Introduction to Bash Shell Scripting

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Slides available for download at
https://github.com/rctraining/HPC_Short_Course_Spring_2018

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Introduction

A *shell* is the environment in which commands are interpreted in Linux.

GNU/Linux provides various numerous shells; the most common one is the Bourne Again shell (`bash`).

Other common shells available on Linux systems include:

1) sh ; 2) csh ; 3) tcsh ; 4) ksh

Shell scripts are files containing collections of commands for Linux systems that can be executed as programs.

Shell scripts are powerful tools for performing many types of tasks.

Introduction

- Can be programmed interactively, directly on the terminal.
- It can also be programmed by script files. The first line of the file must contain `#!/bin/bash`.
- The program loader reconizes the `#!` and will interpret the rest of the line (`/bin/bash`) as the interpreter program.
- If a line starts with `#`, it is a comment and is not run.

An example shell script:

```
1  #!/bin/bash
2  # Shell script to list
3  # the files in /tmp.
4
5  cd /tmp
6  ls
```

Variables

- There are no data types.
- A variable can contain a number, a character, a string of characters.
- Shell variables are local.
- Environment variables are global.

```
$ PI=3.14159
$ name=(Andy Monaghan)
$ echo ${name[0]}
$ Andy
$ echo $USER
$ monaghaa
```

Quoting

Quoting is used to remove the special meaning of certain characters or words to the shell.

Quotation	*Description*
`'string'`	Literally treat as string
`"$var"`	Treat as string but interpret variables
`{ }`	Disambiguation

Creating a file with my username in it's name.

```
$ touch "output_${USER}.txt"
```

Command Substitution

Command substitution allows the output of a command to be substituted in place of the command name itself.

- By enclosing the command with `$()`.
- Legacy syntax is using backticks ``` ``.

```
$ NOW=$(date +%Y-%m-%d)
$ echo $NOW
2015-02-11
```

Arithmetic Expansion

Arithmetic expansion provides a mechanism for evaluating an arithmetic expression and substituting its value.

- By enclosing the command with `$(())`.

```
$ sqr_two=$(( 2 * 2 ))
$ echo ${sqr_two}
$ 4
```

Note that Bash only does integer math by default, however it is easy to do floating point math with 'bc'….

```
$ echo "5.6/9.4" | bc -l
$ .59574468085106382978
```

Tests I

Conditions are evaluated between `[ ]` or after the `test` word.

- File comparisons
  - Exists `[ -f file ]`
  - Executable `[ -x file ]`
  - Newer than `[ file1 -nt file2 ]`
  - Older than `[ file1 -ot file2 ]`
- Integer comparisons
  - Equal `[ num1 -eq num2 ]`
  - Not Equal `[ num1 -ne num2 ]`
  - Less than `[ num1 -lt num2 ]`
  - Less or equal `[ num1 -le num2 ]`
  - Greater than `[ num1 -ge num2 ]`

Tests II

- String comparisons
  - Equal `[ string1 = string2 ]`
  - Not equal `[ string1 != string2 ]`
  - Contains `[ string1 =~ string2 ]`
  - Non zero `[ -n string1 ]`
  - Zero `[ -z string1 ]`
- Combining tests
  - And `[ exp1 -a exp2 ]`
  - Or `[ exp1 -o exp2 ]`

A full list is in the `test` manual page (`man test`).

Decisions I

The `if` command executes a compound-list.

- Consisting of `if`, `elif`, `else` and `fi`.

```
x=$(date +%M)
if [ $x -gt 30 ] ; then
        echo "last half of the hour"
elif [ $x -lt 15 ] ; then
        echo "first quarter of the hour"
else
        echo "we're at ${x}"
fi
```

Decisions II

The `case` command executes a compound-list too.

- Consisting of `case` and `esac`.

```
x=10
case ${x} in
  1)  echo "one"      ;;
  5)  echo "five"     ;;
  10) echo "ten"      ;;
  *)  echo "unknown" ;;
esac
```

Loops

There are two types of loops:

```
x=0
while [ $x -lt 10 ] ; do
  echo $x
  x=$(( $x + 1 ))
done
```

```
list=(a b c)
for v in ${list} ; do
  echo $v
done
```

- `continue` will start the next iteration.
- `break` will exit the loop.

Arguments I

It is often useful to pass arguments to a shell script.

- `$0` denotes the script name.
- `$1` denotes the first argument, `$2` the second, up to `${99}`.
- `$#` the total number of arguments.
- `$*` all arguments as a single word
- `$@` all arguments as individual words.

Arguments II

```
#!/bin/bash
# Calculate the sine of the argument.

if [ $# -eq 1 ] ; then
  sine=$(echo "s($1)" | bc -l )
  echo "The sine of $1 is ${sine}"
else
  echo "Usage: $0 <number in radians>" 2>&1
  exit 1
fi
```

Functions I

A function is a user-defined name that is used as a simple command to call a compound command with new positional parameters.

```
function_name () {
  commands
}
```

It is good practice to check the exit status of commands. I do this repeatedly in scripts, so a function is best to define it.

Functions II

```
#/bin/bash

function e {
  echo $1
}

#now test
e Hello
e World
```

Alternatives for Scripting

- `csh/tcsh` C-shell (tcsh: updated version of csh).
- `ksh` Korn shell; related to sh/bash
- `perl` exceptional text manipulation and parsing.
- `python` excellent for scientific and numerical work.
- `ruby` general scripting.
- `make` building executables from source code

Thank you!

Please fill out the survey:
http://tinyurl.com/curc-survey16

Additional Bash learning resources:
http://tldp.org/HOWTO/Bash-Prog-Intro-HOWTO.html *(general)*
https://www.shell-tips.com/2010/06/14/performing-math-calculation-in-bash/ *(math)*

Bash kernel for jupyter notebooks *(install anaconda first)*:
https://github.com/takluyver/bash_kernel