

09 - Bash Scripting II

CS 2043: Unix Tools and Scripting, Spring 2016 [1]

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Table of contents

1. Scripting Recap
2. Bash Basics
3. Conditonal Statements
4. Loops

Some Logistics

- All materials have been updated: > became >>>.
- Great job with HW1: only about 20 **git** mishaps I am aware of. Out of 200, that's stellar!
- Today is more scripting. The first bit was in [lec06](#).
- **VIM** will be coming back soon when we hit **ssh...review lec06**.
- Lecture demos 7 and 8 are up.
 - **lec07** is just a transcript of what we did at the end.
 - **lec08** is definitely worth taking a look at...**sed** is *very* powerful.

Scripting Recap

Review I

- A script just executes from the top to the bottom.
 - Calling functions or using variables? They must be defined *first*.
- We are doing **bash**. Use the proper Shebang (`#!/bin/bash`).
- Declaring variables: cannot have spaces on side of equals signs!
 - Yes: `F00="value"`
 - No: `F00 = "value"`
- Dereference the value with the `$` symbol.

```
>>> echo "$F00"
```

 - Note: for safety, always expand variables *inside* double quotes.

```
>>> echo 'Singles joining"$F00"' in doubles...'
```
- Single quotes are the one ring to rule them all.
 - Things are read *literally*, including special symbols.

```
>>> echo '$USER'
```

 - Refer to [3] for more.

Review II

- When you need to execute a command and store it in a variable, you have two options:
 - Surround it with backticks (``...cmd...``):
`>>> VAR=`echo value``
 - Surround it with `$(...cmd...)`:
`>>> VAR=$(echo value)`
 - Both still work, but you should prefer `$(...)` to backticks, as backticks are *deprecated*.
 - Not all commands work out as you expect. If you are not getting the results you expect, print out the variable. A bad example:

```
#!/bin/bash
STATUS=$(echo "error string" > /dev/null)
echo "$STATUS"
```

Remember the Exit Codes

Recall from [lec04](#) that commands have exit codes:

- Always execute:

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

- Execute conditioned upon exit code:

```
>>> 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.
- Reference the exit code of the previous command with `$?`

Bash Basics

Arithmetic Expansion

- The shell will expand arithmetic expressions that are encased in `$((expr))`

```
>>> echo $((2+3)) # standard addition
5
>>> echo $((2<3)) # less than: true is 1
1
>>> echo $((2>3)) # greater than: false is 0
0
>>> echo $((2/3)) # division: BASH IS ONLY INTEGERS!!!
0
>>> x=10 # set a variable
>>> echo $((x++)) # post increment: only for variables,
10 # does it AFTER...
>>> echo "$x" # ...but see it did increment
11
>>> echo $((++x)) # pre increment: only for variables,
12 # does it BEFORE...
>>> echo "$x" # ...only one increment took place
12
>>> sum=$((x+10)) # use variables like normal,
>>> echo "$sum" # note: no quotes "$x" (it is a number)
22
```

Syntax Notes

- The Shebang does not need a space, but can have it if you want. The following all work:

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

- Just needs whitespace, the `#!` is the *magic*. Just need:
 - The `#!` to be the very first two characters, and
 - the executable separated by whitespace *on the same line*.
- In bash, you use `#` to start a comment (line / end of line that will not execute).

Passing Arguments to Scripts

- When you pass arguments to a bash script, you can access them in a few different ways:
 - `$1`, `$2`, ..., `$10`, `$11`: values of the first, second, etc arguments to the script.
 - If you do not have that many arguments, the variable value is just *empty*.
 - `$0` is the name of the script.
 - `$#` is the number of arguments (`argc` in C).
 - `$?` is the exit code of the last program executed.
 - You can have your script set this with `exit <number>`, read the `man` page.
 - `$$` is the current process identification number (PID).
 - `$*` expands `$1 .. $n` into one string.
 - `$* \implies "$1 $2 ... $n"`
 - `$@` expands `$1 .. $n` into individual strings.
 - `$@ \implies "$1" "$2" ... "$n"`

Simple Examples

```
#!/bin/bash
# File: multiply.sh
echo $(( $1 * $2 )) # print out arg1 * arg2
```

```
./multiply.sh 5 10
```

```
#!/bin/bash
# File: toLower.sh
tr '[A-Z]' '[a-z]' < $1 > $2 # read in arg1 and tr into arg2
```

```
./toLower.sh input_file output_file
```

```
#!/bin/bash
# File: expansion.sh
# note the use of single quotes to get a literal *
echo 'This is the *:'
for var in "$*"; do
    echo "Var: $var"
done
echo 'This is the @:'
for var in "$@"; do
    echo "Var: $var"
done
```

```
./expansion.sh hello there "billy bob"
```

Conditonal Statements

If Conditionals

- If statements are structured just as you would expect...

```
if [ CONDITION_1 ]
then
    # statements
elif [ CONDITION_2 ]
then
    # statements
else
    # statements
fi # fi necessary
```

```
# The `then` is necessary...
# use a semicolon to shorten code
if [ CONDITION_1 ]; then
    # statements
elif [ CONDITION_2 ]; then
    # statements
else
    # statements
fi # fi necessary
```

- Double brackets `[[expr]]` allow for more features e.g. boolean operations. You generally should *always* use double brackets.

```
if [[ CONDITION_1 ]] || [[ CONDITION_2 ]]; then
    # statements
elif [[ CONDITION_3 ]] && [[ CONDITION_4 ]]; then
    # statements
else
    # statements
fi # fi necessary
```

- Note that you need spaces before and after the brackets!!!

Test Expressions

- Bash has a special set of commands that allow various checks.
- Numerical comparisons (often used with variables):
 - `n1 -eq n2` tests if $n1 = n2$.
 - `n1 -ne n2` tests if $n1 \neq n2$.
 - `n1 -lt n2` tests if $n1 < n2$.
 - `n1 -le n2` tests if $n1 \leq n2$.
 - `n1 -gt n2` tests if $n1 > n2$.
 - `n1 -ge n2` tests if $n1 \geq n2$.
 - If either `n1` or `n2` are not a number, the test fails.
- String comparisons:
 - `s1 == s2` tests if `s1` and `s2` are identical.
 - `s1 != s2` tests if `s1` and `s2` are different.
 - Make sure you have spaces!
 - `s1==s2` will *fail*...

Path Testing

- If **path** is a string indicating a path, we can test its validity and attributes:
 - **-e path** tests if **path** exists.
 - **-f path** tests if **path** is a file.
 - **-d path** tests if **path** is a directory.
 - **-r path** tests if you have permission to read the file.
 - **-w path** tests if you have write permission.
 - **-x path** tests if you have execute permission.
 - **-s path** tests if the file is empty.
 - There are many of these, refer to [2] for more.

Loops

For Loops

```
for var in s1 s2 s3; do
    cmd1
    cmd2
done
```

```
for var in {000..22}; do
    cmd1
    cmd2
done
```

```
for (( i = 0; i < 10; i++ )); do
    cmd1
    cmd2
done
```

While Loops

```
while [[ condition ]]; do
    cmd1
    cmd2
done
```

```
FILE="filename.txt"
while read line; do
    cmd1
    cmd2
done < "$FILE"
```

```
FILE="filename.txt"
for line in $(cat "$FILE"); do # NEVER DO THIS
    cmd1
    cmd2
done
```

More on Loops

- For whatever reason, **bash** is one of the few languages that has an **until** loop:

```
#!/bin/bash
x=0
until [[ "$x" -eq 11 ]]; do
    echo "$x"
    (( x++ ))
done
```

- The **until** loop is exactly how it sounds: execute the loop body *until* the condition evaluates to **true**.
- So once **x** is **11**, the condition is false.
- This means that only **0..10** actually get printed.
- Lets get some practice!

<https://github.com/cs2043-sp16/lecture-demos/tree/master/lec09>

References I

[1] B. Abrahao, H. Abu-Libdeh, N. Savva, D. Slater, and others over the years.

Previous cornell cs 2043 course slides.

[2] TLDP.

Introduction to if.

http://tldp.org/LDP/Bash-Beginners-Guide/html/sect_07_01.html#sect_07_01_01.

[3] H. to Geek.

What's the difference between single and double quotes in the bash shell?

<http://www.howtogeek.com/howto/29980/whats-the-difference-between-single-and-double-q>

