Streams/pipes/redirection in the terminal

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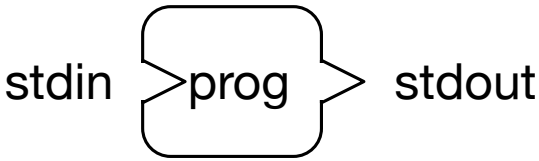
Streams are a unifying concept in UNIX



- Files, websites, 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**)

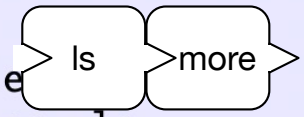
```
$ wc
501 was ok
692 is great!
      2       6      25
$
```

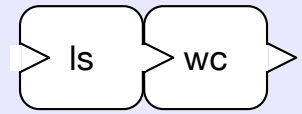
```
$ ls ~/github/msds692/data
AAPL.csv                  TeslaIPO.html          berlitz1/
FB-AAPL-2015.csv          bbc/                   berlitz1.7z
SampleSuperstoreSales.csv bbc.7z                 slate.7z
SampleSuperstoreSales.xls bbc.zip
```

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*
- Examples to right pipe the output of **ls** to the input of **more** and then **wc**

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





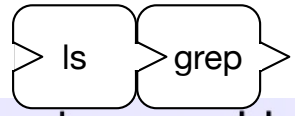
Simple data science pipe example

- Sometimes it's easier to search big data files from the command line, instead of writing code
- Here's how to find all records in a CSV file associated with Backhoe bulldozers:

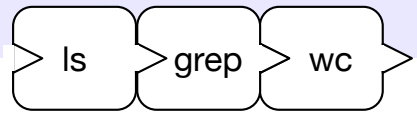
```
varmint:master:~/github/msds621/data $ grep Backhoe bulldozer-train.csv | wc -l
    79416
```

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”



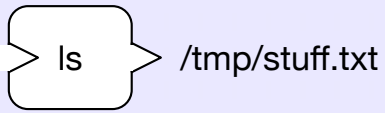

```
$ ls ~/github/msds692/data | grep bbc
bbc/
bbc.7z
bbc.zip
$ ls ~/github/msds692/data | grep bbc | wc
       3       3      20
```



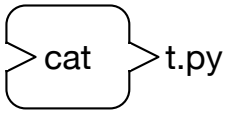
I/O redirection

- Pipes connect the input/output of processes
- 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

Data science redirection example

- When developing a model or performing an analysis, it's often good to start with a small subset of the data to speed up development
- Here's how to get the first 5000 rows of data from a CSV file into another file without having to write code:

```
varmint:~/data $ head -5000 GDP.csv > GDP-5000.csv
varmint:~/data $ wc -l GDP*.csv
     3137 GDP-5000.csv
     3137 GDP.csv
     6274 total
```

Redirecting Python output

- The **print()** function in Python generate standard output, which we can redirect or pipe to another process

```
$ cat t.py
print("a,b,c")
print("1,2,3")
print("4,5,6")
$ python t.py
a,b,c
1,2,3
4,5,6
$ python t.py > t.csv
$ cat t.csv
a,b,c
1,2,3
4,5,6
```

```
$ python t.py | wc -l
       3
$ python t.py | grep 2
1,2,3
$ python t.py | tr ',' ' '
a b c
1 2 3
4 5 6
```

Redirecting standard input

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

I type 3 2 1 then hit control-D (EOF)

```
$ cat > /tmp/stuff.txt
3
2
1
$ sort /tmp/stuff.txt
1
2
3
$ sort < /tmp/stuff.txt
1
2
3
$ cat < /tmp/stuff.txt
3
2
1
$
```

Throwing away program output

- file **/dev/null** is a special “device” that accepts input and does nothing with it
- (This is what happens when I talk to my cat Bonkers)
- 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:
  a | b | c
- redirect program output to a file using “>”
- redirect and append program output to a file using “>>”
- open file and send contents as standard input to a program using ‘<‘ operator
- Redirect both: **prog < infile > outfile**
- Redirect to first program then pipes then redirect:
  a < infile | b | c | d > outfile