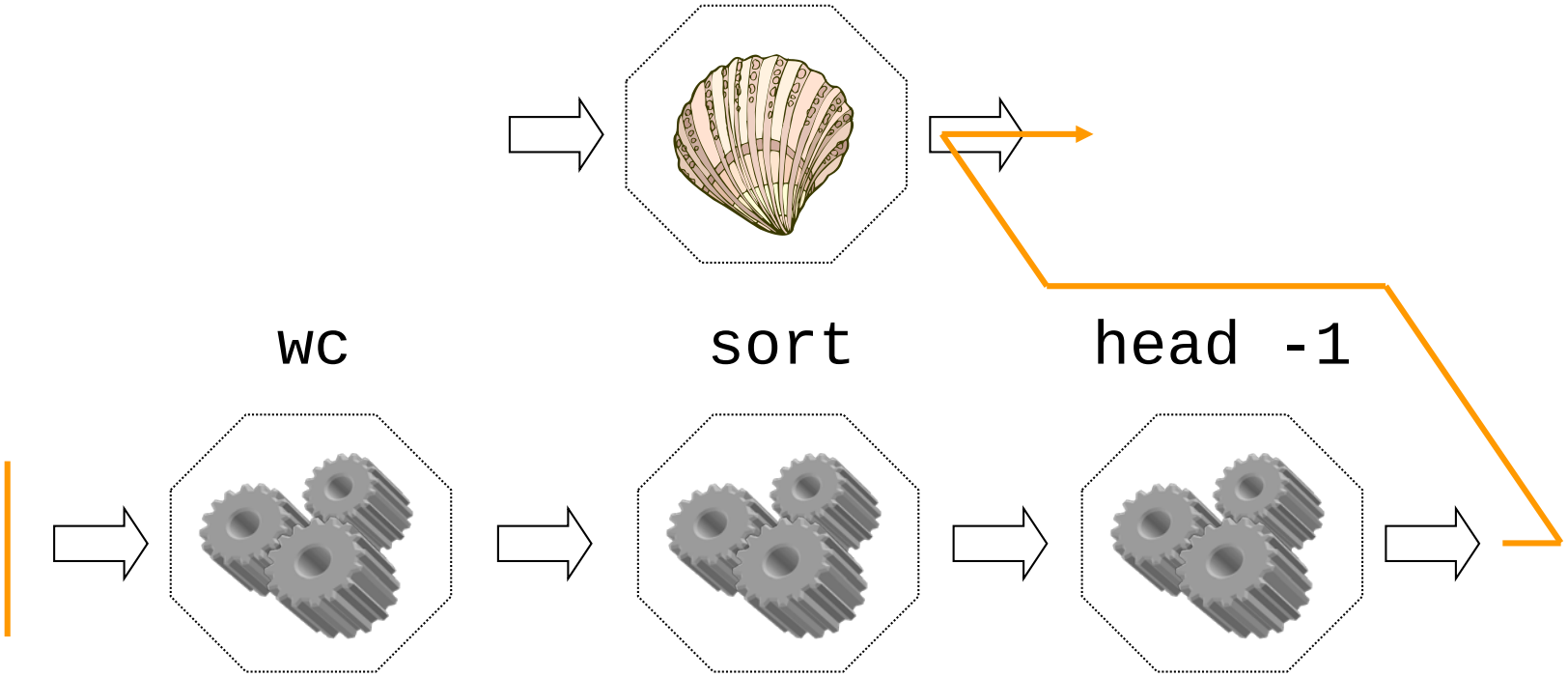
```




```
$ wc -l *.pdb | sort
```




```
$ wc -l *.pdb | sort | head -1
```

This programming model called *pipes and filters*

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A *filter* transforms a stream of input into a stream of output

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A *filter* transforms a stream of input into a stream of output

A *pipe* connects two filters

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A *filter* transforms a stream of input into a stream of output

A *pipe* connects two filters

Any program that reads lines of text from standard input, and writes lines of text to standard output, can work with every other

This programming model called *pipes and filters*

A *filter* transforms a stream of input into a stream of output

A *pipe* connects two filters

Any program that reads lines of text from standard input, and writes lines of text to standard output, can work with every other

You can (and should) write such programs

pwd	mkdir
cd	nano
ls	rm
.	rmdir
..	mv
	cp

pwd	mkdir	wc
cd	nano	sort
ls	rm	head
.	rmdir	
..	mv	
	cp	

pwd	mkdir	wc
cd	nano	sort
ls	rm	head
.	rmdir	*tail*
..	mv	*split*
	cp	*cut*
		uniq

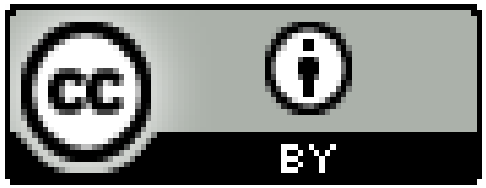
pwd	mkdir	wc	*
cd	nano	sort	>
ls	rm	head	|
.	rmdir	*tail*	
..	mv	*split*	
	cp	*cut*	
		uniq	

pwd	mkdir	wc	*
cd	nano	sort	>
ls	rm	head	|
.	rmdir	*tail*	<
..	mv	*split*	*?*
	cp	*cut*	
		uniq	

created by

Greg Wilson

August 2010



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