CS35L – Fall 2018

Slide set:	2.1
Slide topics:	Shell scripting, regex, streams
Assignment:	2

Hardware prerequisite (Assignment 7)

Seeed Studio BeagleBone Green Wireless Development Board
https://web.cs.ucla.edu/classes/fall18/cs35L/syllabus.html

Environment Variables

- Variables that can be accessed from any child process

Common ones:

- **HOME**: path to user's home directory
- **PATH**: list of directories to search in for command to execute

- Change value:

  export VARIABLE=…

Locale

A locale

- Set of parameters that define a user's cultural preferences
  - Language
  - Country
  - Other area-specific things

`locale` command

prints information about the current locale environment to standard output

LC_* Environment Variables

`locale` gets its data from the LC_* environment variables

Examples:

- LC_TIME
  Date and time formats

- LC_NUMERIC
  Non-monetary numeric formats

- LC_COLLATE
  Order for comparing and sorting

The 'C' Locale

- The default locale
- An environment of “least surprise”
- Behaves like Unix systems before locales

Locale Settings Can Affect Program Behavior!!

Default sort order for the `sort` command depends:

- LC_COLLATE='C': sorting is in ASCII order
- LC_COLLATE='en_US': sorting is case insensitive except when the two strings are otherwise equal and one has an uppercase letter earlier than the other.

Other locales have other sort orders!

`sort`, `comm`, and `tr`

`sort`: sorts **lines** of **text** files

- Usage: sort [OPTION]…[FILE]…
- Sort order depends on locale
- C locale: ASCII sorting

`comm`: compare two **sorted** files **line by line**

- Usage: comm [OPTION]…FILE1 FILE2
- Comparison depends on locale

`tr`: translate **or** delete characters

- Usage: tr [OPTION]…SET1 [SET2]
- Ex: echo "12345" | tr "12" "ab"

Shell Scripting

The Shell and OS

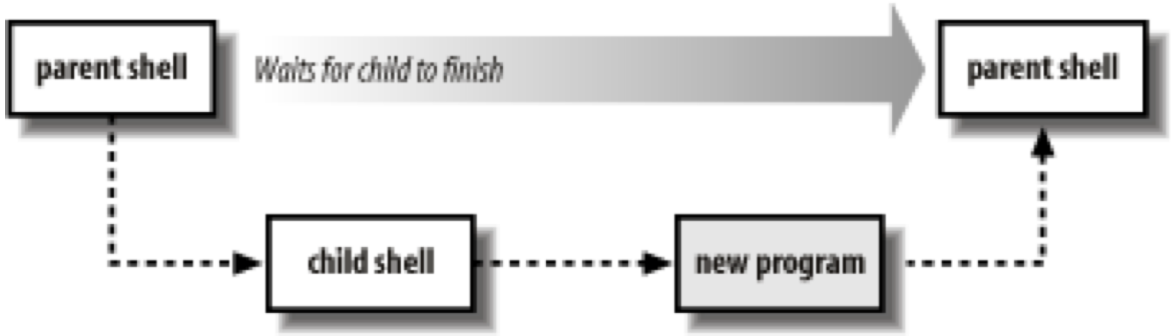
- The shell is a user interface to the OS
- Accepts commands as text, interprets them, uses OS API to carry out what the user wants – open files, start programs...

- Common shells
  - bash, sh, csh, ksh

Scripts: First Line

- A shell script file is just a file with shell commands
- When shell script is executed a new child “shell” process is spawned to run it
- The first line is used to state which child “shell” to use

```
#! /bin/sh
#! /bin/bash
```



Example

- A lab directory for each lab

Before each lab:

- Remove old directory called “lab”

```
rm –rf lab
```

- Create new directory called “lab”

```
mkdir lab
```

- Create 3 files in “lab”

```
touch lab/lab.log
touch lab/lab.txt
touch lab/hw.txt
```

  - lab.log
  - lab.txt
  - hw.txt

Execute shell scripts

```
$ touch script.sh
$ ./script.sh
-bash: ./script.sh: Permission denied
$ ls –al
-rw-r--r--   1 user1 csgrad     0 Apr  6 11:19 script.sh
$ chmod +x script.sh
$ ./script.sh
```

Simple Execution Tracing

- Shell prints out each command as it is executed

- Execution tracing within a script:

  `set -x`: to turn it on

  `set +x`: to turn it off

Output Using `echo` or `printf`

`echo` writes arguments to stdout, can't output escape characters (without –e)

```
$ echo "Hello\nworld"
Hello\nworld
$ echo -e "Hello\nworld"
Hello
world
```

`printf` can output data with complex formatting, just like C printf()

```
$ printf "%.3e\n" 46553132.14562253
4.655e+07
```

Variables

- Declared using =
  - var="hello" **#NO SPACES!!!**
- Referenced using $
  - echo $var

```
#!/bin/sh
message="HELLO WORLD!!!"
echo $message
```

POSIX Built-in Shell Variables

Variable	Meaning
#	Number of arguments given to current process.
@	Command-line arguments to current process. Inside double quotes, expands to individual arguments.
*	Command-line arguments to current process. Inside double quotes, expands to a single argument.
- (hyphen)	Options given to shell on invocation.
?	Exit status of previous command.
$	Process ID of shell process.
0 (zero)	The name of the shell program.
!	Process ID of last background command. Use this to save process ID numbers for later use with the *wait* command.
ENV	Used only by interactive shells upon invocation; the value of $ENV is parameter-expanded. The result should be a full pathname for a file to be read and executed at startup. This is an XSI requirement.
HOME	Home (login) directory.
IFS	Internal field separator; i.e., the list of characters that act as word separators. Normally set to space, tab, and newline.
LANG	Default name of current locale; overridden by the other LC_* variables.
LC_ALL	Name of current locale; overrides LANG and the other LC_* variables.
LC_COLLATE	Name of current locale for character collation (sorting) purposes.
LC_CTYPE	Name of current locale for character class determination during pattern matching.
LC_MESSAGES	Name of current language for output messages.
LINENO	Line number in script or function of the line that just ran.
NLSPATH	The location of message catalogs for messages in the language given by $LC_MESSAGES (XSI).
PATH	Search path for commands.
PPID	Process ID of parent process.
PS1	Primary command prompt string. Default is "$ ".
PS2	Prompt string for line continuations. Default is "> ".
PS4	Prompt string for execution tracing with set -x. Default is "+ ".
PWD	Current working directory.

Exit: Return value

Check exit status of last command that ran with $?

Value	Typical/Conventional Meaning
0	Command exited successfully.
> 0	Failure to execute command.
1-125	Command exited unsuccessfully. The meanings of particular exit values are defined by each individual command.
126	Command found, but file was not executable.
127	Command not found.
> 128	Command died due to receiving a signal

Accessing Arguments

- Positional parameters represent a shell script's command-line arguments

```
#! /bin/sh
#test script
echo "first arg is $1"

./test hello
first arg is hello
```

Quotes-Exercise

```
# a=pwd
# echo ‘$a’
# echo “$a”
# echo `$a`
```

Q) What are the outputs?

Quotes

- Three kinds of quotes
  - Single quotes ' '
    - Do not expand at all, literal meaning
      - Try temp='$hello$hello' ; echo $temp
  - Double quotes " "
    - Almost like single quotes but expand backticks and $
  - Backticks ` ` or $()
    - Expand as shell commands
      - Try temp=`ls` ; echo $temp

if Statements

- If statements use the **test** command or [ ]
- “man test” to see the expressions that can be done

```
#!/bin/bash
if [ 5 –gt 1 ]
then
        echo “5 greater than 1"
else
        echo “error"
fi
```

- Condition for less than or equal??

Loops

- **While loop**

```
#!/bin/sh
COUNT=6
while [ $COUNT -gt 0 ]
do
        echo “Value of count is: $COUNT”
        (( COUNT=COUNT-1 ))
done
```

  - Note the (( )) to do arithmetic operations

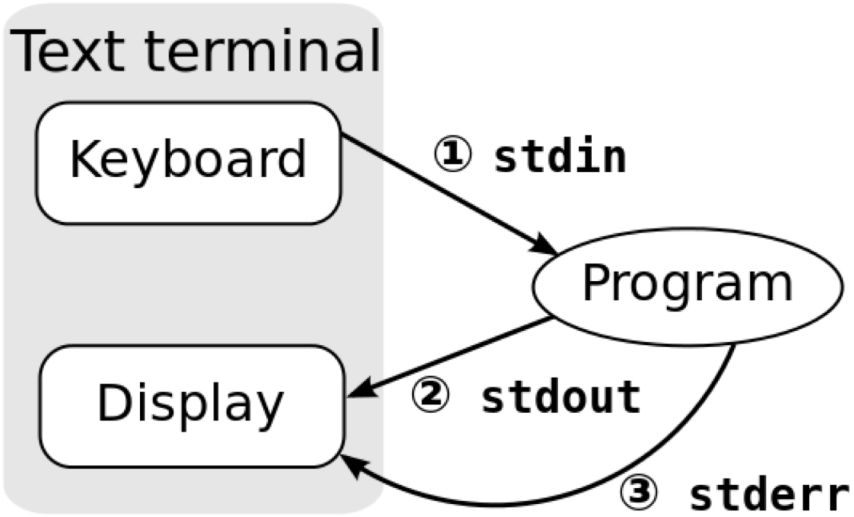
- **For loop**

```
#!/bin/sh
temp=`ls`
for f in $temp
do
        echo $f
done
```

  - f will refer to each word in `ls` output

Standard Streams

- Every program has these 3 streams to interact with the world
  - stdin (0): contains data going into a program
  - stdout (1): where a program writes its output data
  - stderr (2): where a program writes its error msgs



Redirection and Pipelines

- *program < file* redirects *file to programs's stdin*:
  `cat <file`
- *program > file* redirects *program*'s stdout to *file2*:
  `cat <file >file2`
- *program 2> file* redirects *program*'s stderr to *file2*:
  `cat <file 2>file2`
- *program >> file* **appends** program's stdout to *file*
- *program1 | program2* assigns stdout of *program1* as the stdin of *program2; text 'flows' through the pipeline*
  `cat <file | sort >file2`

Regular Expressions

Regular Expressions

- Notation that lets you search for text with a particular pattern:
  - For example: starts with the letter a, ends with three uppercase letters, etc.

- http://regexpal.com/ to test your regex expressions

Regular expressions

Character	BRE / ERE	Meaning in a pattern
\	Both	Usually, turn off the special meaning of the following character. Occasionally, enable a special meaning for the following character, such as for \(...\) and \{...\}.
.	Both	Match any single character except NULL. Individual programs may also disallow matching newline.
*	Both	Match any number (or none) of the single character that immediately precedes it. For EREs, the preceding character can instead be a regular expression. For example, since . (dot) means any character, .* means "match any number of any character." For BREs, * is not special if it's the first character of a regular expression.
^	Both	Match the following regular expression at the beginning of the line or string. BRE: special only at the beginning of a regular expression. ERE: special everywhere.

Regular Expressions (cont'd)

$	Both	Match the preceding regular expression at the end of the line or string. BRE: special only at the end of a regular expression. ERE: special everywhere.
[...]	Both	Termed a bracket expression, this matches any one of the enclosed characters. A hyphen (-) indicates a range of consecutive characters. (Caution: ranges are locale-sensitive, and thus not portable.) A circumflex (^) as the first character in the brackets reverses the sense: it matches any one character not in the list. A hyphen or close bracket (]) as the first character is treated as a member of the list. All other metacharacters are treated as members of the list (i.e., literally). Bracket expressions may contain collating symbols, equivalence classes, and character classes (described shortly).
\{*n*,*m*\}	BRE	Termed an *interval expression*, this matches a range of occurrences of the single character that immediately precedes it. \{*n*\} matches exactly n occurrences, \{*n*,\} matches at least n occurrences, and \{*n*,*m*\} matches any number of occurrences between n and m. n and m must be between 0 and RE_DUP_MAX (minimum value: 255), inclusive.
\(\)	BRE	Save the pattern enclosed between \(and \) in a special *holding space*. Up to nine subpatterns can be saved on a single pattern. The text matched by the subpatterns can be reused later in the same pattern, by the escape sequences \1 to \9. For example, **\(ab\).*\1** matches two occurrences of ab, with any number of characters in between.

Examples

Expression	Matches
tolstoy	The seven letters tolstoy, anywhere on a line
^tolstoy	The seven letters tolstoy, at the beginning of a line
tolstoy$	The seven letters tolstoy, at the end of a line
^tolstoy$	A line containing exactly the seven letters tolstoy, and nothing else
[Tt]olstoy	Either the seven letters Tolstoy, or the seven letters tolstoy, anywhere on a line
tol.toy	The three letters tol, any character, and the three letters toy, anywhere on a line
tol.*toy	The three letters tol, any sequence of zero or more characters, and the three letters toy, anywhere on a line (e.g., toltoy, tolstoy, tolWHOtoy, and so on)

Regular Expressions (cont'd)

\n	BRE	Replay the nth subpattern enclosed in \(and \) into the pattern at this point. n is a number from 1 to 9, with 1 starting on the left.
{n,m}	ERE	Just like the BRE \{*n*,*m*\} earlier, but without the backslashes in front of the braces.
+	ERE	Match one or more instances of the preceding regular expression.
?	ERE	Match zero or one instances of the preceding regular expression.
|	ERE	Match the regular expression specified before or after.
( )	ERE	Apply a match to the enclosed group of regular expressions.

Matching Multiple Characters with One Expression

*	Match zero or more of the preceding character
\{*n*\}	Exactly n occurrences of the preceding regular expression
\{*n*,\}	At least n occurrences of the preceding regular expression
\{*n*,*m*\}	Between n and m occurrences of the preceding regular expression

POSIX Bracket Expressions

Class	Matching characters	Class	Matching characters
[:alnum:]	Alphanumeric characters	**[:lower:]**	**Lowercase characters**
[:alpha:]	Alphabetic characters	[:print:]	Printable characters
[:blank:]	**Space and tab characters**	[:punct:]	Punctuation characters
[:cntrl:]	Control characters	[:space:]	Whitespace characters
[:digit:]	Numeric characters	**[:upper:]**	**Uppercase characters**
[:graph:]	Nonspace characters	[:xdigit:]	Hexadecimal digits

Searching for Text

- grep: Uses basic regular expressions (BRE)

  "meta-characters ?, +, {, |, (, and) lose their special meaning; instead use the backslashed versions" –`man grep`

- egrep (or grep -E): Uses extended regular expressions (ERE) – no backslashes needed
- fgrep (or grep -F): Matches fixed strings instead of regular expressions.

Simple grep

```
$ who                                                    Who is logged on
tolstoy tty1 Feb 26 10:53
tolstoy pts/0 Feb 29 10:59
tolstoy pts/1 Feb 29 10:59
tolstoy pts/2 Feb 29 11:00
tolstoy pts/3 Feb 29 11:00
tolstoy pts/4 Feb 29 11:00
austen pts/5 Feb 29 15:39 (mansfield-park.example.com)
austen pts/6 Feb 29 15:39 (mansfield-park.example.com)

$ who | grep -F austen                        Where is austen logged on?
austen pts/5 Feb 29 15:39 (mansfield-park.example.com)
austen pts/6 Feb 29 15:39 (mansfield-park.example.com)
```

sed (stream editor)

- Now you can extract, but what if you want to replace parts of text?
- Use sed!

```
sed 's/regExpr/replText/[g]'
```

- Example
  - Display the first directory in PATH