

# Computer Systems and Architecture

## UNIX Scripting

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# Outline

Basics

Conditionals

Loops

Advanced

Exercises

# Shell scripts

- ▶ Grouping commands into a single file
  - Reusability
- ▶ Possible to use programming constructs
  - ▶ Variables
  - ▶ Conditionals
  - ▶ Loops
  - ▶ ...
- ▶ No compilation required

# Creating a shell script

1. Save the script as a (.sh) file
2. Add the line `#!/bin/bash` (or `#!/usr/local/bin/bash` on radix) to the beginning of the script
  - ▶ `#!` indicates that the file is a script
  - ▶ `/bin/bash` is the shell that is used to execute the script
  - ▶ When the script is executed, the program after the `#!` is executed and the name of the script is passed to it
  - ▶ Since the line starts with a `#` it is ignored by the shell
3. Make the script executable using `chmod +x`
4. Execute the script by calling it
  - ▶ Put `./` in front of the name in order to avoid confusion with commands

# Comments

- ▶ Comments are placed behind a # and last until the end of the line
- ▶ There are no multiline comments
- ▶ The #! line is a comment

# Variables

- ▶ Setting variables
  - ▶ `VARIABLE=value`
  - ▶ No spaces before and after the '='
- ▶ Using variables
  - ▶ Place a '\$' before the name
  - ▶ If the variable name is followed by text → place the name between braces
    - ▶ E.g.: `echo "Today is the ${DAY}th day of the week"`
- ▶ Waiting for keyboard input
  - ▶ `read VARIABLE`
- ▶ Exporting variables
  - ▶ To make them accessible from other programs
  - ▶ Place 'export' before the name of the variable
  - ▶ E.g.: `export PATH='/bin:/usr/bin'`

# Special variables

- `$@` Expands to the list of positional parameters, separated by commas
- `$#` The number of positional parameters
- `$0` The name of the script
- `$1, ..., $9` The nine first positional parameters
- `$?` The exit status of the last executed command
- `$!` The PID of the last process that was started in the script
- `$RANDOM` A positive random integer

# Example

- ▶ nano script.sh

```
#!/bin/bash
name='whoami'
echo Hello $name !
```
- ▶ Execute:

```
chmod +x script.sh
./script.sh
```



# Conditions

- ▶ Between [ ... ]
- ▶ Spaces before and after [ ]
- ▶ Examples
  - ▶ [ -d dir ] returns true if dir is a directory
  - ▶ [ \$var -eq 2 ] returns true if \$var equals 2
  - ▶ [ \$var -eq 1 ] || [ \$var -eq 2 ] returns true if \$var equals 1 or 2

# Conditions - Files

- e File exists
- d Is a directory
- f Is a regular file
- r Is readable
- w Is writeable

## Conditions - Strings

-n Length of string is nonzero

-z Length of string is zero

$s1 = s2$  s1 and s2 are identical

$s1 != s2$  s1 and s2 are not identical

## Conditions - Numbers

`i1 -eq i2` `i1` and `i2` variables are equal

`i1 -ne i2` `i1` and `i2` variables are not equal

`i1 -gt i2` `i1` is greater than `i2`

`i1 -ge i2` `i1` is greater than or equal to `i2`

`i1 -lt i2` `i1` is less than `i2`

`i1 -le i2` `i1` is less than or equal to `i2`

## Conditions - And, or, not

! negation (NOT) operator

&& AND operator

|| OR operator

## If statements

```
if [ $# -ne 1 ]
then
    echo Please specify your name
elif id $1 > /dev/null
then
    echo Hello $1
else
    echo I don\'t know you
fi
```

# If statements

- ▶ Zero or more elif clauses are possible
- ▶ The else clause is optional
- ▶ The if body is executed if the exit status of the condition is 0

# Case statements

```
case $NUMBER
in
  11|12|13)
    echo ${NUMBER}th
    ;;
  *1)
    echo ${NUMBER}st
    ;;
  *2)
    echo ${NUMBER}nd
    ;;
  *3)
    echo ${NUMBER}rd
    ;;
  *)
    echo ${NUMBER}th
    ;;
esac
```



# Case statements

- ▶ Executes code based on which pattern matches a word
- ▶ Multiple cases can be specified per block by separating them using '|'
- ▶ Each block has to be terminated by a ';;'
- ▶ Use '\*' to match 'the rest'
- ▶ If multiple cases match, the first one is executed

## For loops

```
for FILE in `ls /bin`  
do  
    echo "Creating link to $FILE..."  
    ln -s /bin/$FILE  
done
```

# For loops

- ▶ The list can be
  - ▶ A literal list: a b c
  - ▶ A glob pattern: \*.jpeg
  - ▶ The output of a command: 'ls -a'
- ▶ The body is executed for each element in the list
- ▶ The Loop variable is set to the value of the current word

## While and until loops

```
while [ -f file.txt ]  
do  
    echo file.txt still exists... Please remove it  
    sleep 5  
done
```

# While and until loops

- ▶ The condition is evaluated on each iteration
- ▶ While loops are executed as long as the exit status of the condition is zero
- ▶ Until loops are executed as long as the exit status of the condition is not zero

# Break and continue

```
for I in `seq 10`  
do  
  if [ $I -eq 3 ]  
  then  
    echo Skipping 3...  
    continue  
  fi  
  
  if [ $I -eq 7 ]  
  then  
    echo Stopping at 7...  
    break  
  fi  
  
  echo The square of $I is $((I*I))  
done
```

# Break and continue

- ▶ `break` causes a loop to be exited immediately
- ▶ `continue` causes a loop to continue with the next iteration
- ▶ An integer parameter can be specified to `continue` or `break` from the  $n$ th enclosing loop
  - ▶ `'break 2'` will break from the second enclosing loop
  - ▶ `'continue 1'` is the same as `'continue'`

# Arithmetic

- ▶ Arithmetic can be performed between `(( and ))`
- ▶ Only operations on integers are possible
- ▶ The exit status is 0 when the result of the expression is not zero and 1 if the result of the expression is zero
- ▶ An expression between `$( ( and ) )` expands to the result of the expression.
- ▶ For more advanced calculations `bc` can be used.



# Arithmetic

```
A=$RANDOM
B=$RANDOM
C=$A
D=$B

while ((D != 0))
do
    TEMP=$D
    D=$((C % D))
    C=$TEMP
done

echo "The GCD of $A and $B is $C"
```

# Functions

- ▶ Functions behave the same as commands
- ▶ The exit status of the function is the exit status of the last executed process
- ▶ Parameters are placed in variables \$1, . . . , \$9
- ▶ Use 'return' to exit from the function early
- ▶ Use the 'local' keyword to make local variables

## Further reading

- ▶ The Bash Manual  
`www.gnu.org/software/bash/manual/bashref.html`
- ▶ Advanced Bash-Scripting Guide  
`tldp.org/LDP/abs/html/`

# Exercises

- ▶ `http://msdl.cs.mcgill.ca/people/hv/teaching/ComputerSystemsArchitecture/#CS3`