CS 241: Systems Programming
Lecture 6. Shell Scripting 1

Spring 2020

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Permissions

Every user has an id (uid), a group id (gid) and belongs to a set of groups

Every file has an owner, a group, and a set of permissions

```
steve@clyde:~$ id
uid=1425750506(steve) gid=1425750506(steve) groups=1425750506(steve),1425700508(faculty)
steve@clyde:~$ ls -ld /home
drwxr-xr-x 4 root root 4096 Aug 13  2013 /home
steve@clyde:~$ ls -ld ~
drwxr-x--x 30 steve faculty 50 Sep  2 11:31 /usr/users/noquota/faculty/steve
steve@clyde:~$ ls -l hello.py
-rwx------ 1 steve steve 100 Aug 31 14:31 hello.py
```

First letter of permissions says what type of file it is: `-` is file, `d` is directory

Permissions

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- Files
  - r — the owner/group/other can read the file
  - w — the owner/group/other can write the file
  - x — the owner/group/other can execute the file (run it as a program)

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  - r — the owner/group/other can read the file
  - w — the owner/group/other can write the file
  - x — the owner/group/other can execute the file (run it as a program)
- Directories
  - r — the owner/group/other can see which files are in the directory
  - w — the owner/group/other can add/delete files in the directory
  - x — the owner/group/other can access files in the directory

Permissions example

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-rw-r--r-- 1 steve steve 0 Sep  3 14:25 foo
```

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The owner (steve) can read and write foo, everyone else can read it

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-rwx------ 1 steve steve 100 Aug 31 14:31 hello.py
```
The owner can read, write, or execute, everyone else can do nothing

```
drwxr-x--x 33 steve faculty 54 Sep  3 14:25 .
drwxrwxr-x 2 steve faculty 4 Sep  2 11:45 books/
```
steve and all faculty have full access to ./books, everyone else can see the directory contents

Changing owner/group/perms

Handy shell commands

- `chown` — Change owner (and group) of files/directories
- `chgrp` — Change group of files/directories
- `chmod` — Change permissions for files/directories

Permissions are often specified numerically in octal (base 8)

- `0 = ---` `4 = r--`
- `1 = --x` `5 = r-x`
- `2 = -w-` `6 = rw-`
- `3 = -wx` `7 = rwx`

Common values 777 (`rwxrwxrwx`), 755 (`rwxr-xr-x`) and 644 (`rw-r--r--`)

After running `ls -l` we see the line

```
drwxr-x--- 6 steve faculty 14 Dec 18 15:59 hw6-solutions
```

What of the following statements is **false**?

A. `hw6-solutions` is a directory

B. User `steve` is the only one who can read files in `hw6-solutions`

C. User `steve` is the only one who can write files in `hw6-solutions`

D. Users (other than `steve`) who are not in the `faculty` group cannot see a directory listing for `hw6-solutions`

Shell script basics

The shell executes lines one after another

Here's a file named space (helpfully colored by vim)

```
echo "Hello ${USER}."
disk_usage="$(du --summarize --human-readable "${HOME}" | cut -f 1)"
echo "Your home directory uses ${disk_usage}."
```

I can run this on clyde

```
steve@clyde:~$ bash space
Hello steve.
Your home directory uses 353M.
```

Making the script executable

Provide a "shebang" line

- For bash: `#!/bin/bash`
- This will cause the OS to run `/bin/bash` with the script path as its argument

```
#!/bin/bash

echo "Hello ${USER}."
disk_usage="$(du --summarize --human-readable "${HOME}" | cut -f 1)"
echo "Your home directory uses ${disk_usage}."
```

Make the script executable and run it

```
steve@clyde:~$ chmod +x space
steve@clyde:~$ ./space
Hello steve.
Your home directory uses 353M.
```

For loops

```
for var in word...; do
  commands
done
```

The words undergo expansion

```
for file in *.*; do
  # Expand file and replace everything up to and including the first
  # period with a single period.
  echo "${file/#*./.}"
done
```

Prints out the file extension of each file in the current directory

For loop example

```
for num in {1..10}; do
  echo "${num}"
done
```

Brace expansion makes this identical to

```
for num in 1 2 3 4 5 6 7 8 9 10; do
  echo "${num}"
done
```

C-style for loop

```
for (( num = 1; num <= 10; ++num )); do
  echo "${num}"
done
```

Which for loop should we use to loop over all files with extension `.txt`?

A.
```
for file *.txt; do
  cmds
done
```

B.
```
for file in *.txt; do
  cmds
done
```

C.
```
for file in "*.txt"; do
  cmds
done
```

D.
```
for (( file; *.txt; ++file )); do
  cmds
done
```

E.
```
for (( file; ++file; *.txt )); do
  cmds
done
```

Exit values

Every command returns an integer in the range {0, 1, ..., 127}

- 0 means success
- Everything else means failure

After each command, bash sets the variable `$?` to the exit value of the command

```
$ echo hi; echo "$?"
hi
0
$ ls nonexistant; echo "$?"
ls: cannot access 'nonexistant': No such file or directory
2
```

Conditionals

```
if cmd; then
  more_cmds
fi
```

If `cmd` returns 0 (success), then run `more_cmds`

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```
if cmd1; then
  then_cmds
elif cmd2; then
  then_cmds2
else
  else_cmds
fi
```

```
if true; then
  echo 'Our intuition works!'
fi
```

When run, this code will print out "`Our intuition works!`"

Given that, what value must `true` return?

A. 0

B. 1

C. true

D. false

E. Some other integer

Other loops

while loop

- execute `cmds` as long as `cmd` returns 0

until loop

- execute `cmds` until `cmd` returns 0

```
while cmd; do
  cmds
done

until cmd; do
  cmds
done
```

Conditional expressions

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`[[ expr ]]`

- Evaluates `expr` and returns 0 if it is true and 1 if it is false

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String comparisons

- `str1 OP str2` — `OP` is one of =, !=, <, or >
- `-z str` — true if `str` is an empty string (**z**ero length)
- `-n str` — true if `str` is not an empty string (**n**onzero length)

Conditional expressions

`[[ expr ]]`

- Evaluates `expr` and returns 0 if it is true and 1 if it is false

String comparisons

- `str1 OP str2` — `OP` is one of `=`, `!=`, `<`, or `>`
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Integer comparisons

- `arg1 OP arg2` — `OP` is one of `-eq`, `-ne`, `-lt`, `-le`, `-gt`, or `-ge`

Conditional expressions

File tests

- `-e file` — true if `file` exists
- `-f file` — true if `file` exists and is a regular file
- `-d file` — true if `file` exists and is a directory
- There are a whole bunch more, read `bash(1)` under `CONDITIONAL EXPRESSIONS`

Other operators

- `( expr )` — grouping
- `! expr` — true if `expr` is false
- `expr1 && expr2` — logical AND
- `expr1 || expr2` — logical OR

Complete example

```
#!/bin/bash

# Play a guessing game.

num=$(( RANDOM % 10 + 1 ))

IFS= read -p 'Guess a number between 1 and 10: ' -e -r guess
if [[ "${num}" -eq "${guess}" ]]; then
  echo 'Good guess!'
else
  echo "Sorry. You guessed ${guess} but the number was ${num}."
fi
```

```
$ ./guess
Guess a number between 1 and 10: 3
Sorry. You guessed 3 but the number was 6.
```

In-class exercise

https://checkoway.net/teaching/cs241/2020-spring/exercises/Lecture-06.html

Grab a laptop and a partner and try to get as much of that done as you can!