title: The Unix Shell
subtitle: Creating Things
minutes: 20

The Unix Shell: Creating Things

Learning Objectives

- Create a directory hierarchy that matches a given diagram.
- Create files in that hierarchy using an editor or by copying and renaming existing files.
- Display the contents of a directory using the command line.
- Delete specified files and/or directories.

Creating Things

We now know how to explore files and directories, but how do we create them in the first place? Let's go back to `programming-fundamentals`, `/home/oski/Desktop/programming-fundamentals`,
and use `ls -F` to see what it contains:

```
$ pwd
```

```
/home/oski/Desktop/programming-fundamentals
```

```
$ ls -F
```

```
0-0_Introduction.md     1-2_create.md       README.md
0-1_BCE.md                1-3_pipe.md           data/
0-2_help.md               1-4_loop.md           resource.md
1-0_shell.md              1-5_scripts.md        test/
1-1_fildir.md             LICENSE
```

Let's create a new directory called `thesis` using the command `mkdir thesis` (which has no output):

```
$ mkdir thesis
```

As you might (or might not) guess from its name, `mkdir` means "make directory". Since `thesis` is a relative path (i.e., doesn't have a leading slash), the new directory is created in the current working directory:

```
$ ls -F
```

```
0-0_Introduction.md     1-2_create.md       README.md
0-1_BCE.md                1-3_pipe.md           data/
0-2_help.md               1-4_loop.md           resource.md
1-0_shell.md              1-5_scripts.md        test/
1-1_fildir.md             LICENSE           thesis/
```

However, there's nothing in it yet:

```
$ ls -F thesis
```

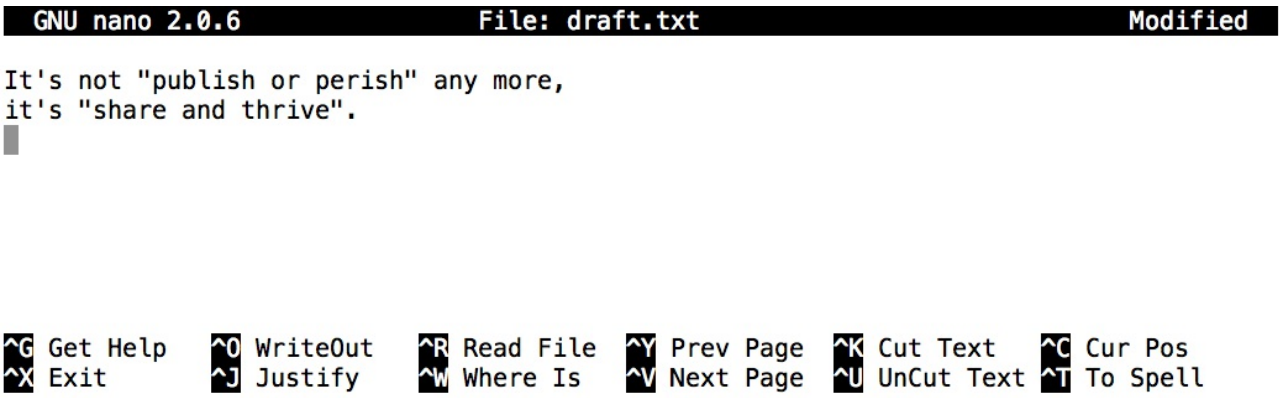
Text Editors

Let's change our working directory to `thesis` using `cd`, then run a text editor called Nano to create a file called `draft.txt`:

```
$ cd thesis
$ nano draft.txt
```

> **Which Editor?**
>
> When we say, "nano is a text editor," we really do mean "text": it can only work with plain character data, not tables, images, or any other human-friendly media. We use it in examples because almost anyone can drive it anywhere without training, but please use something more powerful for real work. On Unix systems (such as Linux and Mac OS X), many programmers use Emacs (http://www.gnu.org/software/emacs/) or Vim (http://www.vim.org/) (both of which are completely unintuitive, even by Unix standards), or a graphical editor such as Gedit (http://projects.gnome.org/gedit/), which is on BCE.
> On Windows, you may wish to use Notepad++ (http://notepad-plus-plus.org/).
>
> Text editors are not limited to .txt files. Code is also text – so any file with an extension like .py (for python) .sh (for shell) can also be edited in a text editor. So can files containing markup, like .html (for HTML) or .md (for markdown). Markup is a way to format text (bold, lists, links, etc) using simple syntax.

Let's type in a few lines of text, then use Control-O to write our data to disk:



Once our file is saved, we can use Control-X to quit the editor and return to the shell. (Unix documentation often uses the shorthand ^A to mean "control-A".) `nano` doesn't leave any output on the screen after it exits, but `ls` now shows that we have created a file called `draft.txt`:

```
$ ls
```

```
draft.txt
```

Removing

Let's tidy up by running `rm draft.txt`:

```
$ rm draft.txt
```

This command removes files ("rm" is short for "remove"). If we run `ls` again,its output is empty once more, which tells us that our file is gone:

```
$ ls
```

> **Deleting Is Forever**
>
> Unix doesn't have a trash bin: when we delete files, they are unhooked from the file system so that their storage space on disk can be recycled. Tools for finding and recovering deleted files do exist, but there's no guarantee they'll work in any particular situation, since the computer may recycle the file's disk space right away.

Let's re-create that file and then move up one directory to `/home/oski/Desktop/programming-fundamentals` using `cd ..`:

```
$ pwd
```

```
/home/oski/Desktop/programming-fundamentals/thesis
```

```
$ nano draft.txt
$ ls
```

```
draft.txt
```

```
$ cd ..
```

If we try to remove the entire `thesis` directory using `rm thesis`,
we get an error message:

```
$ rm thesis
```

```
rm: cannot remove `thesis': Is a directory
```

This happens because `rm` only works on files, not directories. The right command is `rmdir`, which is short for "remove directory". It doesn't work yet either, though, because the directory we're trying to remove isn't empty:

```
$ rmdir thesis
```

```
rmdir: failed to remove `thesis': Directory not empty
```

This little safety feature can save you a lot of grief, particularly if you are a bad typist. To really get rid of `thesis` we must first delete the file `draft.txt`:

```
$ rm thesis/draft.txt
```

The directory is now empty, so `rmdir` can delete it:

```
$ rmdir thesis
```

> **With Great Power Comes Great Responsibility**
>
> Removing the files in a directory just so that we can remove the directory quickly becomes tedious. Instead, we can use `rm` with the `-r` flag (which stands for "recursive"):
>
> ```
> $ rm -r thesis
> ```
>
> This removes everything in the directory, then the directory itself. If the directory contains sub-directories, `rm -r` does the same thing to them, and so on. It's very handy, but can do a lot of damage if used without care.

Moving

Let's create that directory and file one more time. (Note that this time we're running `nano` with the path `thesis/draft.txt`, rather than going into the `thesis` directory and running `nano` on `draft.txt` there.)

```
$ pwd
```

```
/home/oski/Desktop/programming-fundamentals
```

```
$ mkdir thesis
```

```
$ nano thesis/draft.txt
$ ls thesis
```

```
draft.txt
```

`draft.txt` isn't a particularly informative name, so let's change the file's name using `mv`, which is short for "move":

```
$ mv thesis/draft.txt thesis/quotes.txt
```

The first parameter tells `mv` what we're "moving", while the second is where it's to go. In this case, we're moving `thesis/draft.txt` to `thesis/quotes.txt`, which has the same effect as renaming the file. Sure enough, `ls` shows us that `thesis` now contains one file called `quotes.txt`:

```
$ ls thesis
```

```
quotes.txt
```

Just for the sake of inconsistency, `mv` also works on directories -- there is no separate `mvdir` command.

Let's move `quotes.txt` into the current working directory. We use `mv` once again, but this time we'll just use the name of a directory as the second parameter to tell `mv` that we want to keep the filename, but put the file somewhere new. (This is why the command is called "move".) In this case, the directory name we use is the special directory name `.` that we mentioned earlier.

```
$ mv thesis/quotes.txt .
```

The effect is to move the file from the directory it was in to the current working directory. `ls` now shows us that `thesis` is empty:

```
$ ls thesis
```

Further, `ls` with a filename or directory name as a parameter only lists that file or directory. We can use this to see that `quotes.txt` is still in our current directory:

```
$ ls quotes.txt
```

```
quotes.txt
```

Copying

The `cp` command works very much like `mv`, except it copies a file instead of moving it. We can check that it did the right thing using `ls` with two paths as parameters --- like most Unix commands, `ls` can be given thousands of paths at once:

```
$ cp quotes.txt thesis/quotations.txt
$ ls quotes.txt thesis/quotations.txt
```

```
quotes.txt   thesis/quotations.txt
```

To prove that we made a copy, let's delete the `quotes.txt` file in the current directory and then run that same `ls` again. This time it tells us that it can't find `quotes.txt` in the current directory, but it does find the copy in `thesis` that we didn't delete:

```
$ ls quotes.txt thesis/quotations.txt
```

```
ls: cannot access quotes.txt: No such file or directory thesis/quotations.txt
```

Rochelle's Pipeline: Organizing and Moving Files

Knowing just this much about files and directories, Rochelle is ready to organize the files for her text project. First, she `cd`'s into the `programming-fundamentals` directory. From there, she creates a directory called `new-york-times` (to remind herself where the data came from) inside her `data` directory. Inside that, she creates a directory called `2015-01-01`, which is the date she started processing the texts. She used to use names like `conference-paper` and `revised-results`, but she found them hard to understand after a couple of years. (The final straw was when she found herself creating a directory called `revised-revised-results-3`.)

> Rochelle names her directories "year-month-day", with leading zeroes for months and days, because the shell displays file and directory names in alphabetical order. If she used month names, December would come before July; if she didn't use leading zeroes, November ('11') would come before July ('7').

```
$ cd ~/programming-fundamentals/data
$ mkdir new-york-times
$ mkdir new-york-times/2015-01-01
```

Now she's ready to add the text files that she downloaded from LexisNexis into the directory.

The text files that she downloaded are, unsurprisingly, in the directory downloads

```
$ cd downloads
$ ls
```

```
human-rights-2000.TXT  human-rights-2004.TXT  human-rights-2008.TXT
human-rights-2001.TXT  human-rights-2005.TXT  human-rights-2009.TXT
human-rights-2002.TXT  human-rights-2006.TXT
human-rights-2003.TXT  human-rights-2007.TXT
```

Rochelle wants to move them into the directory she just created.

```
$ cp human-rights-2000.TXT ../new-york-times/2015-01-01
$ ls ../new-york-times/2015-01-01
```

```
human-rights-2000.TXT
```

Huzzah! But does Rochelle really have to time in a command for each file she wants to move? No, there's an easier way! Instead of giving an input for each file, Rochelle can write cp *.TXT. The * in *.TXT matches zero or more characters, so the shell turns *.TXT into a complete list of .TXT files

```
$ cp *.TXT ../new-york-times/2015-01-01
$ ls ../new-york-times/2015-01-01
```

```
human-rights-2000.TXT  human-rights-2004.TXT  human-rights-2008.TXT
human-rights-2001.TXT  human-rights-2005.TXT  human-rights-2009.TXT
human-rights-2002.TXT  human-rights-2006.TXT
human-rights-2003.TXT  human-rights-2007.TXT
```

Wildcards {.callout}

* is a **wildcard**. It matches zero or more
characters, so `*.pdb` matches `ethane.pdb`, `propane.pdb`, and so on.
On the other hand, `p*.pdb` only matches `pentane.pdb` and
`propane.pdb`, because the 'p' at the front only matches itself.

? is also a wildcard, but it only matches a single character. This
means that `p?.pdb` matches `pi.pdb` or `p5.pdb`, but not `propane.pdb`.
We can use any number of wildcards at a time: for example, `p*.p?*`
matches anything that starts with a 'p' and ends with '.', 'p', and at
least one more character (since the '?' has to match one character, and
the final '*' can match any number of characters). Thus, `p*.p?*` would
match `preferred.practice`, and even `p.pi` (since the first '*' can
match no characters at all), but not `quality.practice` (doesn't start
with 'p') or `preferred.p` (there isn't at least one character after the
'.p').

When the shell sees a wildcard, it expands the wildcard to create a
list of matching filenames *before* running the command that was
asked for. As an exception, if a wildcard expression does not match
any file, Bash will pass the expression as a parameter to the command
as it is. For example typing `ls *.pdf` in the `new-york-times` directory
(which contains only files with names ending with `.TXT`) results in
an error message that there is no file called `*.pdf`.
However, generally commands like `wc` and `ls` see the lists of
file names matching these expressions, but not the wildcards
themselves. It is the shell, not the other programs, that deals with
expanding wildcards, and this another example of orthogonal design.

Exercises

Challenge 1

cd into the workshop repo. Create a directory called "my_files".

Challenge 2

Within that directory, create a file called "script.sh"

Challenge 3

Copy script.sh into my_files/backup/

Challenge 4

The command `ls -t` returns a listing arranged by time of last edit. Add this command to script.sh.

When you feel you have met these challenges successfully, cd into test/ and type

```
. 1-2_test.sh
```

into the command line. If you were successful, the output will look like this:

```
Challenge 1
...passed
Challenge 2
...passed
Challenge 3
...passed
Challenge 4
...passed
```

Adapted from: [Software Carpentry (http://software-carpentry.org/v5/novice/shell/02-create.html)](http://software-carpentry.org/v5/novice/shell/02-create.html)