

05 – Archiving, Chaining, Piping & Redirection

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File Compression

Making Archives: Zip

Package and Compress (Archive) Files

`zip <name_of_archive> <files_to_include>`

- E.g. `zip files.zip a.txt b.txt c.txt`
- Extracts to `a.txt`, `b.txt`, and `c.txt` in *current directory*.
- To do folders, you need recursion.
 - `zip -r folder.zip my_files/`
 - Extracts to folder named `my_files` in *current directory*.
 - Good practice to ALWAYS zip a folder and distribute with the name it will extract as.
 - `zip -r folder_name.zip folder_name/`
 - Drives me *crazy* when I get a `.zip` that extracts files in the same directory... very difficult to keep track of.

List, Test and Extract Compressed Files in a **zip** Archive

`unzip <archive_name>`

- Use `-l` to list what would extract before doing it.

- **Note:** The original files DO stay intact.

Making Archives: Gzip

GNU zip

```
gzip <files_to_compress>
```

- Less time to compress, larger file: **--fast**
- More time to compress, smaller file: **--best**
- Read the **man** page, lots of options.
- By default, *replaces* the original files!
 - You can use **--keep** to bypass this.

GNU unzip

```
gunzip <archive_name>
```

- Use **-l** to list what would extract before doing it.

• Notes:

- Does not bundle the files.
- Reiterate: *replaces original* by default.
- Usually has better compression than **zip**.

Additional Archive Formats

- This is a non-exhaustive list. There are **many** out there.
- Similar interface to **gzip**:
 - **bzip2**: “Burrows-Wheeler block sorting compression algorithm”
 - **xz**: “x”-zip, uses LZMA compression scheme (good)
- Honorable mentions:
 - **file.rar**: a “**RAR**” archive; used for distributing large files
 - **file.rar.001**, **file.rar.002**, etc: multiple archives needed to reconstruct whole.
 - You extract the first one, it looks for the others in same directory.
 - **file.7z**: “**7**”-zip, successor to RAR, uses LZMA
 - If you are choosing between **.rar** and **.7z**...choose **.7z**.
 - Install **unrar** to deal with these on Unix.
- **Moral**:
 - Working with **tar** and/or only Unix? **Use xz**.
 - Have to support Windows fools? **Use 7zip**.

Making Archives: Tar

- Bundling files together to compress is easy!

Tape archive

```
tar -cf <tar_archive_name> <files_to_compress>
```

- Create a tar archive.

```
tar -xf <tar_archive_name>
```

- Extract all files from archive.

-
- **tar** is a stream tool. By default, it is expecting stream input.
 - Don't forget the **-f** if you are working with files!

• Notes:

- **tar** is just a bundling suite, creating a single file.
- By default, it does *not* compress.
- Original files DO stay in tact.
- Unlike **zip**, you do not need the **-r** flag for folders :)

Making Archives: Tarballs

Making tarballs

```
tar -c[zjJ]f <archive_name> <source_files>
```

```
tar -x[zjJ]f <archive_name>
```

- **[zjJ]** here means *either z, j, or J* — only one.
- YOU have to specify the file extension.
- Use **gzip** compression method: **-z** (or **--gzip**)
 - Extension convention: **.tar.gz**
 - Example: **tar -czf files.tar.gz files/**
- Use **bzip2** compression method: **-j** (or **--bzip2**)
 - Extension convention: **.tar.bz2**
 - Example: **tar -cjf files.tar.bz2 files/**
- Use **xz** compression method: **-J** (or **--xz**)
 - Extension convention: **.tar.xz**
 - Example: **tar -cJf files.tar.xz files/**

Pro Tip: Minimize your Keystrokes

- **Extraction** can *usually* happen automatically:
 - `tar -xf files.tar.gz` will usually work (no `-z`)
 - Best results when:
 - You are obeying filename conventions.
 - `tar` made the archive in the first place.
- **Compression**: no, you have to tell it what to do...
- It's the flag equivalent of the **tab** key.
 - Ok, maybe not...but just remember it!
 - This serves as a not-so-subtle reminder to obsessively hit your **tab** key ;)

Assorted Commands

Before we can Chain...

...we need some more interesting tools to chain together!

Counting

- Ever wanted to show off how cool you are?

Word Count

```
wc [options] <file>
```

- count the number of lines: **-l**
- count the number of words: **-w**
- count the number of characters: **-m**
- count the number of bytes: **-c**

- Great for things like:
 - Reveling in the number of lines you have programmed.
 - Analyzing the verbosity of your personal statement.
 - Showing people how cool you are.
 - Completing homework assignments?

Sorting

Sort Lines of Text

```
sort [options] <file>
```

- Default: sort by the **ASCII** code (*roughly* alphabetical, see [1]) for the whole line.
- Use **-r** to reverse the order.
- Use **-n** to sort by numerical order.
- Use **-u** to remove duplicates.

• Working with the demo file [peeps.txt](#):

```
$ cat peeps.txt  
Manson, Charles  
Bundy, Ted  
Bundy, Jed  
Nevs, Sven  
Nevs, Sven
```

```
$ sort -r peeps.txt  
Nevs, Sven  
Nevs, Sven  
Manson, Charles  
Bundy, Ted  
Bundy, Jed
```

```
$ sort -ru peeps.txt  
Nevs, Sven  
Manson, Charles  
Bundy, Ted  
Bundy, Jed  
# only 1 Nevs, Sven
```

Advanced Sorting: Why?

- The **sort** command is quite powerful, for example you can do:

```
$ sort -n -k 3 -t "," <filename>
#      || |||| |----|==> Use comma as delimiter
#      || ++++=====> Choose the third field as the sort key
#      ++=====> Sort numerically
```

- Sorts the file numerically by using the *third* column, separating by a comma as the delimiter instead of whitespace.
- Read the **man** page!
- Learning **sort** command is particularly worth your time:
 - Easy sorting of text \Rightarrow faster parsing / prototyping.
 - Many commands produce reliably ordered output.
 - Looking for a specific thing? Just sort with that as the **key**!
 - E.g. **grep -Hn** \Rightarrow use the **:** as your delimiter.
 - We'll learn **grep** soon!

Advanced Sorting: Example

- The demo file `numbers.txt` contains:

```
$ cat numbers.txt
```

```
02,there,05
```

```
04,how,03
```

```
01,hi,06
```

```
06,you,01
```

```
03,bob,04
```

```
05,are,02
```

```
# Normal numeric sort
```

```
$ sort -n numbers.txt
```

```
01,hi,06
```

```
02,there,05
```

```
03,bob,04
```

```
04,how,03
```

```
05,are,02
```

```
06,you,01
```

```
# On the third column
```

```
$ sort -n -k 3 -t "," numbers.txt
```

```
06,you,01
```

```
05,are,02
```

```
04,how,03
```

```
03,bob,04
```

```
02,there,05
```

```
01,hi,06
```

- Reverse ordering in 3rd column not necessary, just an example.

Unique — Report or Omit Repeated Lines

`uniq [options] <file>`

- No flags: discards all but one of successive identical lines.
 - Unique occurrences are merged into the *first* occurrence.
- Use `-c` to prints the number of successive identical lines next to each line.
- Use `-d` to only print *repeated* lines.

Search and Replace

- Translate characters / sets (but not regular expressions) easily!

Translate or Delete Characters (or Sets)

```
tr [options] <set1> [set2]
```

- Translate or delete characters / sets.
 - We will cover POSIX / custom sets soon.
 - By default, searches for strings matching **set1** and replaces them with **set2**.
 - If using **-d** to delete, only **set1** is specified.
 - Can use **-c** to invert (complement) the set.
- The **tr** command only works with streams.
 - Examples to come after we learn about chaining commands in the next section.

Chaining Commands

Your Environment and Variables

- There are various *environment* variables defined for your shell.
- They are almost always all capital letters.
- You obtain their value by dereferencing them with a \$.

```
$ echo $PWD      # present working directory
$ echo $OLDPWD   # print previous working directory
$ printenv       # print all environment variables
```

- There are also *local* variables you can use / set.
- Primary difference:
 - *Environment* variables are available in your shell, *and* in scripts.
 - *Local* variables are *only* available in your shell.
 - “Shell” here just means “current terminal session.”

What is Defined?

- The environment:
 - **env**: displays all environment variables.
 - **unsetenv** <var_name>: remove an environment variable.
 - Create an environment variable*:
 1. **env** ENV_VAR_NAME="value"
 2. **export** ENV_VAR_NAME="value"
 - **export** is the most common. Exceptional explanation [here](#).
 - The local variables:
 - **set**: displays all shell / local variables.
 - **unset** <var_name>: remove a local shell variable.
 - Create a local variable*:
 1. **set** local_var="value"
 2. **local_var**="value"
- * These only last for the current shell session; we will learn how to make them “permanent” soon.

Brief Example: Environment Variable Manipulation

```
# MY_ENV_VAR is not set yet, so nothing prints
```

```
$ echo "My env var is: $MY_ENV_VAR"
```

```
My env var is:
```

```
# Set the environment variable (can also use `export` in bash)
```

```
$ env MY_ENV_VAR="Lemming King"
```

```
# Now that we have set it, print it
```

```
$ echo "My env var is: $MY_ENV_VAR"
```

```
My env var is: Lemming King
```

```
# "Delete" with `unsetenv`. Print again, confirming it's gone
```

```
# Emphasis: there is an `env` after `unset`
```

```
$ unsetenv MY_ENV_VAR
```

```
$ echo "My env var is: $MY_ENV_VAR"
```

```
My env var is:
```

Brief Example: Local Variable Manipulation

```
# my_local_var is not set yet, so nothing prints
$ echo "My local var is: $my_local_var"
My local var is:

# Just declare it (can also use the `set` command)
$ my_local_var="King of the Lemmings"

# Now that we have set it, print it
$ echo "My local var is: $my_local_var"
My local var is: King of the Lemmings

# "Delete" with `unset`. Print again, confirming it's gone
# Emphasis: there is *not* an `env` after `unset`
$ unset my_local_var
$ echo "My local var is: $my_local_var"
My local var is:
```

Exit Codes

- When you execute commands, they have an “exit code”.
 - This how you “signal” to others in the shell: through exit codes.
- The exit code of the *last command executed* is stored in `$?`
- There are various exit codes, here are a few examples:

```
$ super_awesome_command
bash: super_awesome_command: command not found...
$ echo $?
127
$ echo "What is the exit code we want?"
What is the exit code we want?
$ echo $?
0
```

- The success code we want is actually `0`. Refer to [3].
- Remember that `cat /dev/urandom` trickery? You will have to `ctrl+c` to kill it, what would the exit code be?

Executing Multiple Commands in a Row

- With exit codes, we can define some simple rules to chain commands together:
- Always execute:

```
$ cmd1; cmd2    # exec cmd1 first, then cmd2
```

- Execute conditioned upon exit code of **cmd1**:

```
$ cmd1 && cmd2 # exec cmd2 only if cmd1 returned 0  
$ cmd1 || cmd2 # exec cmd2 only if cmd1 returned NOT 0
```

- Kind of backwards, in terms of what means continue for *and*, but that was likely easier to implement since there is only one **0** and many *not 0*'s.

Piping & Redirection

Piping Commands

- Bash scripting is all about combining simple commands together to do more powerful things. This is accomplished using the “pipe” character.

Piping

`<command1> | <command2>`

- Pass output from **command1** as input to **command2**.
- Works for almost every command.
 - Note: **echo** does not allow you to pipe to it!
- In some senses, the majority of commands you will learn in this course were designed to support this.

Some Piping Examples

- 1, 2, 3...easy as ABC?

Piping along...

```
$ ls -al /bin | less
```

- Scroll through the long list of programs in `/bin`

```
$ history | tail -20 | head -10
```

- The 10th - 19th most recent commands executed.

```
$ echo * | tr ' ' '\n'
```

- Replaces all spaces characters with new lines.
- Execute just `echo *` to see the difference.

- In all of these examples, try executing it first without the |
 - First: execute `history`
 - Next: execute `history | tail -20`
 - Last: execute `history | tail -20 | head -10`

Redirection

- The redirection operators are: `>`, `>>`, `<`, or `<<`.
 - To redirect standard output, use the `>` operator.
 - `command > file`
 - To redirect standard input, use the `<` operator.
 - `command < file`
 - To redirect standard error, use the `>` operator and specify the stream number **2**.
 - `command 2> file`
 - Combine streams together by using **2>&1** syntax.
 - This says: send standard error to where standard output is going.
 - Useful for debugging / catching error messages...
 - ...or ignoring them (you will often see that sent to `/dev/null`).

Redirection Example

- Bash processes I/O redirection from left to right, allowing us to do fun things like this:

Magic

```
tr -dc '0-9' < test1.txt > test2.txt
```

- Deletes everything but the numbers from **test1.txt**, then store them in **test2.txt**.
 - CAUTION: do not **ever** use the same file as output that was input.
 - Example: `tr -dc '0-9' < original.txt > original.txt`
 - You will *lose* all your data, you cannot read and write this way.
- Piping and Redirection are quite sophisticated, please refer to the Wikipedia page in [4].
 - Hands-on examples in the [lecture demo](#).

References

- [1] ASCII Table. *ASCII Character Codes and html, octal, hex, and decimal chart conversion*. 2010. URL: <http://www.asciitable.com/>.
- [2] Stephen McDowell, Bruno Abrahao, Hussam Abu-Libdeh, Nicolas Savva, David Slater, and others over the years. “Previous Cornell CS 2043 Course Slides”.
- [3] The Linux Documentation Project. *Exit Codes with Special Meanings*. 2017. URL: <http://tldp.org/LDP/abs/html/exitcodes.html>.
- [4] Wikipedia. *Redirection (Computing)*. 2017. URL: https://en.wikipedia.org/wiki/Redirection_%28computing%29.