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*I confirm that I understand my coursework needs to be submitted online via Google Classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and marks of zero will be awarded.*

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# TASK A

## Introduction

Bash is a UNIX command and command processor. It is widely available on different operating system and is default command interpreter on most UNIX systems It is written by Brian fox for the GNU project. Bash stands for Bourne again shell. It is the advanced version of Bourne shell. It is one of the scripting languages. It can be also used for the programming on the POSIX platform for small tasks. It offers functional improvements over sh for both programming and interactive use. It is a command processor usually rums in a window user types commands to perform some actions. It allows users to interact with the system through the command line effectively. It can perform operations on multiple files quickly through command lines. (Rendek, 2020)

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## Script

```
1. #!/bin/bash
2. toContinue(){
3.   echo ""
4.   echo -e "Do you want to continue this again? "
5.   echo "-----------'Yes' or 'No'-------------"
6.   echo -e "Yes- To repeat.\nNo- To exit."
7.   echo ""
8.   read ans
9.   if [ -z $ans ]
10.          then
11.                  echo "****************************************"
12.                  echo "*-----------  Warning!!! -----------   *"
13.                  echo "The input must be either 'Yes' or 'No'."
14.                  echo "****************************************"
15.          elif [ $ans == No ]
16.          then
17.                  exit 0
18.          elif [ $ans == Yes ]
19.          then
20.                  countryCode
21.          else
22.                  echo "Please enter 'Yes' to repeat and 'No' to exit."
23.          fi
24.  }
25.
26.
27.  choosePlayer(){
```

```
28.         if [ $1 == 3 ]
29.         then
30.                 echo ""
31.                 echo "***--Choose your favourite Player.--***"
32.                 PS3="Select the player: "
33.                 select code in $P1 $P2 $P3
34.                 do
35.                         case $code in
36.                         "LM") cat messi
37.                             break
38.                           ;;
39.                          "NJ") cat neymar
40.                             break
41.                           ;;
42.                           "KC") cat kiran
43.                             break
44.                           ;;
45.                           "ZZ")
46.                                 echo
   "***********************************"
47.                                 echo "*  Sorry! File not found.
   *"
48.                                 echo
   "***********************************"
49.                                 break
50.                           ;;
51.                           "HK")
52.                                 echo
   "***********************************"
53.                                 echo "*  Sorry! File not found.
   *"
54.                                 echo
   "***********************************"
55.                                 break
56.                           ;;
57.                           *) echo "Enter valid input.!"
58.                                 choosePlayer 3
59.                           ;;
60.                     esac
61.                 done
62.                 toContinue
63.             else
64.                  echo ""
65.                  echo "Warning!! Please enter valid input"
66.                  PlayerCode
67.             fi
68.  }
69.
70.  playerCode(){
71.         echo ""
72.         echo "************************************"
73.         echo ""
74.         echo "---------------------------------"
75.         echo "| Player Code    | Player Name    |"
76.         echo " ---------------------------------"
77.         echo "| LM             | Lionel Messi   |"
78.         echo "| NJ             | Neymar Junior  |"
```

```
79.         echo "| KC             | Kiran Chemjong |"
80.         echo "| ZZ             | Zheng Zhi      |"
81.         echo "| HK             | Harry Kane     |"
82.         echo "----------------------------------"
83.         echo ""
84.         echo "Choose any three players.(Player code)"
85.         echo ""
86.         echo -e "Enter Players code:(separated by a space)"
87.         read P1 P2 P3
88.         player=($P1 $P2 $P3)
89.         noOfArg=${#player[@]}
90.         if [[ ${#player[@]} -eq 3 ]]
91.         then
92.                 if [ $P1 == $P2 ] || [ $P2 == $P3 ] || [ $P1 == $P3 ]
93.                 then
94.                         echo -e "\n|-----------------------------|"
95.                         echo -e "|Do not enter same player code.|\n|Try
   different code.           |"
96.                         echo -e "|-----------------------------|"
97.                         playerCode
98.                 else
99.                         for a in $player
100.                        do
101.                        if [[ $a == "LM" || $a == "NJ" || $a == "KC" ||
   $a == "ZZ" || $a == "HK" ]]
102.                        then
103.                                continue
104.                        else
105.                                echo ""
106.                                echo "Please enter the valid code
   provided in the list."
107.                                playerCode
108.                        fi
109.                        done
110.                fi
111.                choosePlayer 3
112.        else
113.        echo ""
114.        echo -e ""
115.        echo -e "Enter the code of only 3 players.(seperated by a
   space)"
116.        echo -e ""
117.      playerCode
118.      fi
119. }
120.
121. countryDesc(){
122.        echo "**************************************"
123.        echo "---------------NEPAL-------------------"
124.        echo -e "-Nepal is the best football team.\n-It has recently
   won three Nations Cup.\n"
125.        playerCode
126. }
127.
128. countryCode(){
129.        echo "********************************"
130.        echo ""
```

```
131.        echo "--------------------------------"
132.        echo "| Country Code   | Country Name |"
133.        echo " --------------------------------"
134.        echo "| BRZ            | Brazil       |"
135.        echo "| ARG            | Argentina    |"
136.        echo "| NEP            | Nepal        |"
137.        echo "| CHI            | China        |"
138.        echo "| ENG            | England      |"
139.        echo "--------------------------------"
140.        echo ""
141.
142.        country=""
143.        until [[ $country == NEP ]]
144.        do
145.                echo ""
146.                echo -e "Which is the best football team?"
147.                echo ""
148.                echo -e "Enter the country code here--> \c"
149.                read country
150.                echo ""
151.                case $country in
152.                "BRZ")
153.                echo "****************************************"
154.                echo -e "The code you have entered is wrong.\nPLease
    choose another Country code."
155.                echo "****************************************"
156.                ;;
157.                "ARG")
158.                echo "****************************************"

159.                echo -e "The code you have entered is wrong.\nPLease
    choose another Country code."
160.                echo "****************************************"

161.                ;;
162.                "NEP") echo -e "Congrulations!!!.You have entered
    correct country code."
163.                ;;
164.                "CHI")
165.                echo "****************************************"
166.                echo -e "The code you have entered is wrong.\nPLease
    choose another Country code."
167.                echo "****************************************"

168.                ;;
169.                "ENG")
170.                echo "****************************************"
171.                echo -e "The code you have entered is wrong.\nPLease
    choose another Country code."
172.                echo "****************************************"

173.                ;;
174.                *)
175.                echo "******************************************"

176.                echo "Sorry! Please enter the valid country code."
177.                echo "******************************************"
```

```
178.                 echo ""
179.                 esac
180.         done
181.         echo ""
182.         countryDesc
183. }
184.
185. user(){
186.         echo -e "ID Number: " $1
187.         echo -e "User Name: " $2
188.         echo "Date:" $(date)
189. }
190.
191.
192. if [ $# -gt 2 ]
193. then
194.         echo -e "Sorry! only two parameter are acceptable.\n So,You
   must enter only two parameter to enter into the system."
195. elif [ $# == 2 ]
196. then
197.         num=1
198.         while [ $num -le 5 ]
199.         do
200.                 echo -e "Enter your secret key:--> \c"
201.                 read sk
202.                 if [ $sk == 1 ]
203.                 then
204.                         echo "**********************"
205.                         echo "--------FOOTBALL--------"
206.                         echo "--------WELCOME----------"
207.                         user $2 $1
208.                         countryCode
209.                         break
210.                 else
211.                         echo "You have entered incorrect password $num
   times."
212.                         ((num++))
213.                         if (( $num == 5 ))
214.                         then
215.                                 echo -e "\nThe program is being
   terminated....."
216.                                 sleep 3s
217.                                 exit 0
218.                         fi
219.                 fi
220.         done
221. else
222.         echo "Please enter two parameters to enter into the system."
223. fi
```

**Test cases for testing:**

**Test-1 → Run without name**

| **Test no.** | 1 |
|---|---|
| Input | bash 19031837cw2ii 19031837 was entered |
| Expected output | The program was not opened and error message was displayed saying "Please enter two parameters to enter into the system." |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 1: Test 1*

**Screenshots**

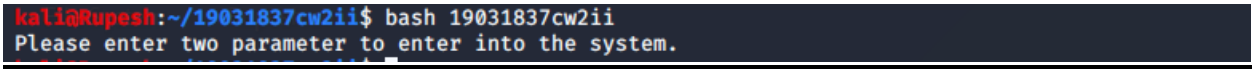


*Figure 1: Running the program without name*

**Test-2 → Run with more than two arguments**

| **Test no.** | 2 |
|---|---|
| Input | bash 19031837cw2ii Rupesh 19031837 aaa fgd was entered |
| Expected output | The program was not opened displaying "Sorry! You must enter two parameters to enter into the system." |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 2: Test 2*

**Screenshots**

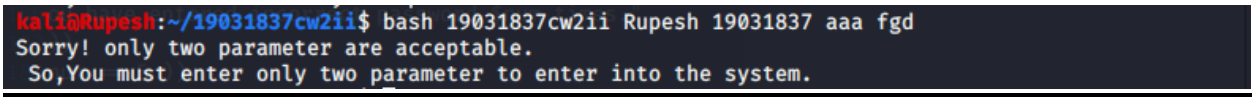


*Figure 2: Running with more than two arguments*

**Test-3 → Run with username and id**

| **Test no.** | 3 |
|---|---|
| Input | bash 19031837cw2ii Rupesh 19031837 was entered |
| Expected output | Program was opened and it asks for secret key. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 3: Test 3*

**Screenshots**

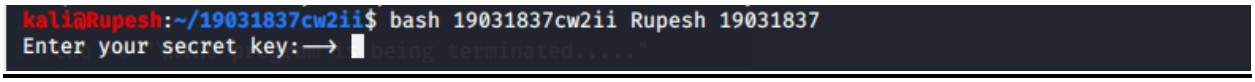


*Figure 3: Running with username and id*

**Test-4 → Run incorrect password 5 times**

| **Test no.** | 4 |
|---|---|
| Input | abc1, xyz123, abc, xyz was entered |
| Expected output | The program will show the incorrect password 5 times. |
| Actual output | As the program was made to enter password only four times so it gets terminated by running four times only. |
| Test Result | The test was failed. |

*Table 4: Test 4*

**Screenshots**

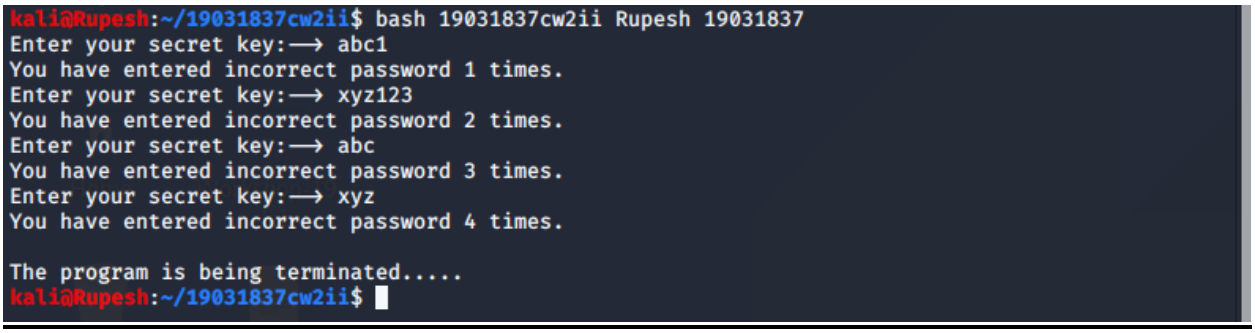


*Figure 4: Running incorrect password 5 times*

**Test-5 → Run correct password**

| **Test no.** | 5 |
|---|---|
| Input | Rup123 was entered |
| Expected output | The secret key was correct and it lead us to next step displaying the country code. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 5: Test 5*

**Screenshots**

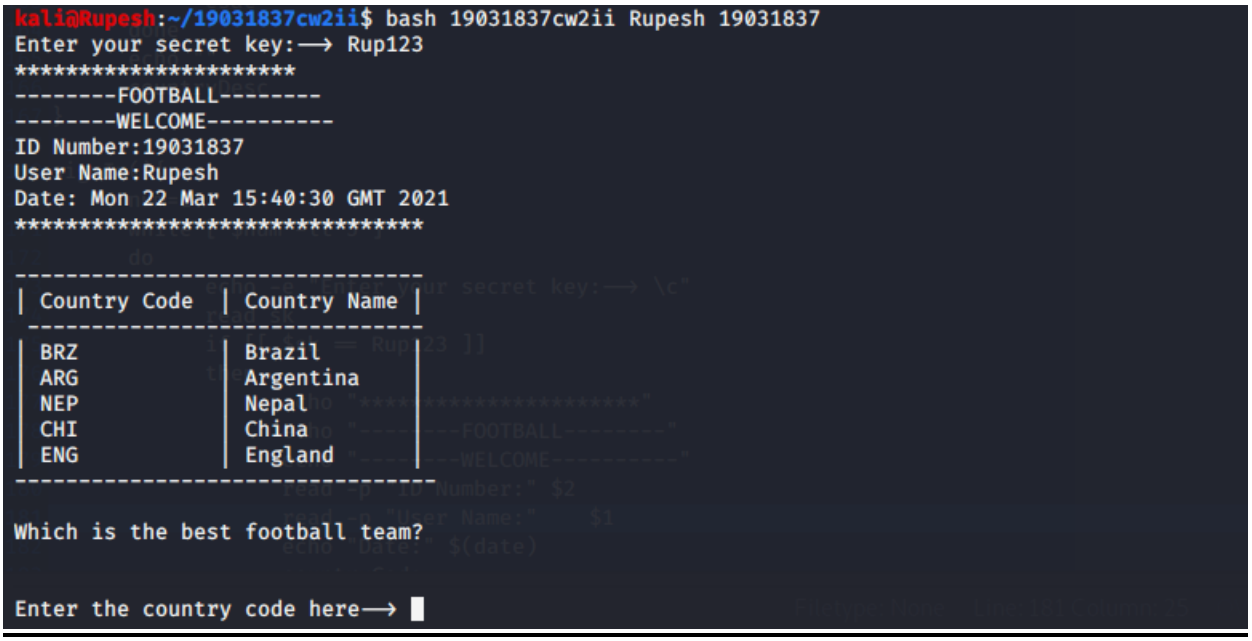


*Figure 5: Running correct password*

**Test-6 → Country name**

| **Test no.** | 6 |
|---|---|
| Input | Nepal was entered |
| Expected output | The entered data was incorrect so it asks to enter valid data again. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 6: Test 6*

**Screenshots**

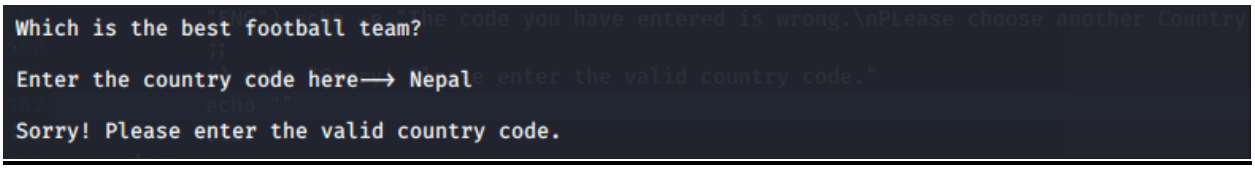


*Figure 6: Running with country name instead of country code*

**Test-7 → Incorrect country Code**

| **Test no.** | 7 |
|---|---|
| Input | AAA was entered |
| Expected output | The entered data was incorrect so it asks to enter valid data again. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 7: Test 7*

**Screenshots**

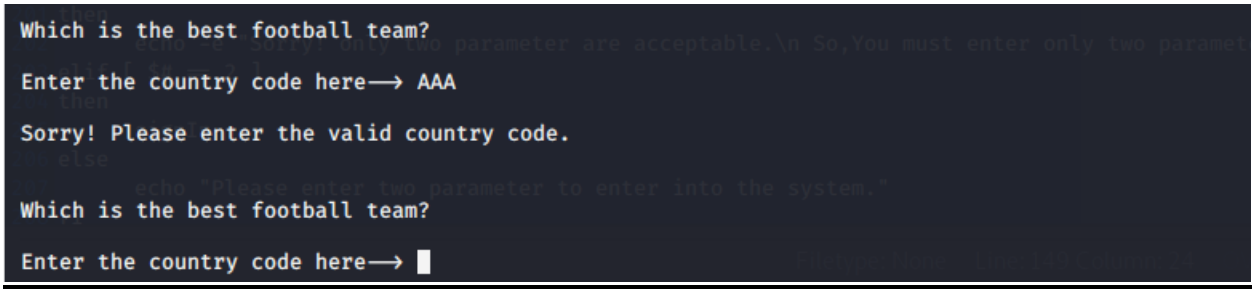


*Figure 7: Running with incorrect country code*

**Test-8 → Correct country code but wrong selection**

| **Test no.** | 8 |
|---|---|
| Input | BRZ was entered |
| Expected output | The entered country code was correct but it was not the right code. So it asks to enter the country code again. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 8: Test 8*

**Screenshots**

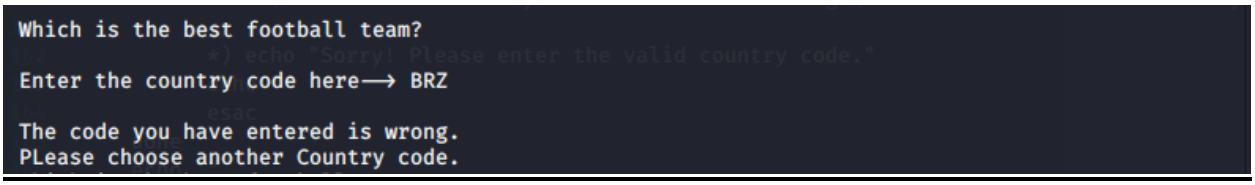


*Figure 8: Running with correct country code but wrong selection*

**Test-9 → Correct country code**

| **Test no.** | 9 |
|---|---|
| Input | NEP was entered |
| Expected output | The country code was right so it leads us to next step displaying the players code. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 9: Test 9*

**Screenshots**

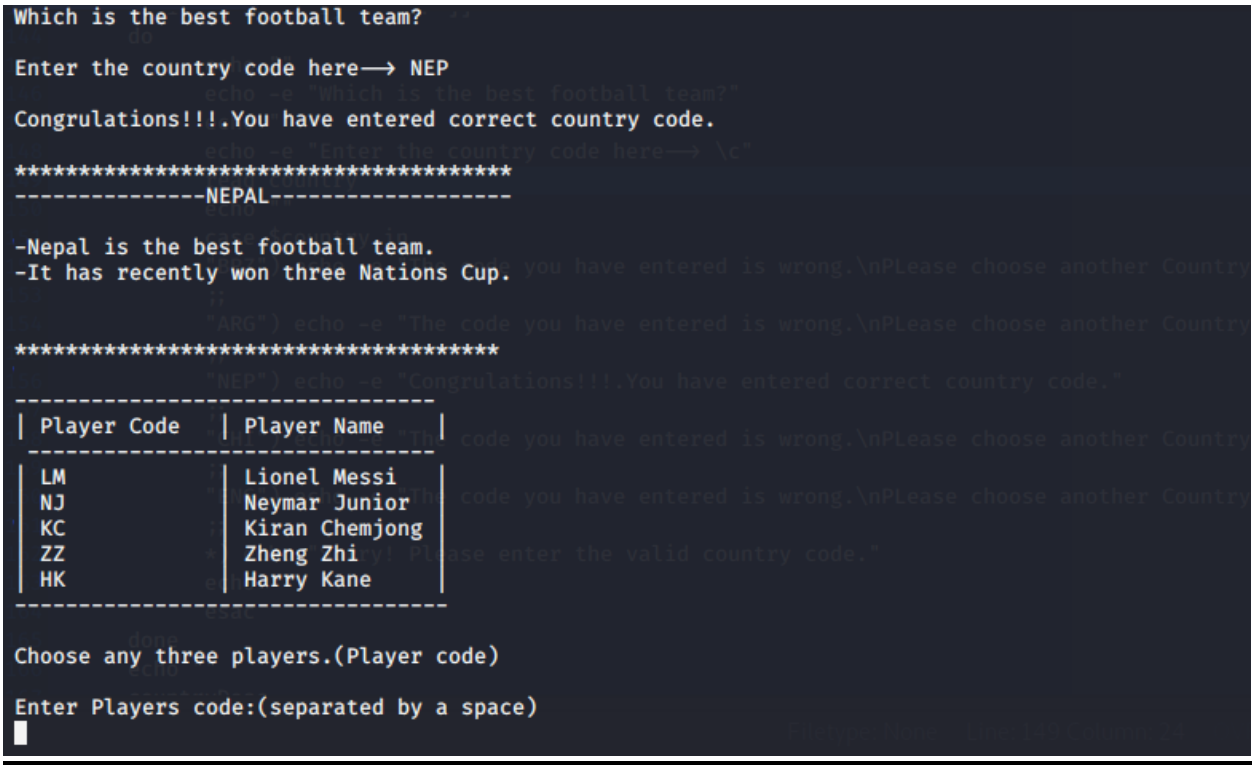


*Figure 9: Running with correct country code*

**Test-10 → Pick 4 player names**

| **Test no.** | 10 |
|---|---|
| Input | LM NJ KC ZZ was entered |
| Expected output | It asks us to enter code of only three players.<br>Code of 4 players is not acceptable. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 10: Test 10*

**Screenshots**


*Figure 10: Putting the name of 4 players*

**Test-11 → Pick same player name**

| **Test no.** | 11 |
|---|---|
| Input | LM LM LM was entered |
| Expected output | It asks us to input code of 3 different players not the same code of a player. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 11: Test 11*

**Screenshots**

```
Choose any three players.(Player code)

Enter Players code:(separated by a space)
LM LM LM

|-----------------------------|
|Do not enter same player code.|
|Try different code.          |
|-----------------------------|

***********************************

--------------------------------
| Player Code   | Player Name   |
 ------------------------------
| LM            | Lionel Messi  |
| NJ            | Neymar Junior |
| KC            | Kiran Chemjong|
| ZZ            | Zheng Zhi     |
| HK            | Harry Kane    |
--------------------------------
```

*Figure 11: Putting the same player name*

**Test-12 → Different player name**

| **Test no.** | 12 |
|---|---|
| Input | LM NJ HK was entered |
| Expected output | This time the code was of 3 different players and the code was correct. So, it asked us to choose our favorite player. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 12: Test 12*

**Screenshots**


*Figure 12: putting different player name*

**Test-13 → Wrong user id**

| **Test no.** | 13 |
|---|---|
| Input | 4 was entered |
| Expected output | Wrong id was selected so it displays to enter valid input only. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 13: Test 13*

**Screenshots**


*Figure 13: putting wrong user id*

**Test-14 → Player without profile**

| **Test no.** | 14 |
|---|---|
| Input | HK was entered |
| Expected output | There was no profile/description of that player so it displayed "Sorry! File not found." |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 14: Test 14*

**Screenshots**

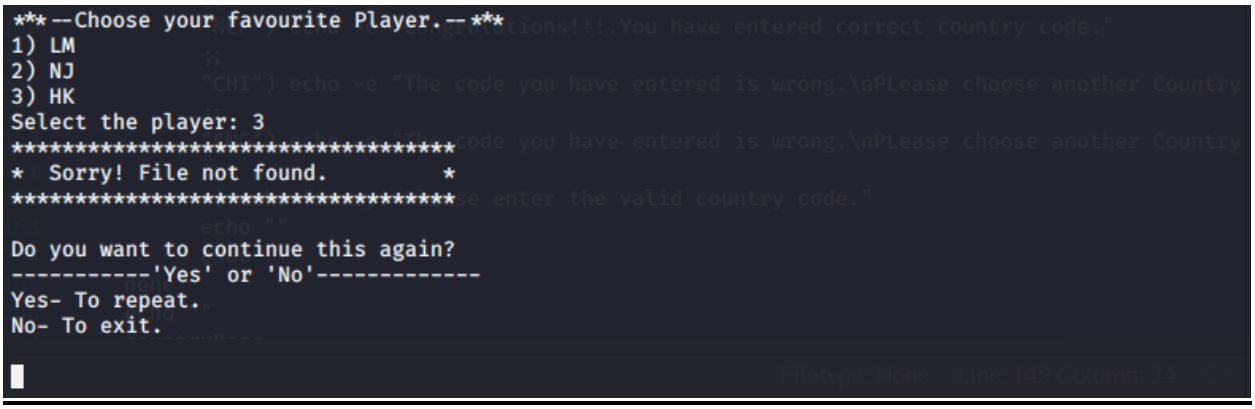


*Figure 14: layer without profile*

**Test-15 → Correct user id**

| **Test no.** | 15 |
|---|---|
| Input | 1 was entered |
| Expected output | The user id was correct so it displayed the description of the player we chose. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 15: Test 15*

**Screenshots**

```
Enter Players code:(separated by a space)
LM NJ HK

**--Choose your favourite Player.--**
1) LM
2) NJ
3) HK
Select the player: 1

*****************************************************
*  His real name is Lionel Andres Messi Cuccitini.  *
*  Messi is a player who plays for club Barcelona.  *
*  He is the first player to receive 6 Ballond'ors. *
*  He has 91 goals in a single calender year.       *
*****************************************************

Do you want to continue this again?
-----------'Yes' or 'No'-------------
Yes- To repeat.
No- To exit.
```

*Figure 15: putting correct user id*

**Test-16 → EXIT Yes**

| **Test no.** | 16 |
|---|---|
| Input | Yes was entered |
| Expected output | It asks whether to continue or not so we choose 'Yes' and it takes us to step 4. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 16: Test 16*

**Screenshots**

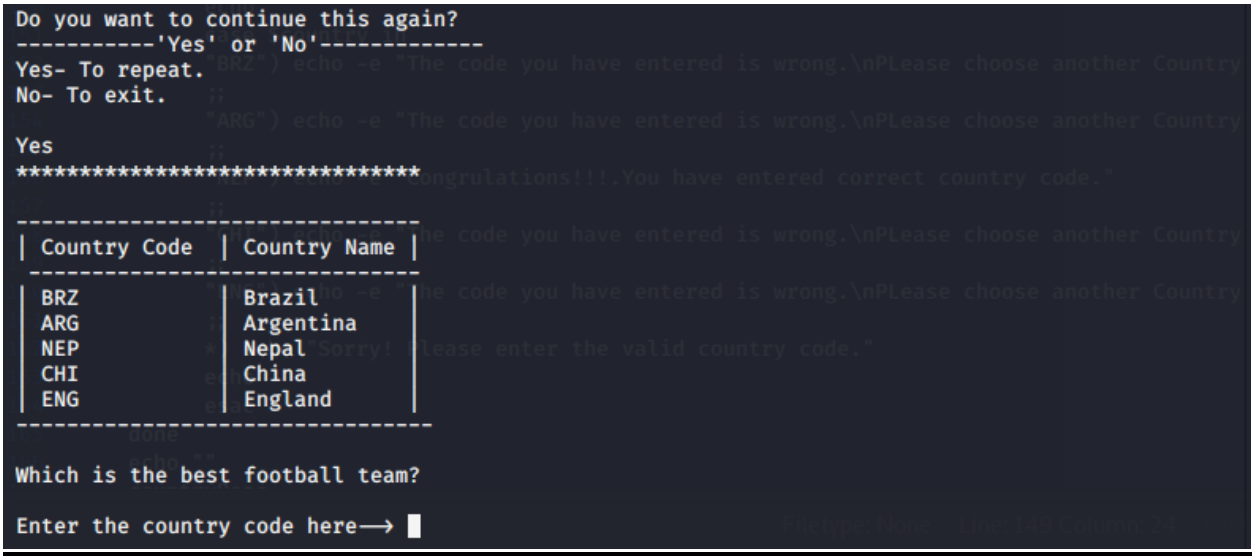


*Figure 16: putting Yes value to exit*

**Test-17 → EXIT No**

| **Test no.** | 17 |
|---|---|
| Input | No was entered |
| Expected output | The input was 'No' so the program was closed. |
| Actual output | The result was obtained as expected. |
| Test Result | The test was successful. |

*Table 17: Test 17*

**Screenshots**

```
Choose any three players.(Player code)

Enter Players code:(separated by a space)
LM NJ HK

**--Choose your favourite Player.--**
1) LM
2) NJ
3) HK
Select the player: 1

*****************************************************
*  His real name is Lionel Andres Messi Cuccitini.  *
*  Messi is a player who plays for club Barcelona.  *
*  He is the first player to receive 6 Ballond'ors. *
*  He has 91 goals in a single calender year.       *
*****************************************************

Do you want to continue this again?
-----------'Yes' or 'No'-------------
Yes- To repeat.
No- To exit.

No
kali@Rupesh:~/19031837cw2ii$
```

*Figure 17: putting No value to exit*

**Contents of three Files (TEXTS)**

- **LM**

His real name is Lionel Andres Messi Cuccitini.

Messi is a player who plays for club Barcelona.

He is the first player to receive 6 Ballond'ors.

He has 91 goals in a single calender year.

- **NJ**

He is a Brazillian professional football player.

His real name is Neymar da silva santos junior.

He has won the gold medal in Olympic football game.

He is recently playing for Paris-Saint-German football team.

- **KC**

He is the Nepali professional Football Player.

He plays as Goalkeeper in the team.

He has recently won three Nations cup playing alongside of Nepal.

**Conclusion**

Here in this part of course work, bash shell is used to perform some actions. Here I have used different types of methods to write a program which I have learned in my classes.

Methods that are used to do the task A of this coursework (coding part) are if…else, for loop, while loop, until, case, etc. They have their own features. If…else statement checks either 1st statement is correct or another one is correct. Similarly, for loop a control flow statement which allows code to execute repeatedly. Similarly, while statement executes if the given condition is true otherwise returns false. Similarly, until is just opposite of while. Until loop only executes until the given condition is false otherwise returns false.

Here bash command is also used to perform some actions. Bash command can both read and execute commands from file called as shell script. There were some difficulties in the coding part but those problem were minimized with the help of friends and lecturers.

# Task B

## Memory issues

### Introduction

Memory is the place in the computer where data are kept to use it for future use. We can have different types of problems related to memory so it needs to be well managed. The process of controlling and coordinating computer memory assigning portions to various programs to optimize overall performance of the system is known as memory management. It is one of the most important feature of operating system. Allocator is the block of program assigned by memory manager. If the data allocated in the memory is no longer required then these blocks can be reassigned. It can be also defined as the process of managing primary memory and that moves back and forth between disk and main memory during the execution. It affects execution processing time directly so an effective memory management ensures the consistency, accuracy and availability of the data imported from secondary to main memory. Its function is to keep track of each and every status of memory location which is either allocated of free. It also determines how the memory is allocated, also decides which gets memory, when they receive it and how much memory they are allowed. It tracks whenever some memory in the system gets freed or unallocated and correspondingly it updates the status. Memory can be physical as well as virtual memory. Hardware, operating system, programs and applications are occupied by memory management. (tutorialspoint, 2020)

### Aims and objectives:

The aims and objectives of memory management are listed below:

i. To keeps track of the status of each memory location which is either allocated or free.
ii. To decides which process should occupy the main memory.
iii. To manages the parts of virtual address space of a process which is non-core resident.
iv. To determine how memory is allocated among competing processes, deciding which gets memory, when they receive it and how much they are allowed.
v. To convert program's logical addresses into physical addresses.

vi. To move around in the memory without affecting its execution.

**Background(Body)**

Here in this body part, we have five contents/topics to be described. These contents are described by re-searching from different of sources like books, journals, website, research papers, etc. They are physical memory, memory placement, description of paging and segmentation, page coloring and page size variation. They are well described below.

**Physical memory:**

Random Access Memory (RAM) is called as physical memory of the computer which is attached to the motherboard. It is also known as primary memory. The data stored in the RAM is not permanent, it will be erased if computer is turned off without saving. So, RAM is also known as volatile/temporary memory. It is directly accessible to the CPU. It holds the instructions of program to execute. When the physical memory is filled then virtual memory also acts as physical memory. If a system is low on physical memory then it leads the system- wide delays and also the complete hang of the system. In the absence of physical memory, no any work is done as there will be no any means to store the data. All the programs running on the computer and which are going to be executed resides in the primary memory. It is the main memory of the system. Until some file are saved on the hard disk, they are stored in the physical memory temporarily. When the process is not in use then we can temporarily swap it and again can be bought in memory for execution. This memory is for the user as well as operating system. (includehelp, 2021)

**Memory Placement**

The process of assigning the physical or the virtual memory address space to a process is known as memory placement/memory allocation. We can allocate the memory in two different ways. They are static memory allocation and dynamic memory allocation. We need to place the memory to execute a process. In static memory, the method assigns the memory to a process before its execution. This method is performed when the program is compiled and the report is generated and these files are merged to obtain a single executable file and this file is loaded in the main

memory for the execution by the loader. The data size required by the process must be known before execution. If the data size is bigger it leads to the wastage of memory and if data size is smaller it leads to inappropriate execution. As the memory is already allocated, it leads to the faster execution of the process. It is more efficient compared to the dynamic memory allocation. (GeeksforGeeks, 2020)

Advantages:

1. There will be no problems for memory allocation as it is already allocated before the execution of the program.
2. Static memory allocation provides an efficient way of assigning the memory to a process.

Disadvantages:

1. The system is unaware of memory requirement so it has to guess the memory required for the program.
2. It leads to memory wastage, if estimated size of memory is bigger then it leads to memory wastage and if estimated size of memory is smaller, the program will execute inappropriately.

In dynamic memory allocation, the memory is allocated during the execution. The memory is allocated to the entities of the program, for first time, while the program is running. As in static memory, here the data size is allocated exactly so this leads to no memory wastage. It provides flexibility to the execution of the program as it can decide the exact memory space required by the program for execution. If the program is large then dynamic memory allocation is performed on different parts of program which is to be used currently. This reduces to memory wastage and improves performance of the system. (GeeksforGeeks, 2020)

Advantages:

1. It reduces the memory wastage as the memory is assigned during the program execution.
2. It provides a flexible way of assigning the memory to a process.

Disadvantage:

1. Due to the repetition of memory allocation action during program execution it leads to

more overheads. As the memory is allocated during program execution.

2. During the execution of program, sometimes memory allocation process are repeated which leads to more overheads. (T, 2019)

**Page coloring**

It is a software technique which is designed to control the mapping of physical memory to a processor's cache blocks. Page coloring is also known as cache coloring. It was first implemented in the MIPS operating system to improve the performance stability by matching virtual and physical page colors. When the pages are remapped in the physical memory, an application's cache behavior remains the same. It ensures best use of processor cache by accessing contiguous pages in virtual memory. It is typically employed by low level dynamic memory allocation code in operating system during mapping virtual memory to the physical memory. Physical memory pages are colored so that different colors of pages have different positions in CPU cache memory. When allocating sequential pages in virtual memory for processes, the kernel collects pages with different colors and maps them to the virtual memory so sequential pages in virtual memory do not contend for a same page line. Page coloring is employed in operating systems such as Solaris, FreeBSD, windows NT and NetBSD. (Dillion, 2021)

**Description of paging and segmentation**

Paging

The memory management scheme which allows a process to be stored in a memory in a fixed manner is known as paging. It solves the problem of external fragmentation. The physical and logical memory spaces are divided into two halves of same fixed-blocks for implementing paging. The fixed sized blocks of physical and logical memory are called frames and pages respectively. The page table maps the logical address to the physical address and contains base address of each page stored in the frames. The size of the page is specified by the hardware. (Admin, 2020)

Its advantages are:

- It allows us to store the data in a fixed manner so there is no external fragmentation.
- We can easily swap between frames and equal-sized pages.

Its disadvantages are:

- The access time increases because of paging as the main memory has to be accessed two times.
- It may suffer from internal fragmentation as the size of the frame is fixed. (javatpoint, n.d.)

Segmentation

The memory management scheme which supports the user's view of memory is known as segmentation. The process is divided into variable size segments and loaded to the logical memory address space which itself is the collection of variable size segments and each segment has its own name and length. The segment from logical memory are loaded to physical memory space for the execution. The size of the segment is specified by the user. Here the logical address to the physical address is mapped by segment table and contains segment number and offset. (Admin, 2020)

Its advantages are:

- There is no internal fragmentation in segmentation.
- The size of page table is bigger than the size of segment table.

Its disadvantages are:

- When the processes are swapped from main memory it may cause external fragmentation.
- The access time increases because of segmentation as the main memory has to be accessed two times. (javatpoint, n.d.)

**Page size variation**

The size of a page in computer system which is a block of stored memory. A page size varies in the computer system. The process of transferring of pages between primary and secondary memory is known as page swapping. It does not support in our mobile pones due to many reasons. The

architecture of processor determines the page size. A large page size always causes more unused program to be in the memory than the small page size. If the allocated memory is more then it leads to the wastage of memory. This is called as internal fragmentation. With x segments and page size of y bytes in a memory then xy/2 bytes of memory will be wasted in internal fragmentation. It argues for the small page size. This wastage of page also extends the cost. If the page size is small then it needs more times to load the pages of same bytes comparing to the large page size. (Tanenbaum, 2008)

## Conclusion

Here in this coursework, we are given to describe about memory issues in the operating system. We should face different kinds of problems which occur in the memory. Here I have described memory management aims and objectives, physical memory, memory placement, page coloring, description of paging and segmentation, page size variation.

While doing this coursework, Task B is all about research. We are said to write a technical report focusing the memory issues on network operating system. I face a little difficulty in re-searching some topics related to memory issues. Memory is the place to store data. In OS, physical memory is the main memory is the place where data are stored first before saving in the permanent storage. Page coloring is a software technique that is designed to control the mapping of physical memory to a processor's cache blocks. Similarly, the process of assigning the physical or the virtual memory address space to a process is memory placement. Likewise, paging and segmentation are the memory management scheme that allows a process to be stored in a memory in a fixed manner and which supports the user's view of memory respectively. The size of a page in computer system which is a block of stored memory and it varies in the computer memory.

The problems faced to this part of work was minimized by continuous re-search on different type of source such as books, website, etc. If there is a problem then obviously there is its solution too. Only the thing we need is to do a little more explore. So, while I was researching for my work I found and was able to understand many things which I didn't knew before.

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# Appendix

### Memory Controller

The part of CPU that is responsible for data exchange between memory and the CPU and also that controls the memory is known as memory controller. It determines how much memory system can use, memory type and speed, memory particle, etc. it has great impact on overall performance of the system as it determines the memory performance of the system. (Adams, 2021)

### Virtual Memory

It is the process of allocating the storage in which secondary memory can be addressed as a part of a memory. It maps memory address used by a program into physical address in computer memory. Using secondary memory as physical memory is called virtual memory. It uses the physical memory as large cache and maintains separate address spaces. If the main memory is filled then it can be used as physical memory. (Krishna, 2021)

### Cache Memory

It is a chip-based computer component that makes retrieving data from the computer's memory more efficiently. It acts as a temporary storage. It is more readily available to the processor than computer's main memory. It has less storage space. It is more expensive than the main memory as it is a complex chip which yields higher performance. (Lutkevich, n.d.)