

# 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



# How to create a Shell Script

1. Save script as a (.sh) file
2. Add the line `'#!/bin/bash'` 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 - Basic

- Assigning a variable
  - `VARIABLE=value`
  - `VARIABLE=$(command -options arguments)`
  - No spaces before and after the '='!
- Using the value of 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"`
- Getting 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'`



# Variables - Specials

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



# Example

```
script.sh
```

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

```
name=$(whoami)
```

```
echo Hello $name !
```

```
Terminal
```

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

```
./script.sh
```





# Example

```
script.sh
#!/bin/bash
name=$(whoami)
echo Hello $name !
```

Location of shell

Store output of whoami into variable name  
Beware: - put commands between ( and )  
- use \$ to point to value of cmd

Call variable name using '\$'

Make script executable

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

Run script.sh



# Conditions - Basic

- 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

- 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

<code>i1 -eq i2</code>	i1 and i2 are equal
<code>i1 -ne i2</code>	i1 and i2 are not equal
<code>i1 -gt i2</code>	i1 is greater than i2
<code>i1 -ge i2</code>	i1 is greater than or equal to i2
<code>i1 -lt i2</code>	i1 is less than i2
<code>i1 -le i2</code>	i1 is less than or equal to i2

- And, or, not

<code>!</code>	NOT operator
<code>&amp;&amp;</code>	AND operator
<code>  </code>	OR operator

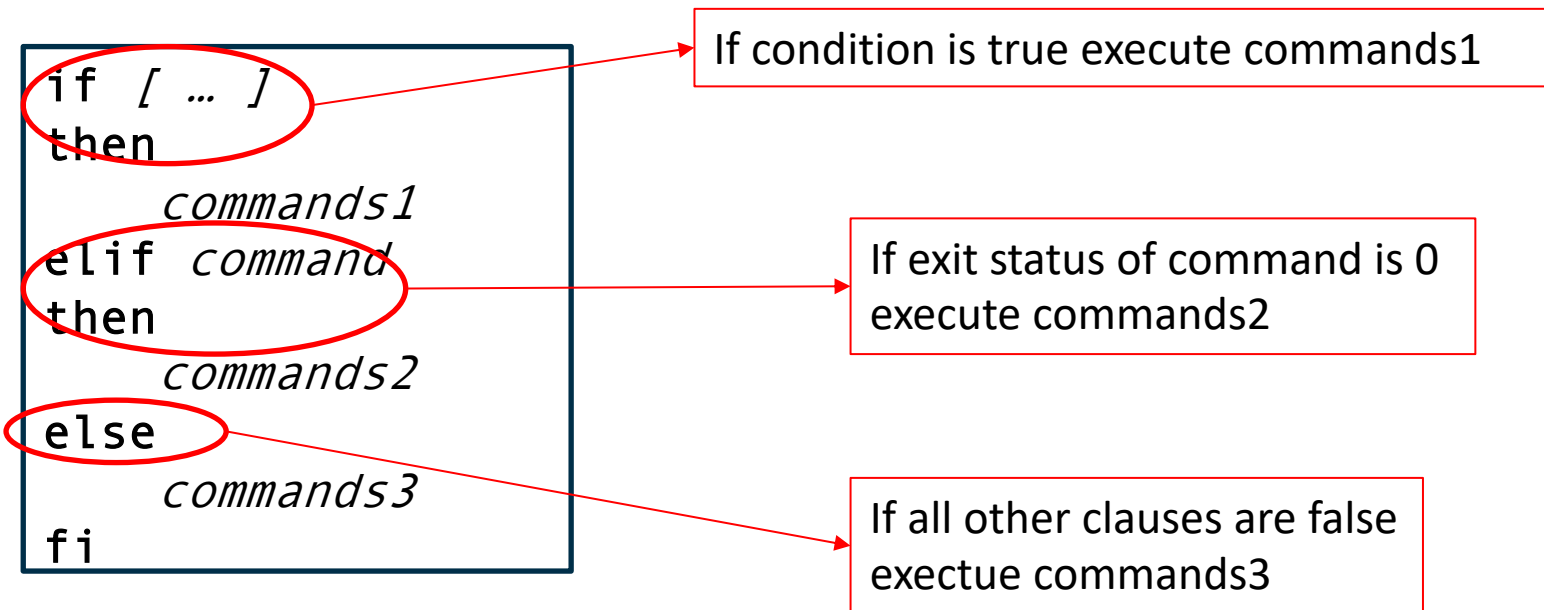
# If statements

- 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

```
if [ ... ]  
then  
    commands1  
elif command  
then  
    commands2  
else  
    commands3  
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

- 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

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

# 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

```
for VARIABLE in list
do
    echo $VARIABLE
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

```
while condition  
do  
    commands  
done
```

```
until condition  
do  
    commands  
done
```

# Break and continue

- Break causes the 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 nth 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 - Example

```
#!/bin/bash

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

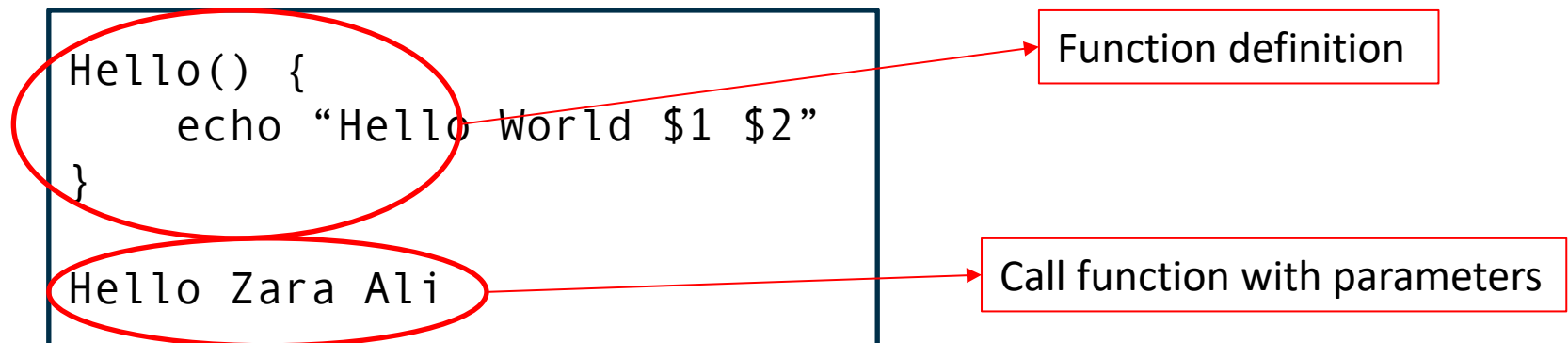
```
Hello() {  
    echo "Hello World $1 $2"  
}
```

```
Hello Zara Ali
```



# Functions

- Functions behave the same as commands
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# Further reading

- The Bash Manual
  - [www.gnu.org/software/bash/manual/bashref.html](http://www.gnu.org/software/bash/manual/bashref.html)
- Advanced Bash-Scripting Guide
  - [www.tldp.org/LDP/abs/html/](http://www.tldp.org/LDP/abs/html/)
- UNIX tutorials
  - [www.tutorialspoint.com/unix/](http://www.tutorialspoint.com/unix/)



# Exercises

- Blackboard
- Course webpage
  - <http://msdl.uantwerpen.be/people/hv/teaching/ComputerSystemsArchitecture/#CS3>