Lecture Participation Poll #3

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Lecture 3: Running Programs in the Shell

CSE 374: Intermediate Programming Concepts and Tools

Administrivia

- Just joined?
- Linux access fixes coming later today
- Discord up and running!

Shell State

- Each new instance of the bash shell maintains a "state"
  - Current location in the file system
- PATH variable
  - Whenever a command is executed there is a list of pre-defined locations bash looks
  - PATH holds the list of pre-designed directories
  - echo $PATH
- Bash rc file
  - A shell script that is automatically run whenever Bash starts up
  - Used to initialize your shell state
  - You can find example files shard online
  - Exists locally on your machine, not on the remote linux server
- Bash history file
  - .bash_history is a hidden file that automatically logs your command history

https://astrobiomike.github.io/unix/modifying_your_path

https://www.gnu.org/software/bash/manual/html_node/Bash-Startup-Files.html

Shell Variables

- Shell variables = string substitution
  - Declare variables in the shell to easily refer to a given string
- Declare variables in the terminal with a name and a string value
  - `<var name>=“<var string>”`
  - EX: `myvar=“myvalue”`
    - Note: no white space allowed on either side of the “=“
- Refer to your variable using the “`$`” symbol before the var name
  - `$<var name>`
  - EX: `echo $myvar`
    - `myvalue`
- Alias
  - Rename a bash command, create your own shortcut
  - `alias <string>=“substitution string”`
    - EX: `alias cheer=“echo hip hip horray!”`
  - Only exists within the currents state of your shell
  - Can store alias in bashrc file to preserve alias across all shells

Math in Bash

- Everything is interpreted as a string
  - No concept of integer values
- To do math use double parenthesis to interpret as arithmetic expression
  - `RES=$((1+2))`
    - `$RES` will be set to "`3`"
  - `MYVAR=$((RES+2))`
    - `$MYVAR` will be "`5`"

Quotes in the Shell

- Double quotes can be used to wrap a string with white space into a single argument
  - EX: `myvar=“Some string”`
- Single quotes tell the shell to treat the string as a literal
  - No variable expansion or command substitution
  - EX: `echo ‘$myvar’`
    - `$myvar`
    - `echo “$myvar”`
    - `Some string`

Demo: Variables and Aliases

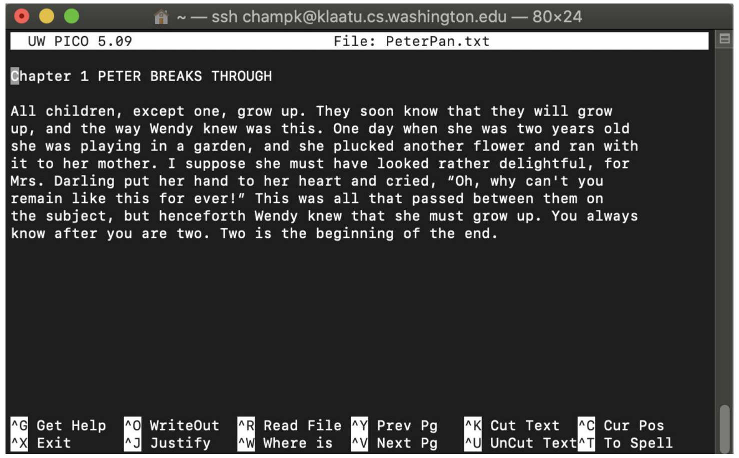
Processes in the Shell

- Programs running in the shell are called "processes"
  - We refer to the code/instructions as the "program"
  - We can run a given program many times, creating many processes
  - Terminal can only run one process in the foreground at a time
    - Use the "`&`" special character to launch a process in the background
    - EX: `emacs &`
- Bash Shell has many built in programs
  - Commands like `cd` and `ls`
- Processes have Input and Outputs
  - Inputs come in two main forms: arguments and stdin
    - Arguments are strings separated by spaces given after the command
  - EX: `cp my/src dest/folder`
      - Arguments: "`my/src`" and "`dest/folder`"
      - Arguments with spaces need to be wrapped in quotes EX: `echo "hello world"`
    - Stdin or Standard Input is a stream that the user enters into the terminal
  - Outputs can be stdout, stderr or a directed to an output file
  - All redirections & string expansions or substitutions are done by the shell before the command

Terminal Text Editing

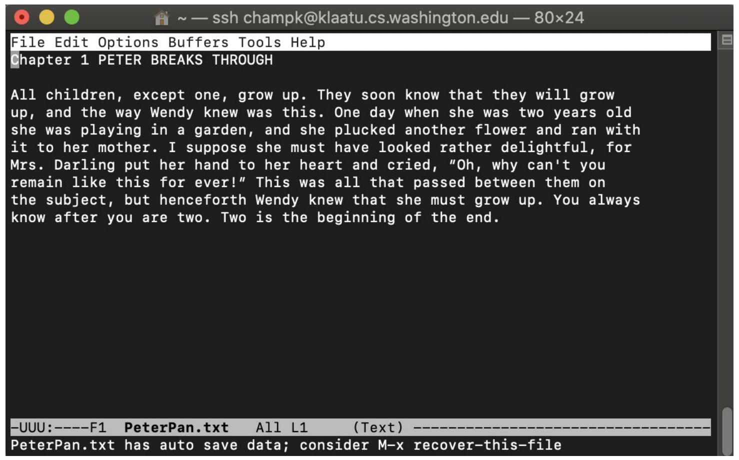
- While working with the text interface for the OS often it is helpful to use the text interface editors
  - You do not have to use any of these in this course
  - You can use Visual Studio Code if you prefer
  - Editors are a matter of preference

PICO



```
  UW PICO 5.09                       File: PeterPan.txt

Chapter 1 PETER BREAKS THROUGH

All children, except one, grow up. They soon know that they will grow
up, and the way Wendy knew was this. One day when she was two years old
she was playing in a garden, and she plucked another flower and ran with
it to her mother. I suppose she must have looked rather delightful, for
Mrs. Darling put her hand to her heart and cried, "Oh, why can't you
remain like this for ever!" This was all that passed between them on
the subject, but henceforth Wendy knew that she must grow up. You always
know after you are two. Two is the beginning of the end.













^G Get Help  ^O WriteOut  ^R Read File ^Y Prev Pg   ^K Cut Text  ^C Cur Pos
^X Exit      ^J Justify   ^W Where is  ^V Next Pg   ^U UnCut Text^T To Spell
```

EMACS



```
File Edit Options Buffers Tools Help
Chapter 1 PETER BREAKS THROUGH

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-UUU:----F1  PeterPan.txt    All L1      (Text) ----------------------------------
PeterPan.txt has auto save data; consider M-x recover-this-file
```
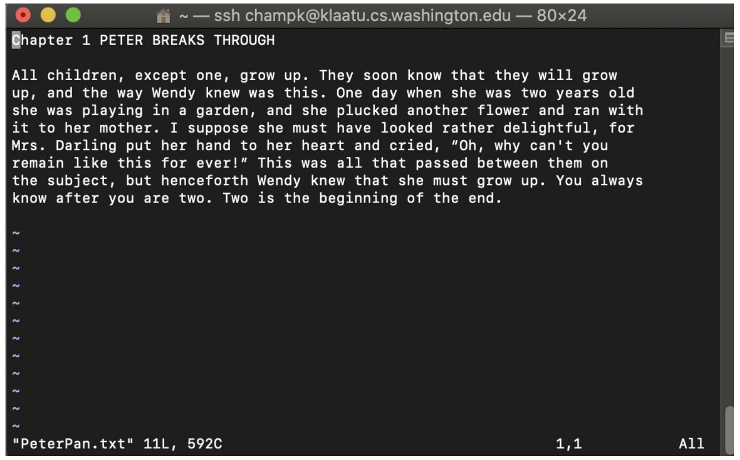

VIM



```
Chapter 1 PETER BREAKS THROUGH

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~
~
~
~
~
~
~
~
~
~
~
~
"PeterPan.txt" 11L, 592C                                      1,1           All
```
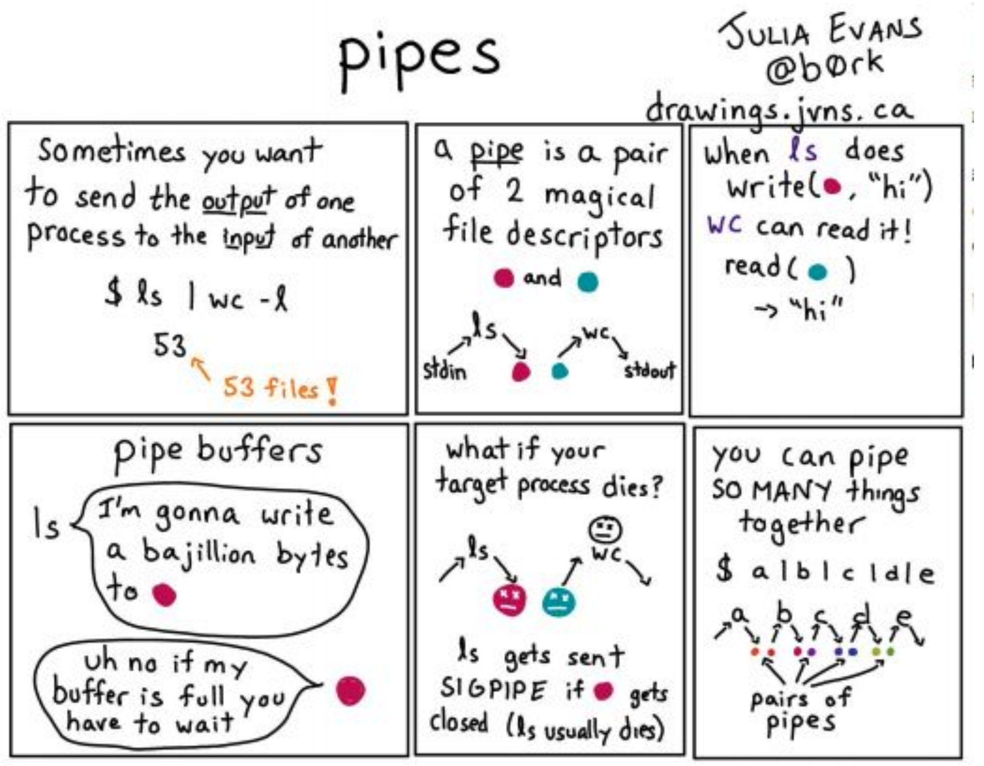

Streams

- stdin – Standard in (File Descriptor = 0)
  - Keyboard input typed into the terminal
- stdout – Standard out (File Descriptor = 1)
  - Results of a process after it has completed printed to the screen of the terminal
- stderr – Standard error (File Descriptor = 2)
  - Results of a process if it exits in error printed to the screen of the terminal
- I/O streams can be redirected
  - `< yourInput`
  - `> yourOutput`
    - Redirect stdout to a file
  - `>> appendYourOutput`
- Pipes – special character "|"
  - Redirect the output of one process to the input of another
  - `cmd1 | cmd2`

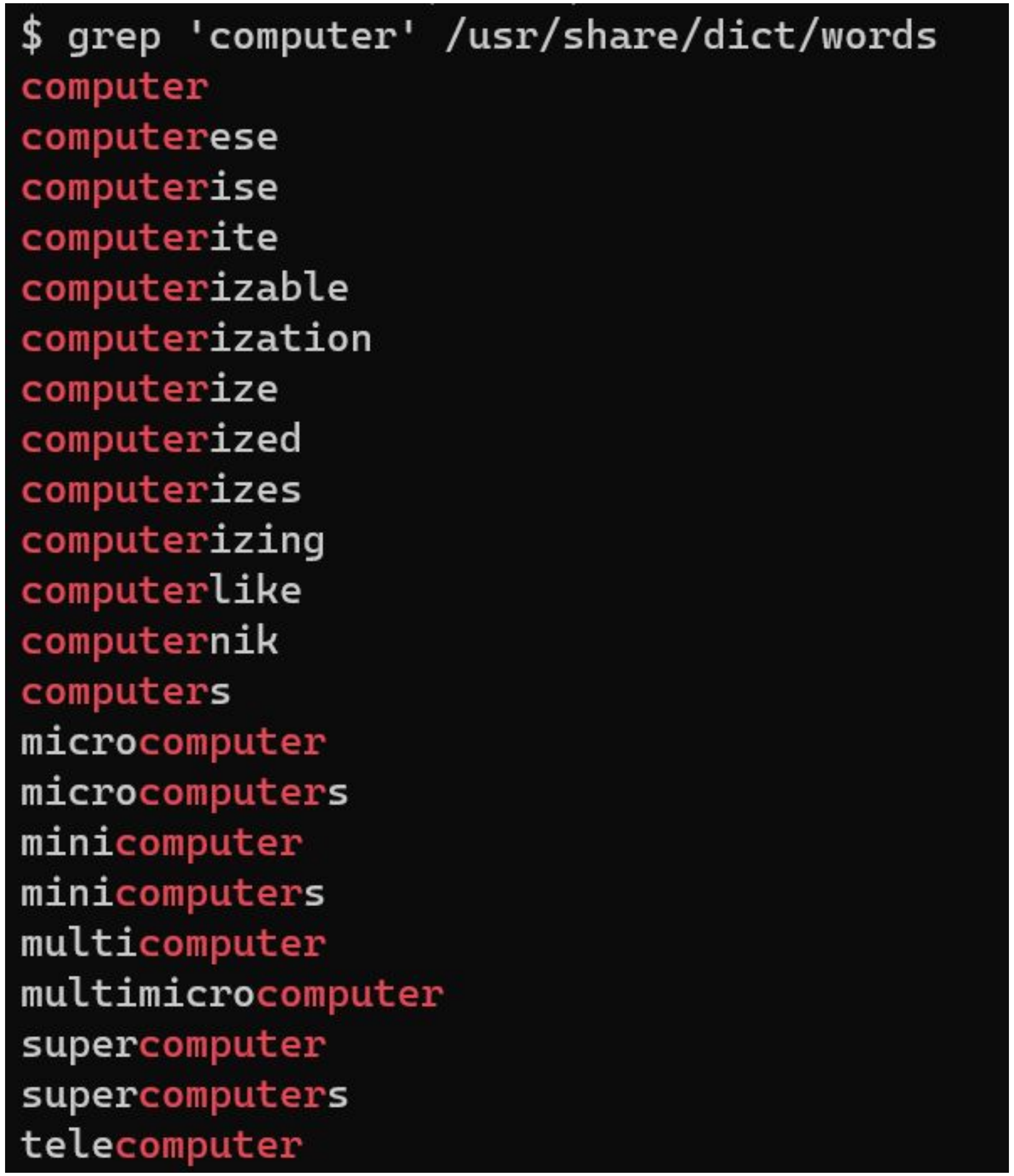

pipes
JULIA EVANS @b0rk drawings.jvns.ca
Sometimes you want to send the output of one process to the input of another
$ ls | wc -l
53
53 files!
a pipe is a pair of 2 magical file descriptors
● and ●
stdin ls wc stdout
when ls does write(●, "hi")
wc can read it!
read(●) → "hi"
pipe buffers
ls
I'm gonna write a bajillion bytes to ●
uh no if my buffer is full you have to wait
what if your target process dies?
ls wc
ls gets sent SIGPIPE if ● gets closed (ls usually dies)
you can pipe SO MANY things together
$ a | b | c | d | e
pairs of pipes

https://www.gnu.org/software/bash/manual/html_node/Redirections.html

https://wiki-dev.bash-hackers.org/syntax/redirection

grep

- Search for a given string within a given file
  - `grep [options] pattern [files]`
  - EX: `grep “computer” /usr/share/dict/words`
- Helpful Options
  - `-c` : prints count of lines with given pattern
  - `-h` : display matched lines (without filenames)
  - `-i` : ignore case when matching
  - `-l` : display list of filenames with matches



```
$ grep 'computer' /usr/share/dict/words
computer
computerese
computerise
computerite
computerizable
computerization
computerize
computerized
computerizes
computerizing
computerlike
computernik
computers
microcomputer
microcomputers
minicomputer
minicomputers
multicomputer
multimicrocomputer
supercomputer
supercomputers
telecomputer
```

https://www.geeksforgeeks.org/grep-command-in-unixlinux/

Demo: Grep

Questions

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Lists in Bash

- Lists in bash are strings with multiple words separated by white space
  - Bash does not have arrays

Writing Scripts

- In a new file…
  - Make first line “#!/bin/bash” this specifies which interpreter to execute
  - Add your commands, save file
  - Make the file executable with chmod u+x