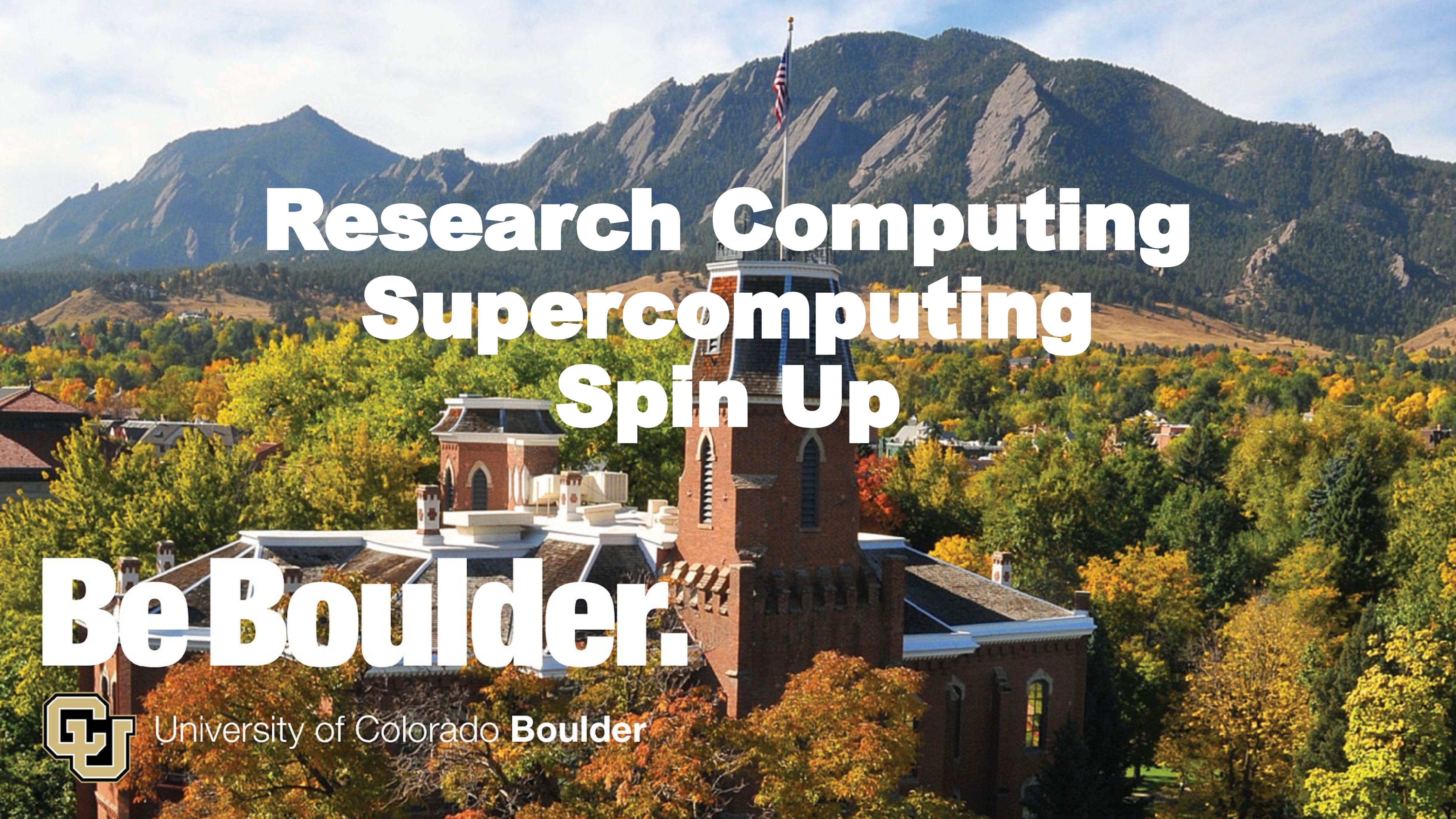
Research Computing Supercomputing Spin Up



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Introduction to Bash Shell Scripting

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Slides and other files available for download and viewing:
https://github.com/ResearchComputing/Supercomputing_Spin_Up_Spring_2020

Intro Demonstration

- A quick intro to demonstrate how you might use shell scripts
- Demo: Making a tool to manage the output from “squeue”
  - Often 1000 lines on Summit
  - Hard to manage
  - Harder to make meaningful

Let’s log in to RC

- (If you are not using your local system)
- To connect to a remote system, use Secure Shell (SSH)
  - From Windows – GUI SSH app such as PuTTY
  - From Linux or Mac OS X terminal, or Windows GUI such as PuTTY or Gitbash, ssh on the command line:

```
ssh <username>@login.rc.colorado.edu
```

Access the slides and examples

- `git clone https://github.com/ResearchComputing/Supercomputing_Spin_Up_Spring_2020.git`

- How to get there: github.com/ResearchComputing/Supercomputing_Spin_Up_Spring_2020
- Clone the repo in your terminal window

- Or open files in a browser and copy/paste

Overview

- Introduction
- Variables
- Quoting
- Command Substitution
- Arithmetic Expansion
- Tests
- Decisions (if)
- Loops (for, while)
- Arguments
- Functions
- Alternatives

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:

- sh, csh, tcsh, ksh, zsh

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.

- 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 recognizes 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.

`#!/bin/bash`	Shell to run
`# the files in /tmp.`	Comments
`cd /tmp`	Change directories
`ls`	List everything in /tmp
`# cd # not needed,why?`	Return to previous?

File editing

- **nano** – simple and intuitive to get started with; not very feature-ful; keyboard driven
- **vi/vim** – universal; keyboard driven; powerful but some learning curve required
- **emacs** – keyboard or GUI versions; helpful extensions for programmers; well-documented
- **LibreOffice** – for WYSIWYG
- Use a local editor via an SFTP program to remotely edit files.

Example 1

test.sh (found in ~/<repo for class>/bash_tutorial)

Note: you can use “nano” to edit files in this tutorial

- type “nano <filename> at the prompt.
- You can edit text as you would in, e.g. MS Word.
- When you are finished, type ctrl-o to write, ctrl-x to exit. See commands at the bottom of the screen.
- How can we run the script?

- **Task: Try adding functionality to only show the last 15 lines/tmp.**

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=(Gerardo Hidalgo)
$ echo ${name[0]}
Gerardo
$ echo $USER
gehi0941
```

Example 2

local_vs_global.sh

- Try to run it first (make sure it’s executable)
- Take a look at the file
- Why does the last “echo” command print correctly?

- **Task: What do we need to set to make this script run as intended?**

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
2018-10-09
```

Example 3

hello_world.txt & **hello.txt**

- Can we execute hello_world.txt?
- What is a command we could use to see the contents of hello_world.txt?

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 the Bash calculator tool, ‘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
```

Example 4

test_for_file.sh

- Task: Write a script (you can name it whatever you'd like) that tests if "calcsine.sh" is executable.

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
```

Example

case_example.sh

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 iteratio
- `break` will exit the loop.

Example

while_example.sh

for_example.sh & for_example_2.sh

- task: fix the depreciated syntax in “for_example.sh”

dateloop_allbash.sh

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.*

*behave differently with double quotes “”

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>"
  exit 1
fi
```

Example

calcsin.sh

- Task: Create a script that prints out the first (non-file name) argument.
- Extra: Check that one (and only one) argument was passed; otherwise let the user know.

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.

Functions II

```
#/bin/bash

# function e
e () {
   echo $1;
}

#now test e
e Hello
e World
```

Example

function.sh

- Task: Modify “function.sh” to echo two arguments passed into the script.

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!

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Please fill out the survey:
http://tinyurl.com/curc-survey18

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