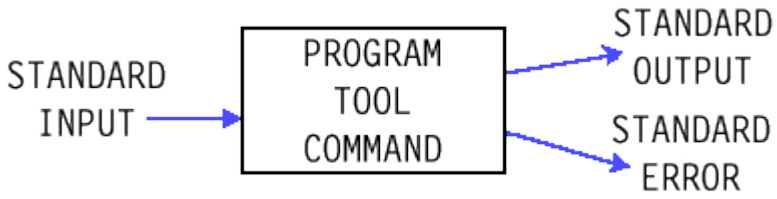
# I/O Redirection and Filters

- Each UNIX command is written as a general purpose program.
- Inputs come from ***STDIN***; outputs go to ***STDOUT***.




## File Descriptors

- When a UNIX command is invoked, the shell automatically open 3 files which that command will use for I/O.

| File Descriptor | Common Name | Default File |
|---|---|---|
| 0 | STDIN | Keyboard |
| 1 | STDOUT | CRT |
| 2 | STDERR | CRT |

- Unless you specify differently, the default files will be opened.
- These default files can easily be changed when the command is invoked.

## Redirecting Output

- To redirect the output of the *ls* command to go into a disk file instead of going to the terminal screen.

```
ls -A > MYFILE
```

- To see the contents of *MYFILE*:

```
cat MYFILE
.profile
adir
bdir
report
code
myfile
```

- When the output of the *ls* command is redirected into *MYFILE*, the shell opens the following file descriptors.

| File Descriptor | Common Name | File |
|---|---|---|
| 0 | STDIN | Keyboard |
| 1 | STDOUT | *MYFILE* |
| 2 | STDERR | CRT |

# Redirecting Input

- Redirection of input is not as common as redirection of output.
- Most commands are designed to take their input from files anyway, instead of from *STDIN*.
- If you call up a command that expects a filename, and you don't provide one, input will come from the keyboard until a **Ctrl-D** is read.
- Example of a command using *STDIN* as the input file.

```
cat
 Some text is typed here.
```

This text will be stored up and sent to *STDOUT* when a ***Ctrl-D*** is read.

```
^D  (user pressed Ctrl-D)
 Some text is typed here.
```

- Or you could put the above text into *MYFILE* and direct *cat*to use *MYFILE* as *STDIN*.

```
cat < MYFILE
```

## Redirecting Diagnostic Output

- Let's say you wanted to compile a C program, and send all of the error messages to *ERRORFILE*, rather than to the screen.

```
cc thisfile.c 2>ERRORFILE
```

- In the case of *STDERR*, you must precede the greater-than by the file descriptor number 2.
- The file descriptor for *STDOUT* is number 1, and is optional for redirecting.

## I/O Redirection

- The following commands are equivalent:

```
cat 0<MYFILE
cat <MYFILE
cat < MYFILE
cat<MYFILE
```

- The following commands are equivalent:

```
ls 1>MYFILE
ls >MYFILE
```

## Appending

- This is a special case of redirecting *STDOUT*.
- Instead of truncating the output file to length zero and directing output to it, the output is appended onto the end of the output file.

- Example:

```
cat MYFILE
THIS TEXT EXISTS.
pwd >> MYFILE
cat MYFILE
THIS TEXT EXISTS.
/usr/user1
```

## Redirecting Both STDOUT and STDERR

To redirect both STDOUT and STDERR into *different* files:

*command* **1>***output_file* **2>***error_file*

In this case, you can run the command *in the background*, since all output will be saved, and you don't have to wait for the command to finish.

*command* **1>***output_file* **2>***error_file* **&**

To redirect both STDOUT and STDERR to the *same* file:

*command* **1>***output_file* **2>&1**

If you are using Bash, you can do this in a shorter command line:

*command* **>&***output_file*

## Discarding STDOUT and/or STDERR

If you want to ignore either or both of the STDOUT or STDERR output, you can redirect it to the special file, called **/dev/null** (a.k.a. the "bit bucket").

Example:

```
ls -lR >everything 2>/dev/null
```

will throw away any error messages for directories where you don't have read or execute permission, only files and directories that are "visible" to you will be saved.

# Pipes


- Pipes allow the output of one command to become the input to another command.
- The following example will sort *MYFILE*, and send it to the *lpr* program to be spooled to the printer.

```
cat MYFILE | sort | lpr
```

# I/O Redirection vs. Pipes

| | |
|---|---|
| **>**<br>**<**<br>**>>**<br>**2>** | Redirect the output of a command, input to a command, or diagnostic output into some file or I/O device. |
| **\|** | Redirect the output of a command to become the input to another command. |

*command* **>** *filename*

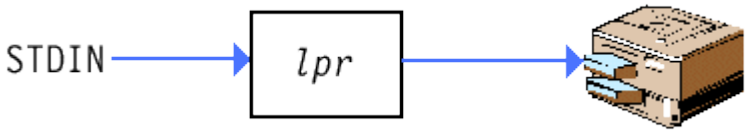
*command* **<** *filename*

*command* **>***filename1* **2>***filename2*

*command1* **|** *command2*

# Filters

- Most commands in UNIX are filters.
- Filters take their input from *STDIN* and put their output to*STDOUT*.
- Filter commands can occur between two |'s in a pipeline.
- *lpr* is not a filter. Its output must always be to a printer.




## tee

- *tee* is a program which sends its inputs to both *STDOUT* and and a file.

```
ls  |  tee DIRECTORY
```

- Since it is a command, you can view the manual page for tee:

```
man tee
```

- *tee* can also be used as a filter.

```
ls  |  tee  files  | wc -l
```

- Either way, tee (almost) always has a pipe on its left.
- If tee has a pipe on its right, it writes the output to both the filename given and to the pipe, which feeds it to the command immediately following the tee (to the right of the pipe.)
- If tee doesn't have a pipe on its right, it writes the output to both the filename given and to STDOUT.