Introduction

Definition of Bash scripting

A bash script is a file containing a sequence of commands that are executed by the bash program line by line. It allows you to perform a series of actions, such as navigating to a specific directory, creating a folder, and launching a process using the command line.

By saving these commands in a script, you can repeat the same sequence of steps multiple times and execute them by running the script.

Advantages of Bash scripting

Bash scripting is a powerful and versatile tool for automating system administration tasks, managing system resources, and performing other routine tasks in Unix/Linux systems. Some advantages of shell scripting are:

- **Automation**: Shell scripts allow you to automate repetitive tasks and processes, saving time and reducing the risk of errors that can occur with manual execution.
- **Portability**: Shell scripts can be run on various platforms and operating systems, including Unix, Linux, macOS, and even Windows through the use of emulators or virtual machines.
- **Flexibility**: Shell scripts are highly customizable and can be easily modified to suit specific requirements. They can also be

combined with other programming languages or utilities to create more powerful scripts.

- **Accessibility**: Shell scripts are easy to write and don't require any special tools or software. They can be edited using any text editor, and most operating systems have a built-in shell interpreter.
- **Integration**: Shell scripts can be integrated with other tools and applications, such as databases, web servers, and cloud services, allowing for more complex automation and system management tasks.
- **Debugging**: Shell scripts are easy to debug, and most shells have built-in debugging and error-reporting tools that can help identify and fix issues quickly.

Overview of Bash shell and command line interface

The terms "shell" and "bash" are used interchangeably. But there is a subtle difference between the two.

The term "shell" refers to a program that provides a command-line interface for interacting with an operating system. Bash (Bourne-Again SHell) is one of the most commonly used Unix/Linux shells and is the default shell in many Linux distributions.

A shell or command-line interface looks like this:

(The shell accepts commands from the user and displays the output)

In the above output, `zaira@Zaira` is the shell prompt. When a shell is used interactively, it displays a `$` when it is waiting for a command from the user.

If the shell is running as root (a user with administrative rights), the prompt is changed to `#`. The superuser shell prompt looks like this:

```
[root@host ~]#
```

Although Bash is a type of shell, there are other shells available as well, such as Korn shell (ksh), C shell (csh), and Z shell (zsh). Each shell has its own syntax and set of features, but they all share the common purpose of providing a command-line interface for interacting with the operating system.

You can determine your shell type using the `ps` command:

```
ps
```

Here is the output for me:

(Checking the shell type. I'm using bash shell)

In summary, while "shell" is a broad term that refers to any program that provides a command-line interface, "Bash" is a specific type of shell that is widely used in Unix/Linux systems.

Note: In this tutorial, we will be using the "bash" shell.

How to Get Started with Bash Scripting

Running Bash commands from the command line

As mentioned earlier, the shell prompt looks something like this:

```
[username@host ~]$
```

You can enter any command after the `$` sign and see the output on the terminal.

Generally, commands follow this syntax:

```
command [OPTIONS] arguments
```

Let's discuss a few basic bash commands and see their outputs. Make sure to follow along :)

- `date`: Displays the current date

```
zaira@Zaira:~/shell-tutorial$ date

Tue Mar 14 13:08:57 PKT 2023
```

- `pwd`: Displays the present working directory.

```
zaira@Zaira:~/shell-tutorial$ pwd

/home/zaira/shell-tutorial
```

- `ls`: Lists the contents of the current directory.

```
zaira@Zaira:~/shell-tutorial$ ls

check_plaindrome.sh  count_odd.sh  env  log  temp
```

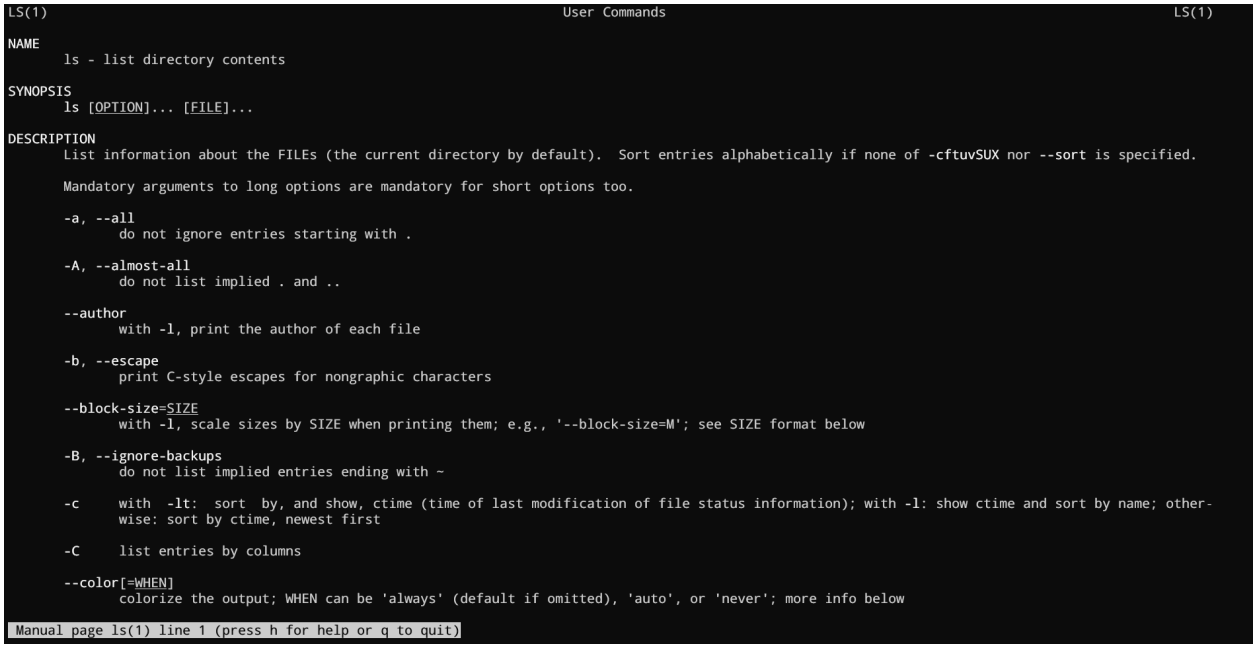
- `echo`: Prints a string of text, or value of a variable to the terminal.

```
zaira@Zaira:~/shell-tutorial$ echo "Hello bash"

Hello bash
```

You can always refer to a commands manual with the `man` command.

For example, the manual for `ls` looks something like this:



You can see options for a command in detail using `man`

How to Create and Execute Bash scripts

Script naming conventions

By naming convention, bash scripts end with `.sh`. However, bash scripts can run perfectly fine without the `sh` extension.

Adding the Shebang

Bash scripts start with a `shebang`. Shebang is a combination of `bash` `#` and `bang` `!` followed by the bash shell path. This is the first line of the script. Shebang tells the shell to execute it via bash shell. Shebang is simply an absolute path to the bash interpreter.

Below is an example of the shebang statement.

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

You can find your bash shell path (which may vary from the above) using the command:

```
which bash
```

Creating our first bash script

Our first script prompts the user to enter a path. In return, its contents will be listed.

Create a file named `run_all.sh` using the `vi` command. You can use any editor of your choice.

```
vi run_all.sh
```

Add the following commands in your file and save it:

```
#!/bin/bash
echo "Today is " `date`

echo -e "\nenter the path to directory"
read the_path

echo -e "\n you path has the following files and folders: "

ls $the_path
```

Script to print contents of a user supplied directory

Let's take a deeper look at the script line by line. I am displaying the same script again, but this time with line numbers.

```
1 #!/bin/bash
2 echo "Today is " `date`
3
4 echo -e "\nenter the path to directory"
```

```
5 read the_path
6
7 echo -e "\n you path has the following files and folders: "

8 ls $the_path
```

- Line #1: The shebang (`#!/bin/bash`) points toward the bash shell path.
- Line #2: The `echo` command is displaying the current date and time on the terminal. Note that the `date` is in backticks.
- Line #4: We want the user to enter a valid path.
- Line #5: The `read` command reads the input and stores it in the variable `the_path`.
- line #8: The `ls` command takes the variable with the stored path and displays the current files and folders.

Executing the bash script

To make the script executable, assign execution rights to your user using this command:

```
chmod u+x run_all.sh
```

Here,

- `chmod` modifies the ownership of a file for the current user :`u`.

- `+x` adds the execution rights to the current user. This means that the user who is the owner can now run the script.
- `run_all.sh` is the file we wish to run.

You can run the script using any of the mentioned methods:

- `sh run_all.sh`
- `bash run_all.sh`
- `./run_all.sh`

Let's see it running in action 🚀

Bash Scripting Basics

Comments in bash scripting

Comments start with a `#` in bash scripting. This means that any line that begins with a `#` is a comment and will be ignored by the interpreter.

Comments are very helpful in documenting the code, and it is a good practice to add them to help others understand the code.

These are examples of comments:

```
# This is an example comment

# Both of these lines will be ignored by the interpreter
```

Variables and data types in Bash

Variables let you store data. You can use variables to read, access, and manipulate data throughout your script.

There are no data types in Bash. In Bash, a variable is capable of storing numeric values, individual characters, or strings of characters.

In Bash, you can use and set the variable values in the following ways:

1. Assign the value directly:

```
country=India
```

2. Assign the value based on the output obtained from a program or command, using command substitution. Note that `$` is required to access an existing variable's value.

```
same_country=$country
```

This assigns the value of `country` to the new variable `same_country`
To access the variable value, append `$` to the variable name.

```
zaira@Zaira:~$ country=India
zaira@Zaira:~$ echo $country
Pakistan
zaira@Zaira:~$ new_country=$country
zaira@Zaira:~$ echo $new_country
```

```
India
```

Assigning and printing variable values

Variable naming conventions

In Bash scripting, the following are the variable naming conventions:

1. Variable names should start with a letter or an underscore (_).
2. Variable names can contain letters, numbers, and underscores (_).
3. Variable names are case-sensitive.
4. Variable names should not contain spaces or special characters.
5. Use descriptive names that reflect the purpose of the variable.
6. Avoid using reserved keywords, such as `if`, `then`, `else`, `fi`, and so on as variable names.

Here are some examples of valid variable names in Bash:

```
name
count
_var
myVar
MY_VAR
```

And here are some examples of invalid variable names:

```
2ndvar (variable name starts with a number)
my var (variable name contains a space)
my-var (variable name contains a hyphen)
```

Following these naming conventions helps make Bash scripts more readable and easier to maintain.

Input and output in Bash scripts

Gathering input

In this section, we'll discuss some methods to provide input to our scripts.

1. Reading the user input and storing it in a variable

We can read the user input using the `read` command.

```
#!/bin/bash
echo "Today is " `date`

echo -e "\nenter the path to directory"
read the_path

echo -e "\nyour path has the following files and folders: "

ls $the_path
```

2. Reading from a file

This code reads each line from a file named `input.txt` and prints it to the terminal. We'll study while loops later in this article.

```
while read line
do
  echo $line
done < input.txt
```

3. Command line arguments

In a bash script or function, `$1` denotes the initial argument passed, `$2` denotes the second argument passed, and so forth.

This script takes a name as a command-line argument and prints a personalized greeting.

```
echo "Hello, $1!"
```

We have supplied `Zaira` as our argument to the script.

```
#!/bin/bash

echo  "Hello, $1!"
```

The code for the script: `greeting.sh`

Output:

Displaying output

Here we'll discuss some methods to receive output from the scripts.

1. Printing to the terminal:

```
echo "Hello, World!"
```

This prints the text "Hello, World!" to the terminal.

2. Writing to a file:

```
echo "This is some text." > output.txt
```

This writes the text "This is some text." to a file named `output.txt`. Note that the `>`operator overwrites a file if it already has some content.

3. Appending to a file:

```
echo "More text." >> output.txt
```

This appends the text "More text." to the end of the file `output.txt`.

4. Redirecting output:

```
ls > files.txt
```

This lists the files in the current directory and writes the output to a file named `files.txt`. You can redirect output of any command to a file this way.

Basic Bash commands (echo, read, etc.)

Here is a list of some of the most commonly used bash commands:

1. `cd`: Change the directory to a different location.
2. `ls`: List the contents of the current directory.
3. `mkdir`: Create a new directory.
4. `touch`: Create a new file.
5. `rm`: Remove a file or directory.
6. `cp`: Copy a file or directory.
7. `mv`: Move or rename a file or directory.
8. `echo`: Print text to the terminal.
9. `cat`: Concatenate and print the contents of a file.
10. `grep`: Search for a pattern in a file.
11. `chmod`: Change the permissions of a file or directory.
12. `sudo`: Run a command with administrative privileges.
13. `df`: Display the amount of disk space available.
14. `history`: Show a list of previously executed commands.

15. `ps`: Display information about running processes.

Conditional statements (if/else)

Expressions that produce a boolean result, either true or false, are called conditions. There are several ways to evaluate conditions, including `if`, `if-else`, `if-elif-else`, and nested conditionals.

Syntax:

```
if [[ condition ]];
then
     statement
elif [[ condition ]]; then
     statement
else
     do this by default

fi
```

Syntax of bash conditional statements

We can use logical operators such as AND `-a` and OR `-o` to make comparisons that have more significance.

```
if [ $a -gt 60 -a $b -lt 100 ]
```

This statement checks if both conditions are `true`: a is greater than 60 AND b is less than 100.

Let's see an example of a Bash script that uses `if`, `if-else`, and `if-elif-else` statements to determine if a user-inputted number is positive, negative, or zero:

```
#!/bin/bash

echo "Please enter a number: "
read num

if [ $num -gt 0 ]; then
   echo "$num is positive"
elif [ $num -lt 0 ]; then
   echo "$num is negative"
else
   echo "$num is zero"
fi
```

Script to determine if a number is positive, negative, or zero

The script first prompts the user to enter a number. Then, it uses an `if` statement to check if the number is greater than 0. If it is, the script outputs that the number is positive. If the number is not greater than 0, the script moves on to the next statement, which is an `if-elif` statement. Here, the script checks if the number is less than 0. If it is, the script outputs that the number is negative. Finally, if the number is neither greater than 0 nor less than 0, the script uses an `else` statement to output that the number is zero.

(Seeing it in action 🚀)

Looping and Branching in Bash

While loop

While loops check for a condition and loop until the condition remains `true`. We need to provide a counter statement that increments the counter to control loop execution.

In the example below, `(( i += 1 ))` is the counter statement that increments the value of `i`. The loop will run exactly 10 times.

```
#!/bin/bash
i=1
while [[ $i -le 10 ]] ; do
     echo "$i"
    (( i += 1 ))

done
```

(While loop that iterates 10 times.)

For loop

The `for` loop, just like the `while` loop, allows you to execute statements a specific number of times. Each loop differs in its syntax and usage.

In the example below, the loop will iterate 5 times.

```
#!/bin/bash

for i in {1..5}
do
       echo $i

done
```

(For loop that iterates 5 times.)

Case statements

In Bash, case statements are used to compare a given value against a list of patterns and execute a block of code based on the first pattern that matches. The syntax for a case statement in Bash is as follows:

```
case expression in
     pattern1)
          # code to execute if expression matches pattern1
          ;;
     pattern2)
          # code to execute if expression matches pattern2
          ;;
     pattern3)
          # code to execute if expression matches pattern3
          ;;
     *)
          # code to execute if none of the above patterns match expression
          ;;
esac
```

Case statements syntax

Here, "expression" is the value that we want to compare, and "pattern1", "pattern2", "pattern3", and so on are the patterns that we want to compare it against.

The double semicolon ";;" separates each block of code to execute for each pattern. The asterisk "*" represents the default case, which executes if none of the specified patterns match the expression.

Let's see an example.

```
fruit="apple"

case $fruit in
      "apple")
            echo "This is a red fruit."
            ;;
      "banana")
            echo "This is a yellow fruit."
            ;;
      "orange")
            echo "This is an orange fruit."
            ;;
      *)
            echo "Unknown fruit."
            ;;
esac
```

Example of case statement

In this example, since the value of "fruit" is "apple", the first pattern matches, and the block of code that echoes "This is a red fruit." is executed. If the value of "fruit" were instead "banana", the second pattern would match and the block of code that echoes "This is a yellow fruit." would execute, and so on. If the value of "fruit" does

not match any of the specified patterns, the default case is executed, which echoes "Unknown fruit."

How to Debug and Troubleshoot Bash Scripts

Debugging and troubleshooting are essential skills for any Bash scripter. While Bash scripts can be incredibly powerful, they can also be prone to errors and unexpected behavior. In this section, we will discuss some tips and techniques for debugging and troubleshooting Bash scripts.

Set the `set -x` option

One of the most useful techniques for debugging Bash scripts is to set the `set -x` option at the beginning of the script. This option enables debugging mode, which causes Bash to print each command that it executes to the terminal, preceded by a `+` sign. This can be incredibly helpful in identifying where errors are occurring in your script.

```
#!/bin/bash

set -x

# Your script goes here
```