Streams/pipes/redirection in the terminal

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Streams are a unifying concept in UNIX

- Files, networks, keyboards, … can all be accessed as streams
- Every UNIX process has:
  - a current working directory
  - standard **input** (defaults to keyboard input)
  - standard **output** (defaults to terminal output)
  - (standard **error**)

```
$ wc
501 was ok
692 is great!
      2       6      25
$
```

```
$ ls ~/github/msds692/data
AAPL.csv                    TeslaIPO.html               berlitz1/
FB-AAPL-2015.csv            bbc/                        berlitz1.7z
SampleSuperstoreSales.csv   bbc.7z                      slate.7z
SampleSuperstoreSales.xls   bbc.zip
```

UNIX has lots of commands we can mix and match to solve problems without new code

- To combine programs, we need to send the output of one program to the input of another
- This lets us transform or simplify data in multiple steps
- The mechanism for passing the standard output of one program to the standard input of another program is called a *pipe*
- Here's an example piping the output of **ls** to the input of **more** and then **wc**:

```
$ ls ~/github/msds692/data | more
AAPL.csv
FB-AAPL-2015.csv
SampleSuperstoreSales.csv
SampleSuperstoreSales.xls
TeslaIPO.html
bbc/
bbc.7z
bbc.zip
berlitz1/
berlitz1.7z
slate.7z
$ ls ~/github/msds692/data | wc
      11       11      143
```

Deeper pipelines

- Pipe the output of **ls** to **grep** (search for string in line) and send that output to **wc**, which counts how many filenames contain “bbc”

```
$ ls ~/github/msds692/data | grep bbc
bbc/
bbc.7z
bbc.zip
$ ls ~/github/msds692/data | grep bbc | wc
       3       3      20
```

I/O redirection

- Pipes connect process input/output
- Redirection:
  - **< file**
    hooks process standard input to file
  - **> file**
    hooks process standard output to file

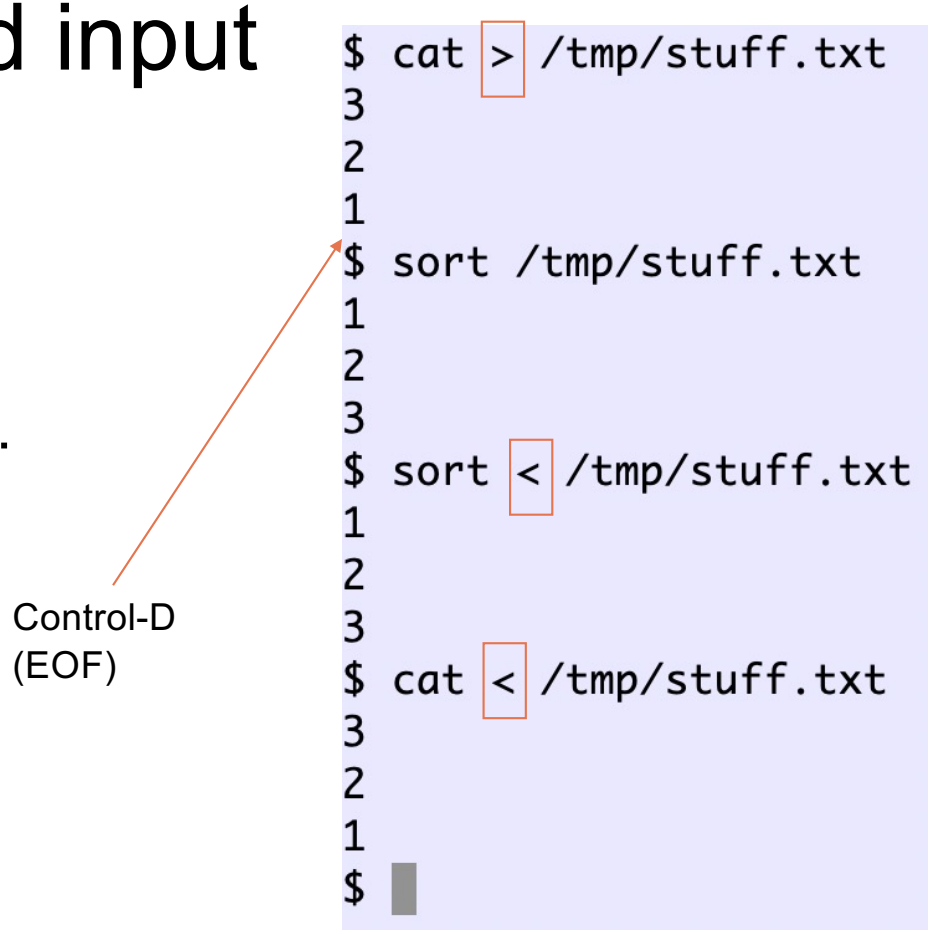
```
$ ls ~/github/msds692/data > /tmp/stuff.txt
$ cat /tmp/stuff.txt
AAPL.csv
FB-AAPL-2015.csv
SampleSuperstoreSales.csv
SampleSuperstoreSales.xls
TeslaIPO.html
bbc/
bbc.7z
bbc.zip
berlitz1/
berlitz1.7z
slate.7z
```

```
$ cat > t.py
print("692 is great!")
$ python t.py
692 is great!
```

I'm hitting control-D (EOF) here to indicate end of input

Redirecting standard input

- Less common but still useful
- Many commands take both commandline arguments and redirection: **sort**, **cat**, **wc** etc…



Throwing away program output

- file **/dev/null** is a special “device” that accepts input and does nothing with it
- It’s a great way to hide all of that debugging output you have in your program

```
$ ls ~/github/msds692/data > /dev/null
$ cat /dev/null
$
```

Appending standard output

- If you want to send the output of multiple commands to a file, you can use the append redirection operator, which looks **>>**

```
$ echo "501" > /tmp/stuff.txt
$ echo "692" >> /tmp/stuff.txt
$ echo "621" >> /tmp/stuff.txt
$ cat /tmp/stuff.txt
501
692
621
$
```

Summary

- pipe “|” hooks output of one process to input of another
- redirect program output to a file using “>”
- redirect program output to a file using “>>” to append not overwrite
- open file and send contents as standard input to a program using ‘<‘ operator