Week 2
Shell Scripting, RegEx, and Streams

14 January 2019

CS 35L Lab 4

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Announcements

- Assignment #1 **was** due January 12 by 11:55pm
  - You can still submit the assignment
  - If you submit before 11:55pm tonight, it's only a 2% penalty!
- Assignment #2 is due January 23 (Wednesday) by 11:55pm
  - Professor Eggert is making changes to the homework section
- If you are still not in the lab/section you desire, put your name down in the notebook going around
  - Include any and all lab sections you can attend
  - We will work through attempting swaps Wednesday
  - Currently Lab 1 and Lab 8 have openings

Questions?

Outline

- Locales and environmental variables
- Shell scripting
  - Writing scripts
  - Conditional statements
- Regular Expressions
- Lab 2 Tips

Locale

➔ What is a locale?

Locale

- What is a locale?
  - A set of parameters that define a user's cultural preferences
    - E.g. Language or Country
- The `locale` command
  - Prints information about the current locale environment to stdout

Environment Variables

- Variables that can affect how processes run
- Common ones:
  - **`HOME`**: path to user's home directory
  - **`PATH`**: list of directories to search in for command to execute
    - Thus, why you preppended a path in assignment #1
- Changing an environment variable's value

```
export VARIABLE=...
```

LC_* Environment Variables

- `locale` gets its data from the LC_* environment variables
- Example
  - LC_TIME
    - Date and time formats
  - LC_CTYPE
    - Character classification and case conversion

Locale matters!

For example, if you ran `sort`:

- ➔ LC_COLLATE=‘C’
  - Sorting is in ASCII order
- ➔ LC_COLLATE=‘en_US’
  - Sorting is case insensitive

It’s important to change your locale for assignment #2

More useful commands

- `sort`
  - Sorts lines of text files
- `comm`
  - Compare two sorted files line by line
- `tr`
  - Translate or delete characters

Shell Scripting

What is a shell script?

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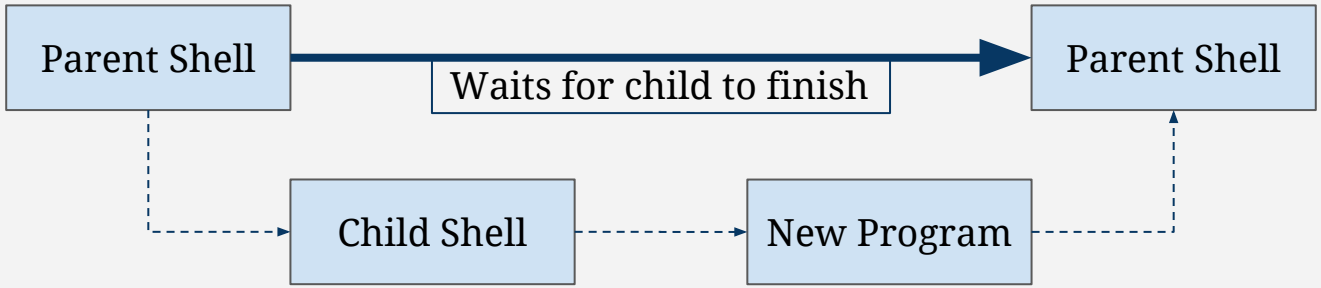
- ➔ It is a file that holds one or more shell command(s)
- ➔ Why is this useful?

What is a shell script?

- ➔ It is a file that holds one or more shell command(s)
- ➔ Why is this useful?
  - ◆ Commands run in succession can be contained in one file
  - ◆ You can introduce conditionals to your shell commands
  - ◆ Clearer variable declarations

The first line

➔ A shell script spawns a “shell” process to run it



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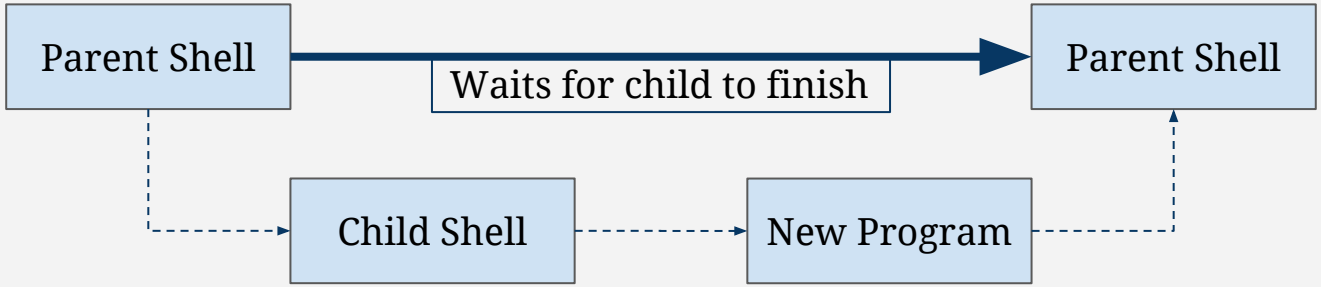

- Reminder: a shell is a command-line interpreter
- There are many types of shells
  - E.g. Bash, Bourne shell, C shell, KornShell
- How do we make sure the correct shell is used in our process?

SHEBANG!

The first line

- The shebang (“#!”) opens the first line
- The line includes the absolute path to the interpreter
- E.g.
  - #!/bin/bash
  - #!/bin/sh

Example

Write a script that copies a file called “RA.txt”, places it into a new directory called “songs”, and also creates a new file in songs called “newsong.txt”. Assume you’re already in the directory with RA.txt

Example

```
#!/bin/bash

mkdir songs

cp RA.txt songs

touch songs/newsong.txt
```

Executing scripts

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  - `./script.sh`

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  - How to fix?

Executing scripts

- How do you run your newly created script?
  - `./script.sh`
- Why might that not work?
  - Newly created files are not automatically given execution permission
  - How to fix?
    - `chmod u+x script.sh`

Execution tracing

- Shell can print out commands as it runs them
- `set -x`
  - turns tracing on
- `set +x`
  - Turns tracing off
- If you want it to trace within the script, this command must be within your script

Variables

- Within a shell script you can declare
  - `myvar="aloha"`
  - Note that there are no spaces!
- And reference variables
  - `echo $myvar`
  - You can use curly brackets to denote which part is the variable
    - `echo "${myvar}_Jeremy"`

POSIX built-in shell variables

- There are a number of potentially useful built in variables
  - E.g. PATH
- You should avoid naming your own variables the same names
- Some useful variables
  - #
    - Number of arguments given to current process
  - ?
    - Exit status of previous command
  - IFS
    - Internal Field Separator

Exit Status

- When a command finishes, it provides an exit status code
- You can check this by referencing the ? variable
- 0
  - The command exited successfully
- 1-125
  - The command exited unsuccessfully
  - Each has their own meaning
    - E.g. try running ls on an imaginary directory, or cd into a text file
- 127
  - Command not found

More built in variables

- If your script takes in arguments, they are automatically saved as variables
- The first argument is “1”, the second “2”, etc.
- You can then reference these like variables
  - E.g. `echo "${1}"`
- If your script has a variable number of arguments
  - `"$@"` references an array with all arguments passed
  - This can be iterated over
  - E.g. `for FILENAME in "${@}"`

If statements

Can be used with the `test` command (Hint: man test)

```
if [ ${1} -ge 0 ]
then
   echo “Nonnegative”
else
   echo “Negative”
fi
```

While

While loops work similarly

```
count=1
while [ ${count} -le 10 ]
do
   echo “${count}”
   let count=count+1
done
```

For

For loops also work similarly

```
phrase="hello world"
for c in $phrase
do
   echo "${c}"
done
```

Quotes

- Different quotes mean different things
- Single Quotes: ‘ ’
  - Literal meaning, do not expand
- Double Quotes: “ ”
  - Expand only backticks and $
- Backticks: ` `
  - Expand as shell commands

Redirection Refresher

- Programs have 3 streams
  - stdin (0)
    - Contains data going to program
  - stdout (1)
    - Program writes output here
  - stderr (2)
    - Program writes error messages here

Redirection Refresher

- program < file_in
  - Redirects file_in to stdin
- program > file_out
  - Redirects stdout to file_out
- program 2> file_err
  - Redirects stderr to file_err
- program >> file_out
  - Appends stdout to file_out
- program1 | program2
  - Redirects stdout from program1 to stdin of program2

Regular Expressions

RegEx

- ➔ Allows you to search for patterns rather than a direct search
- ➔ Similar to wildcards
  - ◆ Note however, that they function slightly differently

Anchors

- ^
  - Match the following regular expression with the beginning of a line or string
- $
  - Match the preceding regular expression with the end of a line or string

Quantifiers

- **.**
  - Match any single character
- *****
  - Match 0 or more of the preceding character
- **+**
  - Match 1 or more of the preceding character
- **?**
  - Match 0 or 1 of the preceding character

Quantifiers

- ➔ $\{n\}$
  - Match exactly n of the preceding character
- ➔ $\{n,\}$
  - Match n or more of the preceding character
- ➔ $\{n,m\}$
  - Match n to m of the preceding character

Bracket

- **[...]**
  - Allows a match to any one of the enclosed characters
- **-**
  - A hyphen within a bracket designates a range, like A-Z

POSIX Bracket expressions

Expression	Meaning
[:alnum:]	Alphanumeric Characters
[:alpha:]	Alphabetic Characters
[:blank:]	Space and Tab Characters
[:cntrl:]	Control Characters
[:digit:]	Numeric Characters
[:graph:]	Nonspace Characters

POSIX Bracket expressions

Expression	Meaning
[:lower:]	Lowercase Characters
[:print:]	Printable Characters
[:punct:]	Punctuation Characters
[:space:]	Whitespace Characters
[:upper:]	Uppercase Characters
[:xdigit:]	Hexadecimal Digits

Parentheses

- Parentheses allow you to apply quantifiers to sequences of characters
  - E.g. (ab)*
- Additionally, parentheses form capturing groups
  - These can be backreferenced later in the regular expression
  - E.g. (ab)c\1c
  - You can only store 9 capturing groups (\1-\9)

BRE vs ERE

- Basic Regular Expression (BRE) is the standard mode for sed and grep
- Extended Regular Expression (ERE) is an optional flag you can use with the commands
- What's the difference?
  - BRE tends to take things more literally

BRE vs ERE

- In BRE ‘ ? ’, ‘ + ’, ‘ { ’, ‘ } ’, ‘ (’, and ‘) ’ lose their special meanings
  - They are treated literally
- To use the special meanings, you will either need to use the ERE option, or use ‘ \ ’
  - E.g. \(ab\)\+
- For characters with special meaning, ‘ \ ’ can be used to turn off special meanings of characters
  - Yes, it’s a bit confusing

Searching text with RegEx

- `grep [OPTIONS] PATTERN [FILE...]`
  - Search either FILE(s) or STDIN for the given RegEx PATTERN
  - It will return matching lines
- Useful grep options
  - -E
    - Uses extended regular expressions
  - -F
    - Matches fixed strings

Searching text with RegEx

- `grep [OPTIONS] PATTERN [FILE...]`
  - Search either FILE(s) or STDIN for the given RegEx PATTERN
  - It will return matching lines
- Useful grep options
  - -l
    - Suppress output to only print the filename with matching line
  - -L
    - Suppress output to only print the filename without matching line
  - -v
    - Invert the sense of matching
    - Select non-matching lines

Replacing text with RegEx

- `Sed SCRIPT [FILE]`
  - Stream Editor
- How to construct SCRIPT?
  - Theoretically many ways, but we will focus on text replacement
    - `'s/`***`regexp`***`/`***`replacement`***`/`***`flags`***`'`
  - The ‘s’ signifies substitution
  - Useful flags
    - g - global, replace all matches to ***regexp***, not just the first
    - I - case-**in**sensitive matching
- E.g.
  - `sed 's/[Jj]eremy/John/g'`

Assignment #2

Lab #2

- ➔ Build a file with Hawaiian words
  - ◆ Download a copy of the linked webpage that contains a basic English-to-Hawaiian dictionary
  - ◆ Extract the Hawaiian words
    - Treat upper-case letters as if they were lower-case
    - Treat “<u>a<\u>” as “a”, also for other letters like this
      - Kahako, or a macron, which extends the vowel
    - Treat ` as '
      - Okina, or a glottal stop
    - Treat spaces and commas as breaks between separate words
    - Some entries may be incorrect, so you will need to reject entries that include letters not in the Hawaiian alphabet
      - This means if a word has a non-Hawaiian character, reject the entire word!

Lab #2

- ➔ Automate your site scrape in a script
  - ◆ You should not have to do anything by hand
    - You can download the html outside of the script
  - ◆ It should read the file **from stdin** and write a sorted list of unique words **to stdout**
    - cat foo.html bar.html | ./buildwords | less
      - This command should work with your submitted script
- ➔ Modify the given spell checker to work for Hawaiian
- ➔ Test your spell checker on the hwords file you build, as well as the assignment webpage

Hints

- sed ‘s/<[^>]*>//g’ a.html
  - This will remove all html tags
- sed ‘/pattern1/,/pattern2/d’ input.txt
  - This will delete from pattern1 to pattern2, inclusive
- Useful tr options
  - -d
    - Deletes options in the field, does not translate
  - -s
    - Squeeze repeats, repeated characters reduced to 1 character
- Remember that your spell checker won’t work on upper-case letters if your dictionary is all lower-case