



BIRZEIT UNIVERSITY

Faculty of Engineering & Technology

Linux Laboratory – ENCS3130

**Shell Scripting Project – Medical Test Management
System**

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Abstract:

In this project, it is required to create a shell scripting system that efficiently handles medical test data for individual patients. It should include the ability to retrieve specific test results by patient ID or test type, add new test results, update existing records, and delete outdated or incorrect entries. This system will serve as a basic tool for managing patient records.

The system will interact with and manage two key files: one containing **medical records** and the other containing **medical test data**. The medical records file will store essential patient information, such as patient IDs, their test results, and other relevant details. The medical tests file will hold specific data related to various medical tests performed in our medical centre, including test types, dates, and results. The system will be designed to efficiently access and update the medical record file based on its format, allowing for the seamless addition of new test results, updating of existing records, deletion of outdated or incorrect entries, and retrieval of specific test results based on patient ID, test type, or other criteria.

- This Report represents a collection of test cases and their provided results, to demonstrate the efficiency and success of the built system .

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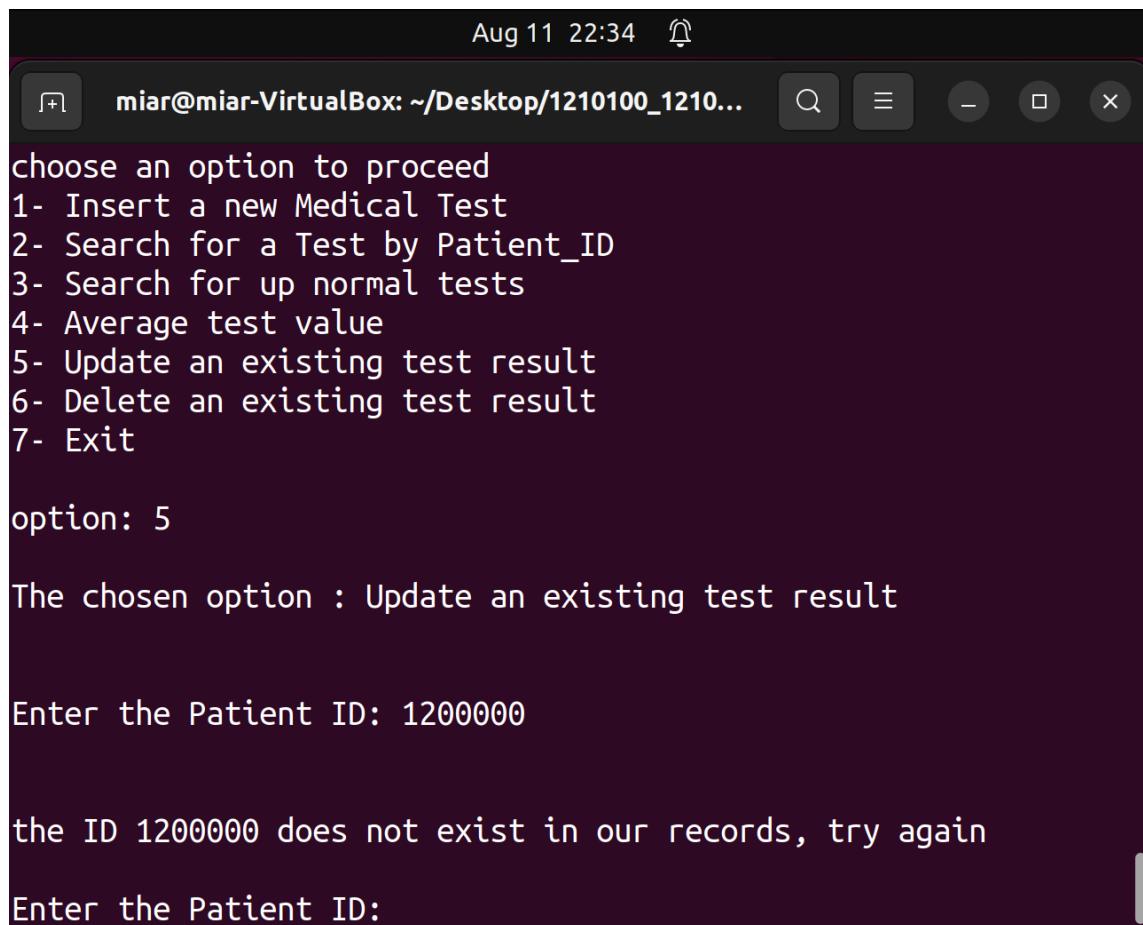
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1. Error Handling:

1.1. Non Existing Patient:

When performing a specific operation (Select , Update , Delete) on the record file , the patient ID is inserted to determine which record to operate on , the following image represents **the handling of the error of updating a non existent patient** :



A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The window shows a menu of options and a user interaction where they choose option 5 (Update an existing test result) and enter a patient ID that does not exist.

```
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 5

The chosen option : Update an existing test result

Enter the Patient ID: 1200000

the ID 1200000 does not exist in our records, try again

Enter the Patient ID:
```

Figure [1.1.1]-: Patient error handling

As viewed in the previous figure , the non-existence of the record with that patient ID was detected , thus the program requests the user to enter it again.

1.2. Non Existing Record:

When performing the select operation on the record file based on different fields , records based on the inputted data may not exist, the following image represents **the handling of the error of retrieving a non existent record**:

- **Searching based on the date:**

The screenshot shows a terminal window with a dark background and light-colored text. At the top, it displays the date and time: Aug 11 22:42. The title bar shows the user's name and session path: miar@miar-VirtualBox: ~/Desktop/1210100_1210... . The window has standard Linux-style window controls (minimize, maximize, close) at the top right.

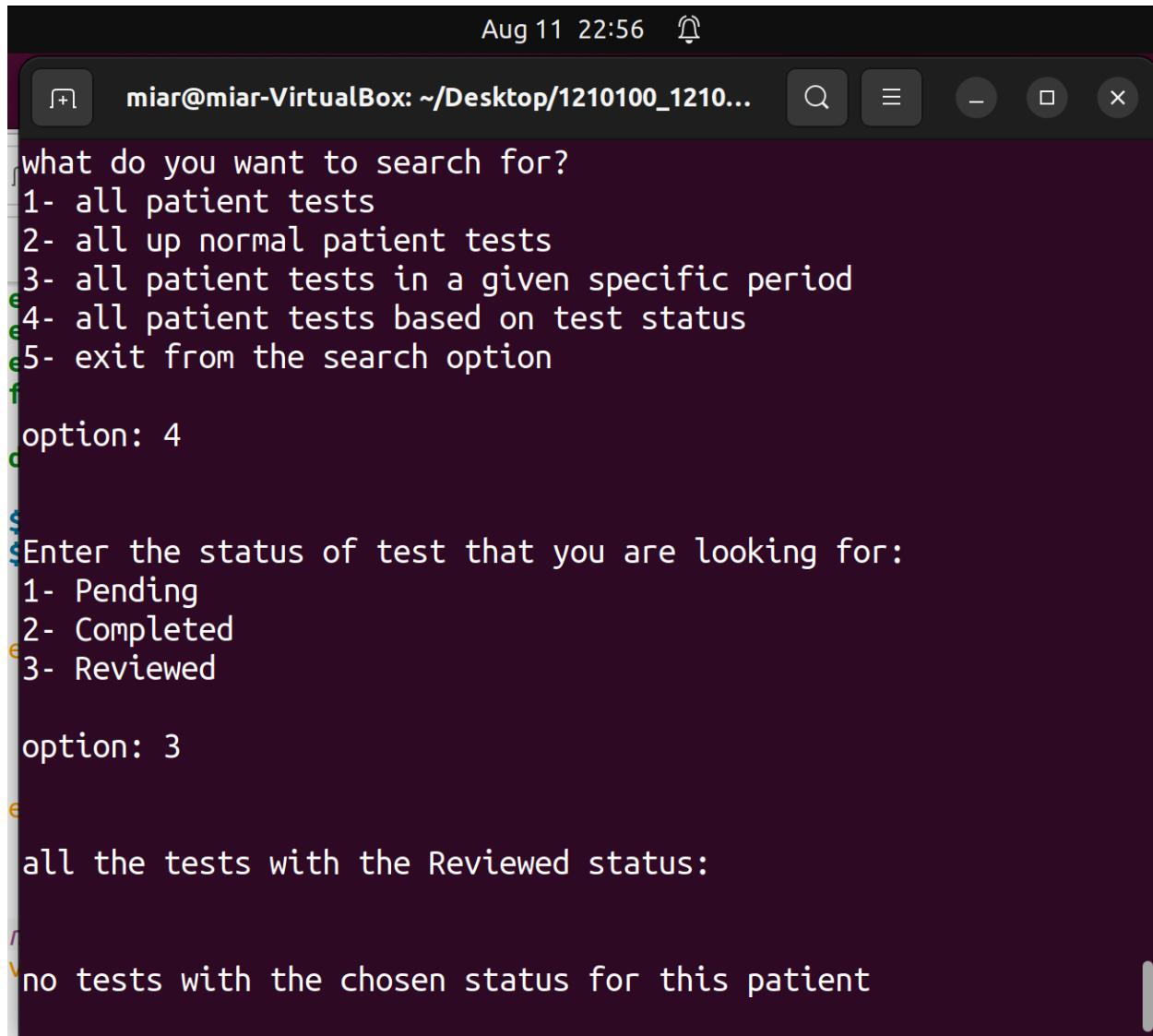
The terminal output is as follows:

```
what do you want to search for?  
1- all patient tests  
2- all up normal patient tests  
3- all patient tests in a given specific period  
4- all patient tests based on test status  
5- exit from the search option  
  
option: 3  
  
Enter the date of the beginning of the period in the following  
format YYYY-MM  
2021-01  
  
Enter the date of the end of the period in the following format  
YYYY-MM  
2021-02  
  
The tests from 2021-01 to 2021-02 are:  
  
no tests for this patient in the given period
```

Figure [1.2.1]-: Non existing record error handling (date)

As viewed in the previous figure , the non-existence of the record was detected , thus the menu will reappear again

- **Searching based on the status:**



The screenshot shows a terminal window with a dark background and light-colored text. At the top, it displays the date and time: Aug 11 22:56. Below that, the user's session information: miar@miar-VirtualBox: ~/Desktop/1210100_1210... The window has standard Linux-style window controls (minimize, maximize, close) at the top right.

The terminal output is as follows:

```
what do you want to search for?  
1- all patient tests  
2- all up normal patient tests  
3- all patient tests in a given specific period  
4- all patient tests based on test status  
5- exit from the search option  
  
option: 4  
  
Enter the status of test that you are looking for:  
1- Pending  
2- Completed  
3- Reviewed  
  
option: 3  
  
all the tests with the Reviewed status:  
  
no tests with the chosen status for this patient
```

Figure [1.2.2]-: Non exiting record error handling (status)

As viewed in the previous figure , the non existence of the record was detected , thus the menu will reappear again, to keep the system going.

- **Searching for normal records:**

```
Aug 11 23:00  ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
🔍 ⚙️ ⌂ ✖️

The chosen option : all up normal tests:

Choose the test that you are looking for
1- Hemoglobin (Hgb)
2- Blod Glucose Test (BGT)
3- Cholestrol Low-Density Lipoprotein (LDL)
4- Systolic Blood Pressure (systole)
5- Diastolic Blood Pressure (diastole)

option: 1

the normal Hgb tests:

no normal tests

choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
```

Figure [1.2.3]-: Non exiting record error handling (normality)

1.3. Non Existing files:

When performing any operation on the record file, both the record file and the test file should exist , thus their existence is checked before starting the program ,the following image s represents **the handling of the error of the non existence of the record file and the medical test file :**

- Non Existence of medical record file :

```
Aug 12 21:44 通知  
mlar@mlar-VirtualBox: ~/Desktop/1210100_1210447_ProjectOne  
Welcome To our Medical System  
the file that contains all the medical records does not exist  
do you want to create one?  
press 1 to proceed, or 0 to exit  
option: 1  
medicalRecord file is successfully created, fill it with data then you can use the program  
mlar@mlar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$ ./main.sh
```

Figure [1.3.1]-: Non existing record file error handling

- Non Existence of medical Test file :

```
Aug 12 21:43 通知  
miar@miar-VirtualBox: ~/Desktop/1210100_1210447_ProjectOne  
miar@miar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$ ./main.sh  
  
Welcome To our Medical System  
  
the file that contains all the medical tests information does not exist  
  
do you want to create one?  
press 1 to proceed, or 0 to exit  
option: 1  
medicalRecord file is successfully created, fill it with data then you can use the program  
miar@miar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$
```

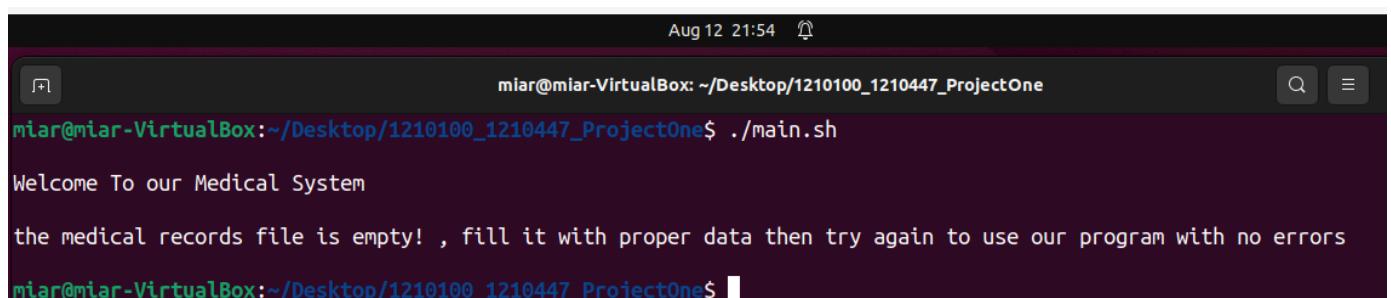
Figure [1.3.2]-: Non existing medical test file error handling

As viewed in the previous figure , the non-existence of both files in both cases was detected , thus the user is given the choice to create a new file for each, but since the new files are empty the user is required to fill the files with data then use the program, therefore the program is quit since it cant be executed without data.

1.4. Empty files:

When performing any operation on the record file, both the record file and the test file should be filled with data , thus their emptiness is checked before starting the program ,the following images represents **the handling of the error of the empty record file and the empty medical test file** :

- **An empty medical record file :**

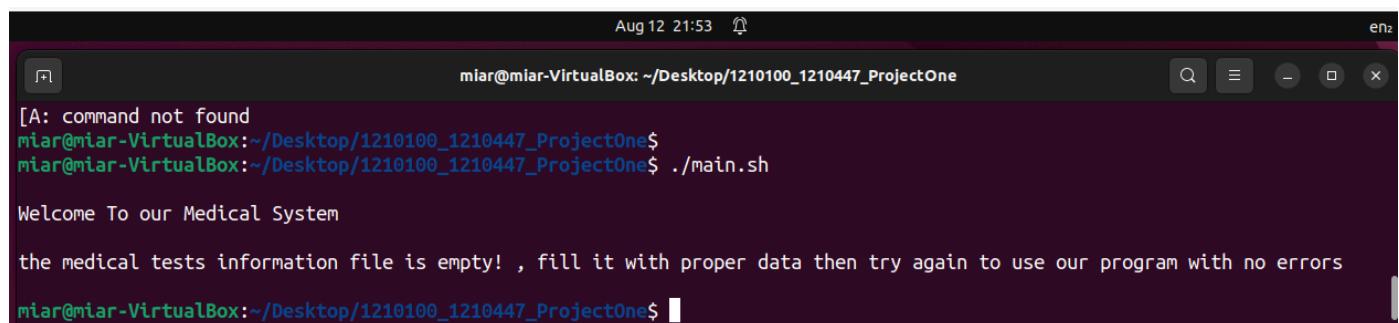


A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210447_ProjectOne". The terminal shows the command "main.sh" being run. The output includes a welcome message, a note about the empty medical records file, and a final prompt at the end of the line.

```
Aug 12 21:54
miar@miar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$ ./main.sh
Welcome To our Medical System
the medical records file is empty! , fill it with proper data then try again to use our program with no errors
miar@miar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$
```

Figure [1.4.1]-: Empty record file error handling

- **An empty medical Test file :**



A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210447_ProjectOne". The terminal shows the command "main.sh" being run. The output includes a welcome message, a note about the empty medical tests information file, and a final prompt at the end of the line.

```
Aug 12 21:53
[A: command not found
miar@miar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$
miar@miar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$ ./main.sh
Welcome To our Medical System
the medical tests information file is empty! , fill it with proper data then try again to use our program with no errors
miar@miar-VirtualBox:~/Desktop/1210100_1210447_ProjectOne$
```

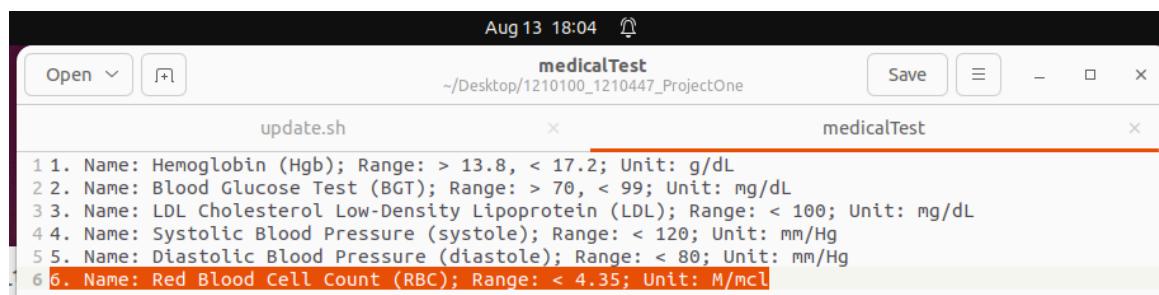
Figure [1.4.2]-: Empty medical test file error handling

As viewed in the previous figure s, the emptiness of both files in both cases was detected , thus since the files are empty the user is required to fill the files with data then use the program, therefore the program is quit since it cant be executed without data.

1.5. Non Fixed Medical Tests :

When performing a specific operation on the record file , the medical test file which contains the primary information for each test should be scanned, in our program the medical test file wasn't considered a static file with fixed information but in fact it was handled as a variable file, thus if any medical test was added or deleted from the system , the program would still operate successfully , **the following images represent the successful functionality of the program when the medical test file is altered:**

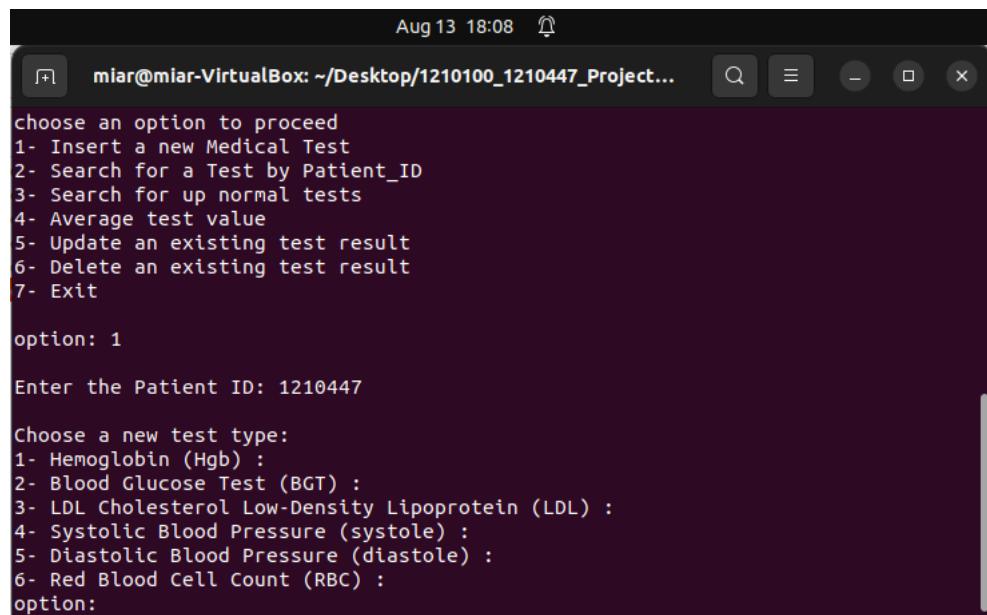
- A new medical test RBC is added to test whether it will be used in the program:



```
Aug 13 18:04 ⓘ
Open ⌂ medicalTest
~/Desktop/1210100_1210447_ProjectOne Save ⌂ ⌂ ⌂
update.sh × medicalTest ×
1 1. Name: Hemoglobin (Hgb); Range: > 13.8, < 17.2; Unit: g/dL
2 2. Name: Blood Glucose Test (BGT); Range: > 70, < 99; Unit: mg/dL
3 3. Name: LDL Cholesterol Low-Density Lipoprotein (LDL); Range: < 100; Unit: mg/dL
4 4. Name: Systolic Blood Pressure (systole); Range: < 120; Unit: mm/Hg
5 5. Name: Diastolic Blood Pressure (diastole); Range: < 80; Unit: mm/Hg
6 6. Name: Red Blood Cell Count (RBC); Range: < 4.35; Unit: M/mcL
```

Figure [1.5.1]-: Adding a new medical Test

- Inserting a new record:



```
Aug 13 18:08 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210447_Project...
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 1

Enter the Patient ID: 1210447

Choose a new test type:
1- Hemoglobin (Hgb) :
2- Blood Glucose Test (BGT) :
3- LDL Cholesterol Low-Density Lipoprotein (LDL) :
4- Systolic Blood Pressure (systole) :
5- Diastolic Blood Pressure (diastole) :
6- Red Blood Cell Count (RBC) :
option:
```

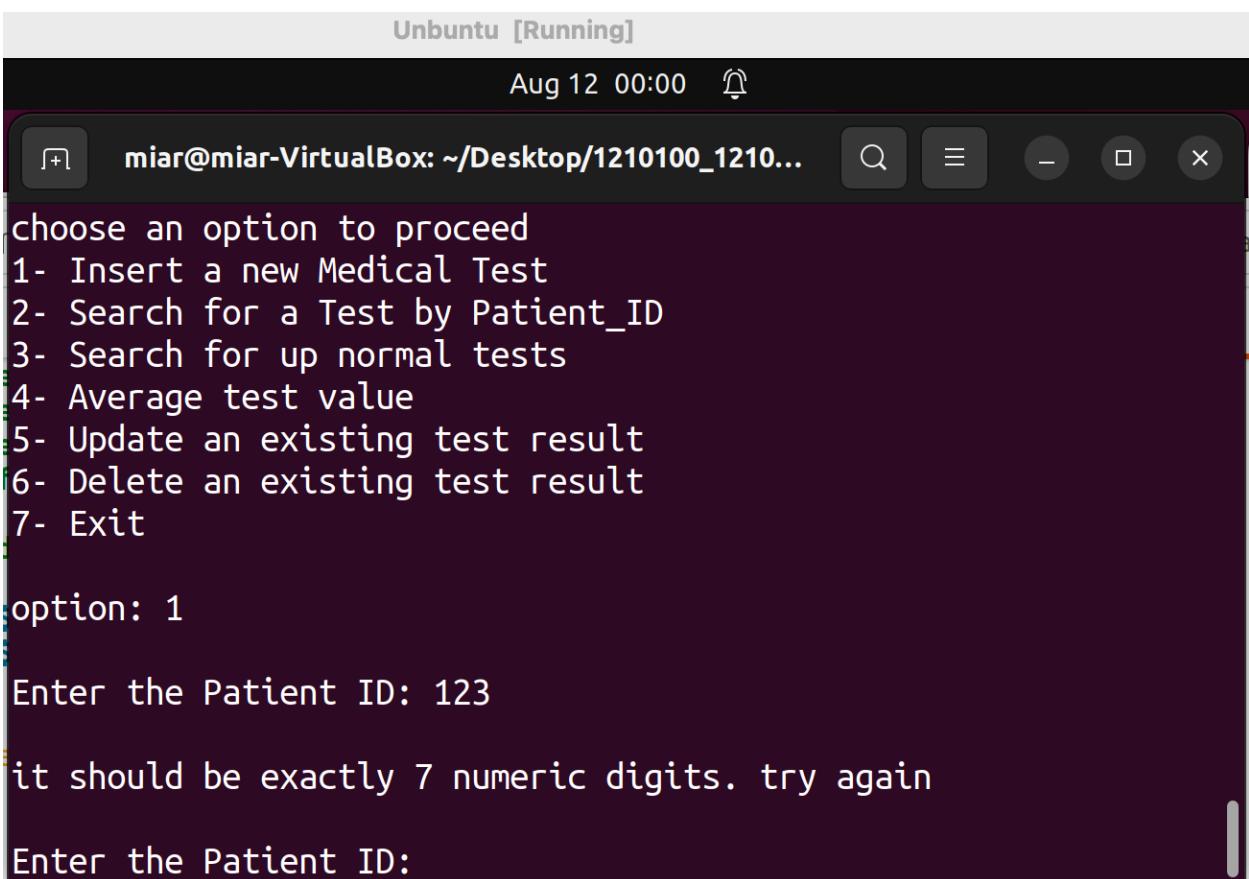
Figure [1.5.2]-: Detecting the new medical Test

As viewed in the previous figure , the new medical test was detected and appears as a new option in the medical test types when inserting a record.

2. Data Validation:

2.1. Patient ID:

When performing a specific operation (Select , Update , Delete) on the record file , the patient ID is inserted to determine which record to operate on ,thus the patient ID should be checked whether it's a valid 7 value number, the following image represents the checking of its validity :



The screenshot shows a terminal window titled "Ubuntu [Running]". The terminal prompt is "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The user has entered the following command:

```
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 1

Enter the Patient ID: 123

it should be exactly 7 numeric digits. try again

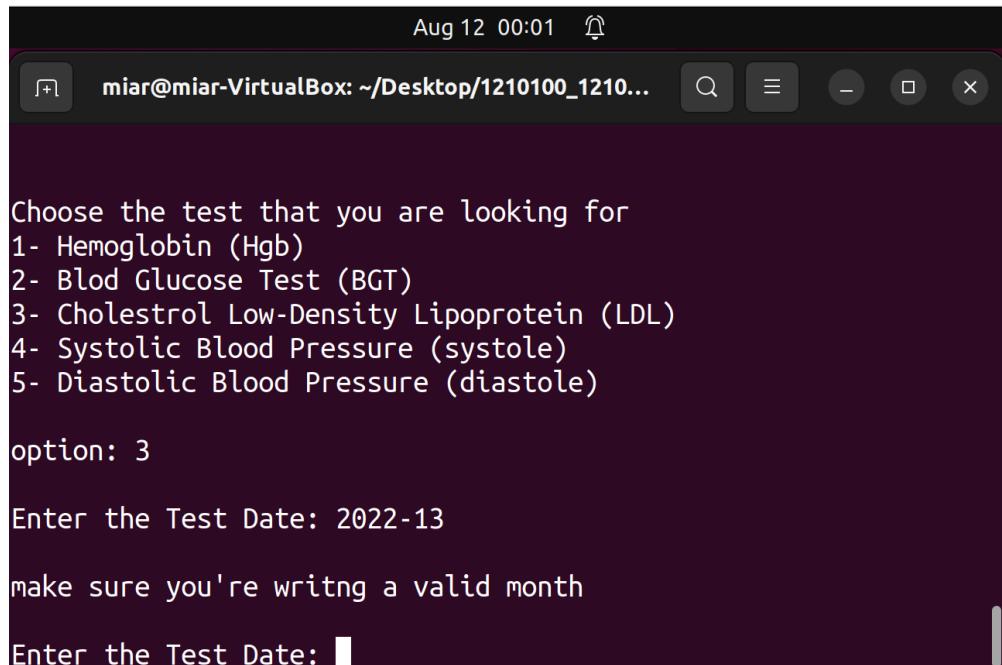
Enter the Patient ID:
```

Figure [2.1.1]-: Patient ID checking

2.2.Date Checking:

When inputting a date to insert into a new record or when updating a record , the date should be checked whether it's a valid date written in the YYYY-MM format, the following image represents the checking of its validity :

- **Month Validity :**



A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The terminal shows the following interaction:

```
Aug 12 00:01 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
Choose the test that you are looking for
1- Hemoglobin (Hgb)
2- Blod Glucose Test (BG)
3- Cholestrol Low-Density Lipoprotein (LDL)
4- Systolic Blood Pressure (systole)
5- Diastolic Blood Pressure (diastole)

option: 3

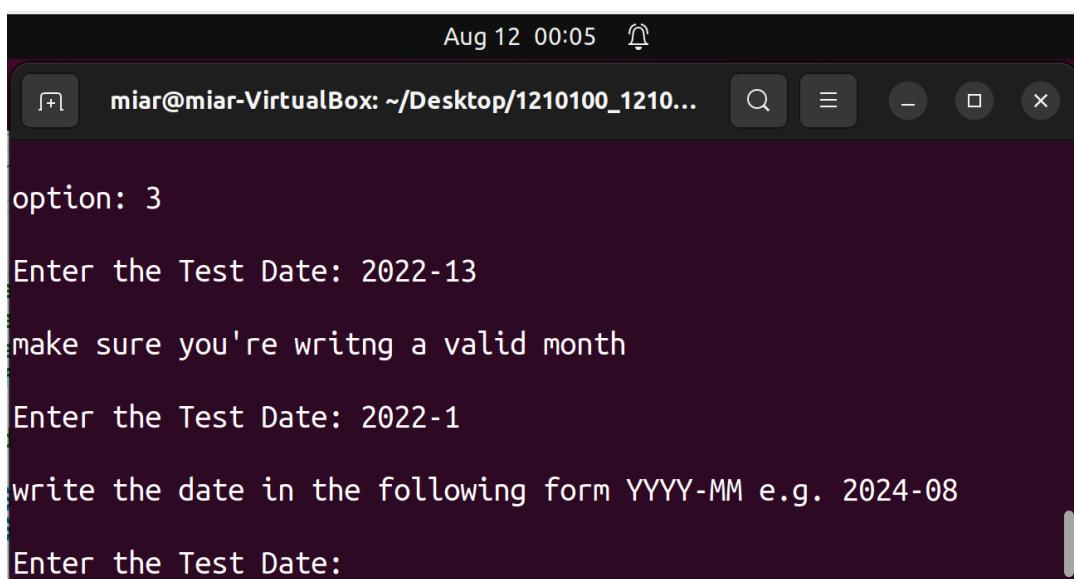
Enter the Test Date: 2022-13

make sure you're writng a valid month

Enter the Test Date: 
```

Figure [2.2.1]-: Month Validity Checking

- **Date Validity :**



A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The terminal shows the following interaction:

```
Aug 12 00:05 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
option: 3

Enter the Test Date: 2022-13

make sure you're writng a valid month

Enter the Test Date: 2022-1

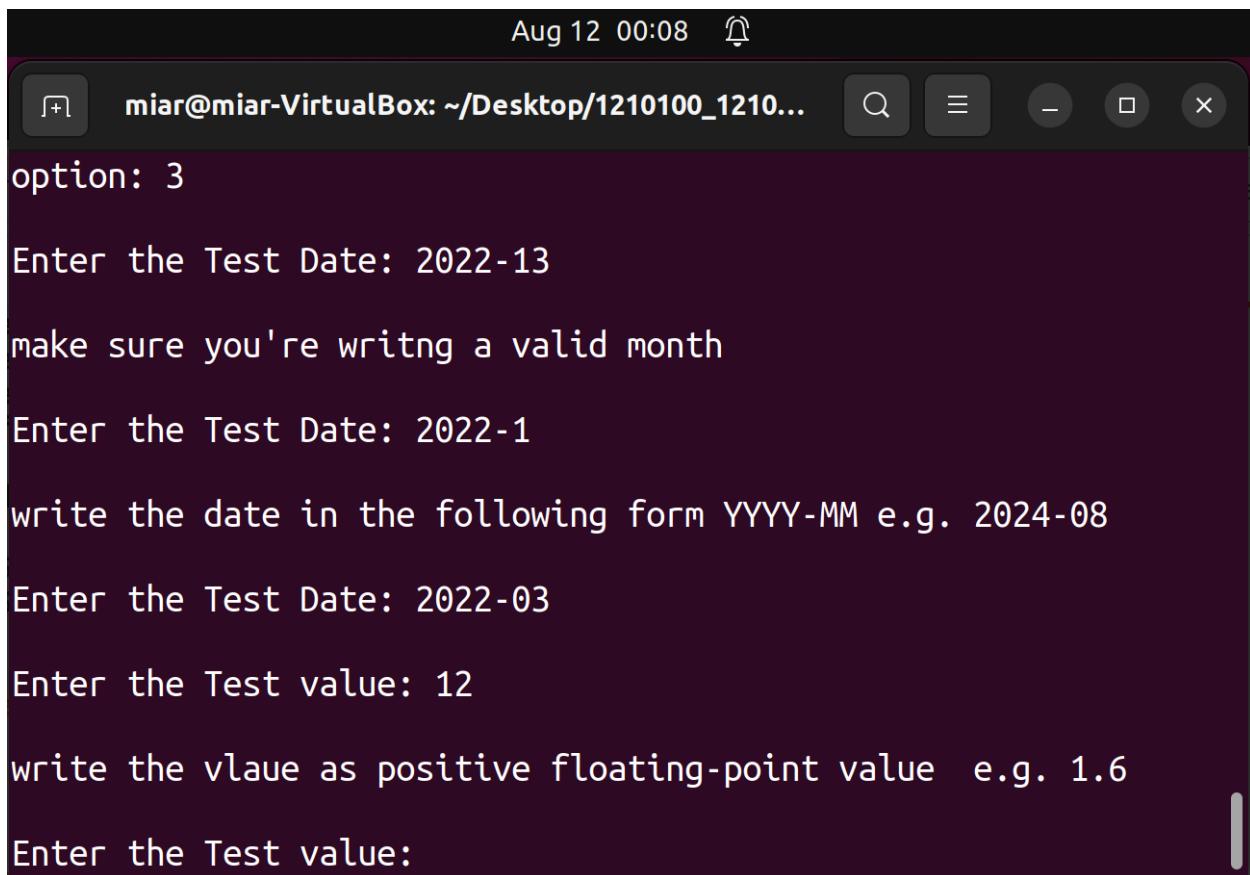
write the date in the following form YYYY-MM e.g. 2024-08

Enter the Test Date: 
```

Figure [2.2.2]-: Date Validity Checking

2.3.Test Value Checking:

When inputting a value to insert into a new record or when updating a record , the value should be checked whether it's a valid float written in the format of int.int , the following image represents the checking of its validity :



A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The terminal shows the following interaction:

```
option: 3
Enter the Test Date: 2022-13
make sure you're writing a valid month
Enter the Test Date: 2022-1
write the date in the following form YYYY-MM e.g. 2024-08
Enter the Test Date: 2022-03
Enter the Test value: 12
write the value as positive floating-point value e.g. 1.6
Enter the Test value:
```

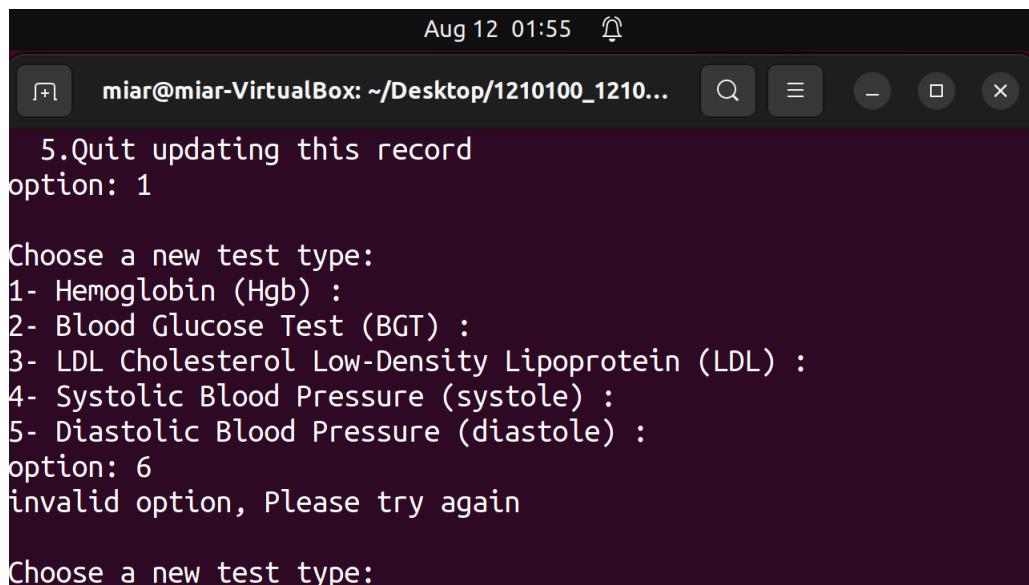
Figure [2.3.1]-: Test value checking

As viewed in the image , an invalid float value was entered , thus it was rejected and required the user to enter a valid value.

2.4. Test Type and status checking:

When inputting the type and status od the test to insert into a new record or when updating a record , the date should be checked whether it's a valid type and status chosen from the existing types in the medical test files , thus for each of the tyoe and status a menu is printed to chose a valid existing value from it , as shown in the following images :

- **Test Type:**



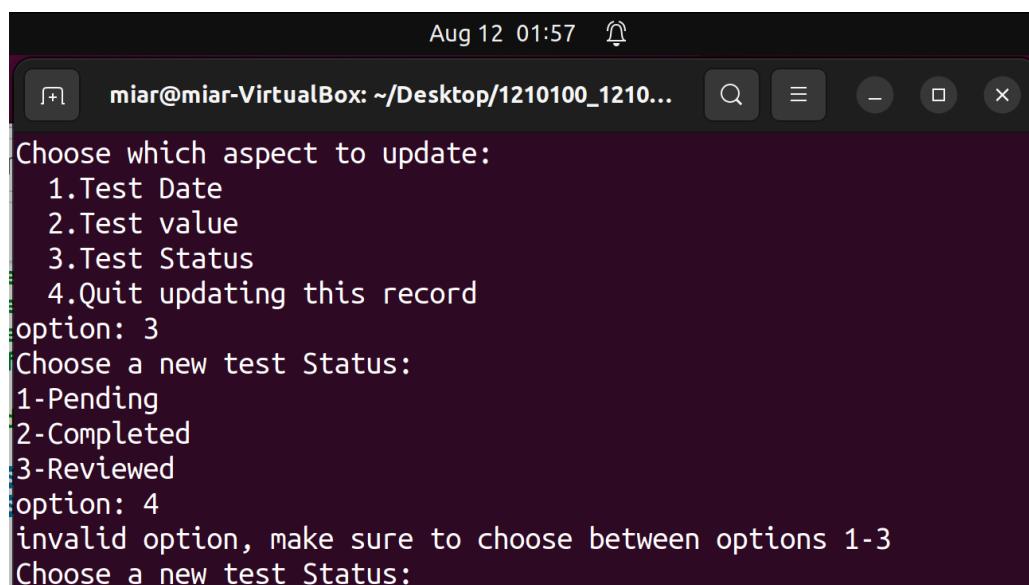
A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The window shows the following text:
Aug 12 01:55
5.Quit updating this record
option: 1

Choose a new test type:
1- Hemoglobin (Hgb) :
2- Blood Glucose Test (BGT) :
3- LDL Cholesterol Low-Density Lipoprotein (LDL) :
4- Systolic Blood Pressure (systole) :
5- Diastolic Blood Pressure (diastole) :
option: 6
invalid option, Please try again

Choose a new test type:

Figure [2.4.1]-: Test type checking

- **Test Status:**

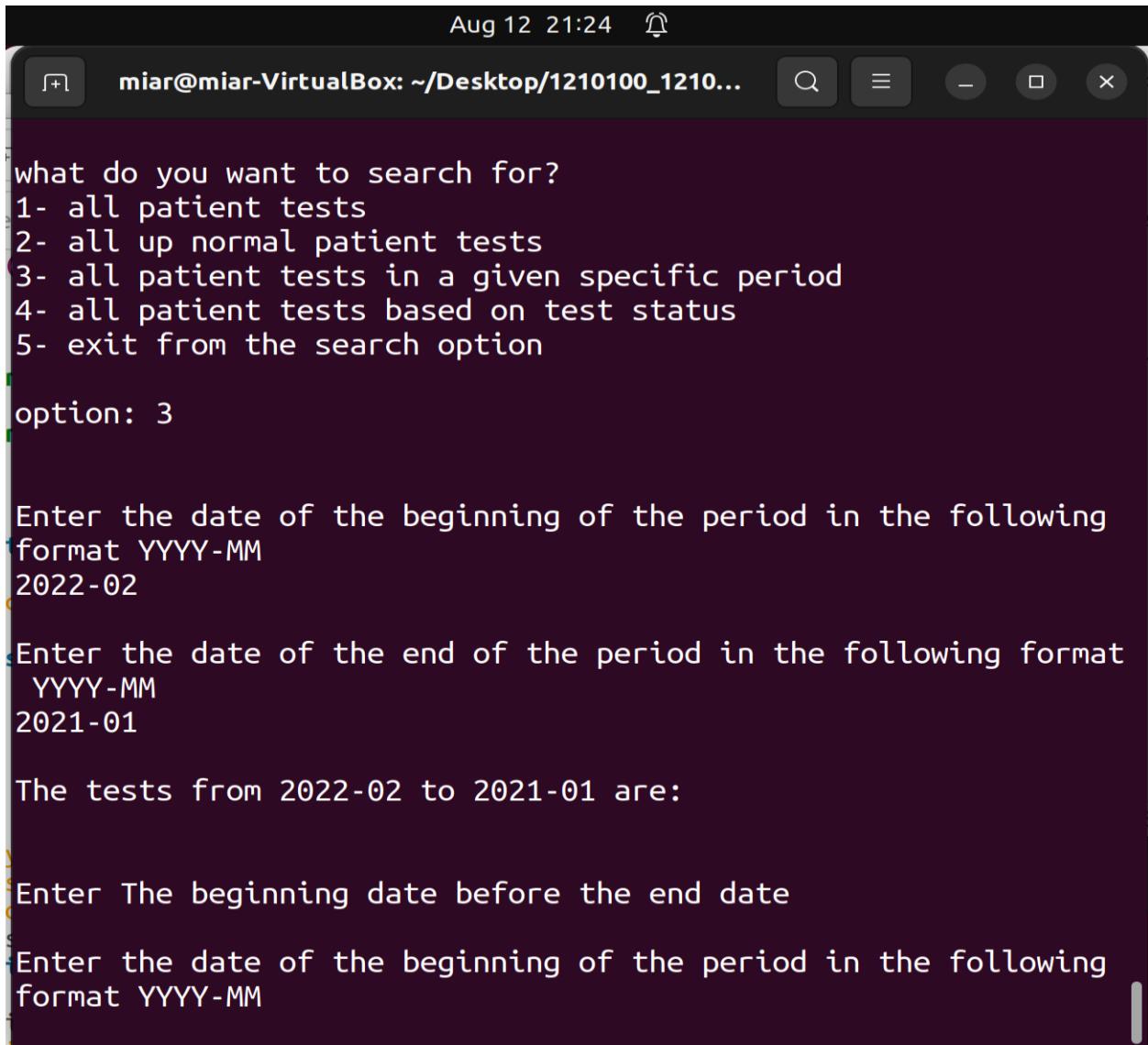


A screenshot of a terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The window shows the following text:
Aug 12 01:57
Choose which aspect to update:
1.Test Date
2.Test value
3.Test Status
4.Quit updating this record
option: 3
Choose a new test Status:
1-Pending
2-Completed
3-Reviewed
option: 4
invalid option, make sure to choose between options 1-3
Choose a new test Status:

Figure [2.4.2]-: Test status checking

2.5.Valid Range Checking :

When inputting a specific range of date to retrieve a number of records from , the range should be checked whether it's a valid range , as in the first date should be a date before the second date ,which is checked as shown in the following image:



The screenshot shows a terminal window with a dark background and light-colored text. At the top, the window title is "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The terminal displays the following interaction:

```
Aug 12 21:24  ⓘ
what do you want to search for?
1- all patient tests
2- all up normal patient tests
3- all patient tests in a given specific period
4- all patient tests based on test status
5- exit from the search option

option: 3

Enter the date of the beginning of the period in the following
format YYYY-MM
2022-02

Enter the date of the end of the period in the following format
YYYY-MM
2021-01

The tests from 2022-02 to 2021-01 are:

Enter The beginning date before the end date

Enter the date of the beginning of the period in the following
format YYYY-MM
```

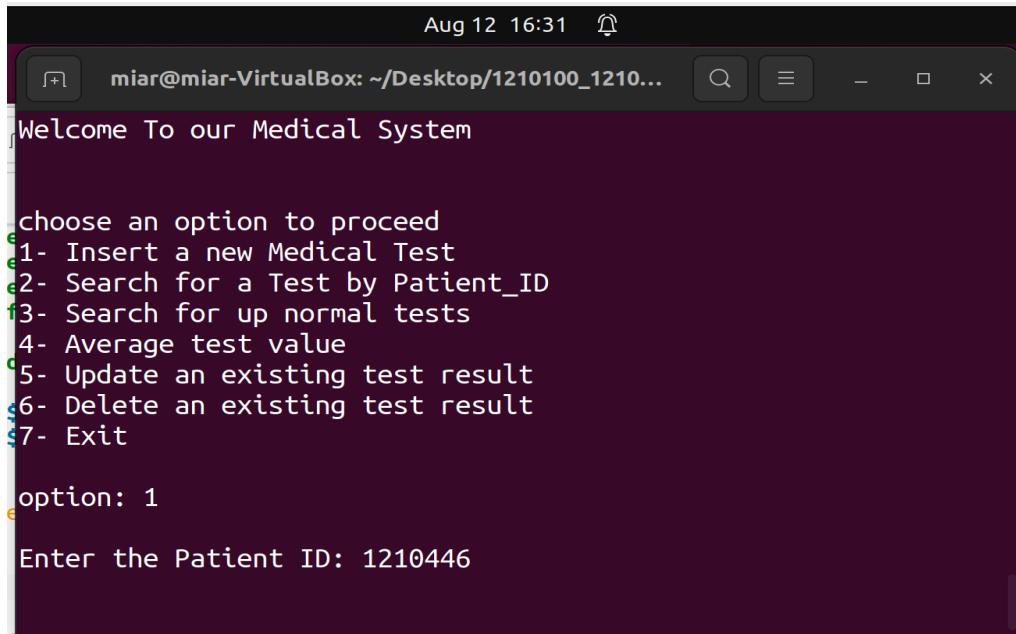
Figure [2.5.1]-: Valid Range checking

As viewed in the picture , an invalid range of dates was entered , thus it was rejected and required the user to enter a valid range

3. Execution :

3.1.Inserting :

The following images represent inserting a new record into the medical record file with valid inputs , the output will be observed in the file after executing :



```
Aug 12 16:31
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
Welcome To our Medical System

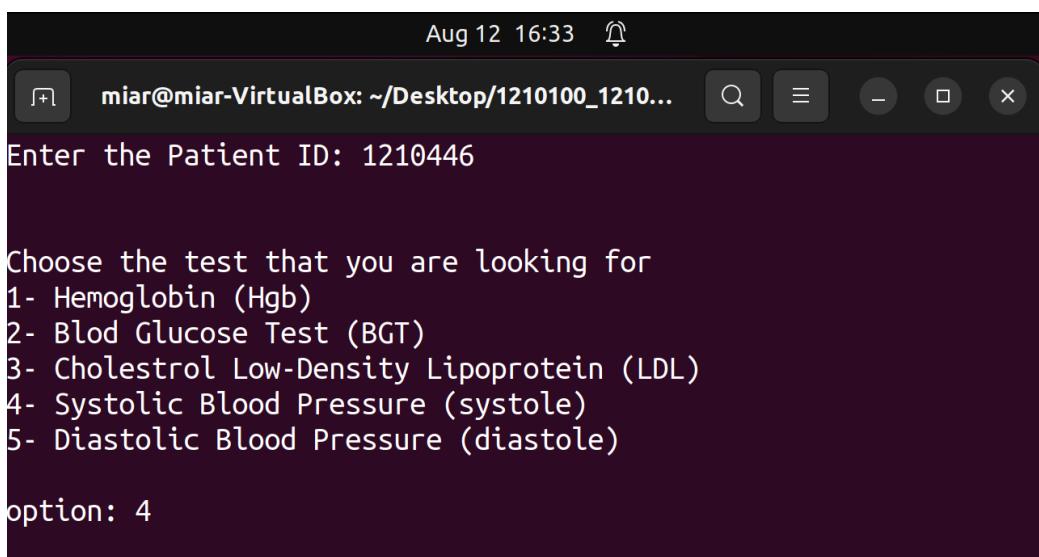
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 1

Enter the Patient ID: 1210446
```

Figure [3.1.1]-: Choosing the insert operation

After Selecting the insert option from the option menu , a valid 7 integer number is inserted as the patient ID, in addition to selecting a valid test type from the test type menu.



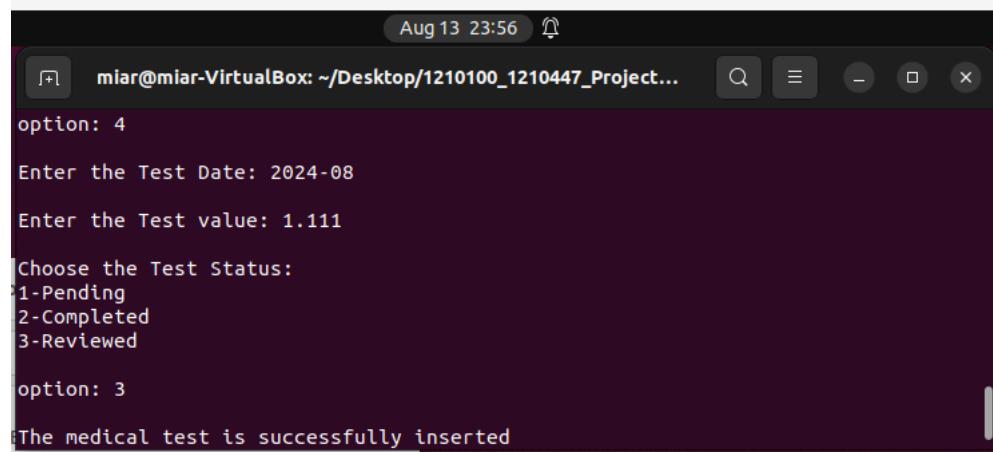
```
Aug 12 16:33
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
Enter the Patient ID: 1210446

Choose the test that you are looking for
1- Hemoglobin (Hgb)
2- Blod Glucose Test (BGT)
3- Cholestrol Low-Density Lipoprotein (LDL)
4- Systolic Blood Pressure (systole)
5- Diastolic Blood Pressure (diastole)

option: 4
```

Figure [3.1.2]-: (a) inputting valid values

Also valid values for the date ,test value and the status were inserted as viewed down below :



```
Aug 13 23:56
miar@miar-VirtualBox: ~/Desktop/1210100_1210447_Project...
option: 4
Enter the Test Date: 2024-08
Enter the Test value: 1.111
Choose the Test Status:
1-Pending
2-Completed
3-Reviewed
option: 3
The medical test is successfully inserted
```

Figure [3.1.2]-: (b) inputting valid values

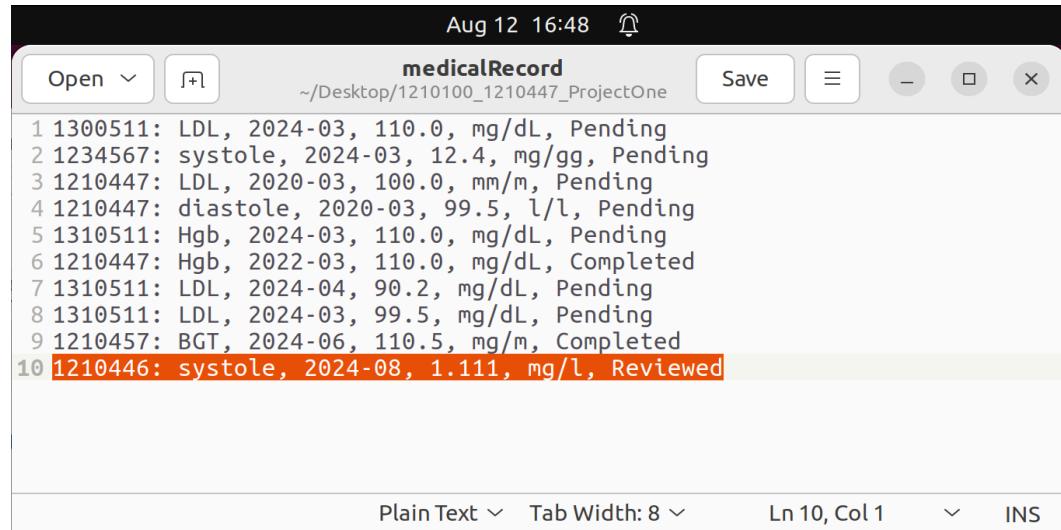
Note: The unit value isn't required to be inserted since its determined by the test type and is taken directly from the file .

- **Output :**

According to the previous images' inputs , the following record should be inserted :

1210446: systole, 2024-08, 1.111 ,mg/l , Reviewed

Which was in fact successfully inserted as viewed down below :



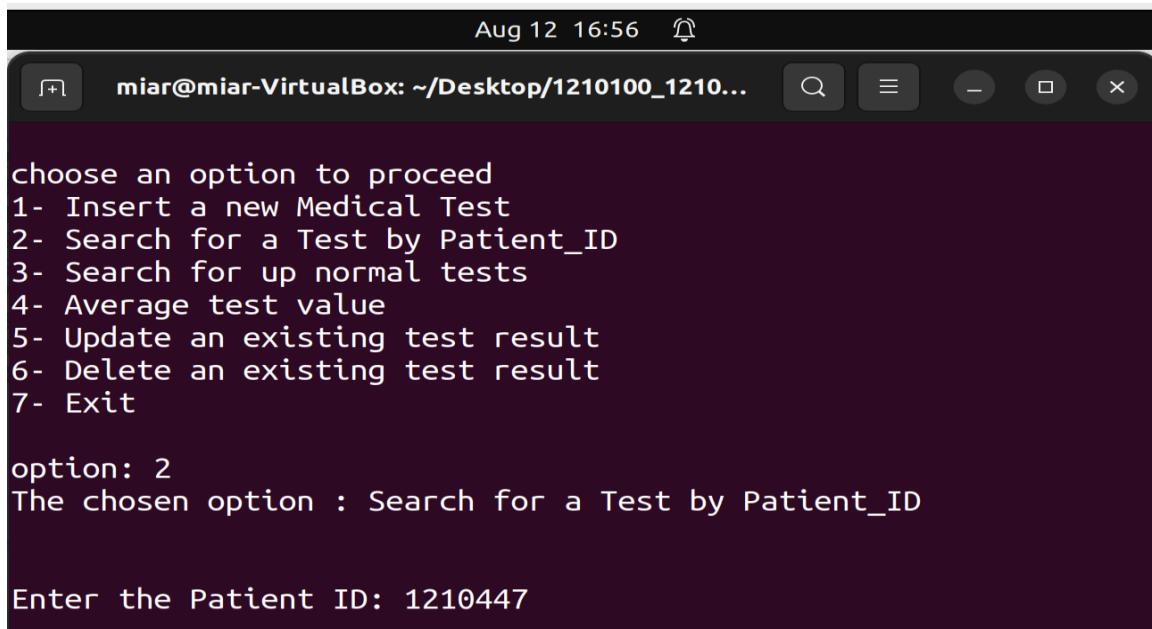
```
Aug 12 16:48
medicalRecord
~/Desktop/1210100_1210447_ProjectOne
Save
Open ▾  ⌂  1 1300511: LDL, 2024-03, 110.0, mg/dL, Pending
2 1234567: systole, 2024-03, 12.4, mg/gg, Pending
3 1210447: LDL, 2020-03, 100.0, mm/m, Pending
4 1210447: diastole, 2020-03, 99.5, l/l, Pending
5 1310511: Hgb, 2024-03, 110.0, mg/dL, Pending
6 1210447: Hgb, 2022-03, 110.0, mg/dL, Completed
7 1310511: LDL, 2024-04, 90.2, mg/dL, Pending
8 1310511: LDL, 2024-03, 99.5, mg/dL, Pending
9 1210457: BGT, 2024-06, 110.5, mg/m, Completed
10 1210446: systole, 2024-08, 1.111, mg/l, Reviewed
```

Figure [3.1.3]-: Insertion output

3.2.Searching based on ID:

The following images represent searching for a record in the medical record file:

The operation starts by selecting the search by patient ID option from the option menu, then inserting an existing patient ID to search for :



```
Aug 12 16:56
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

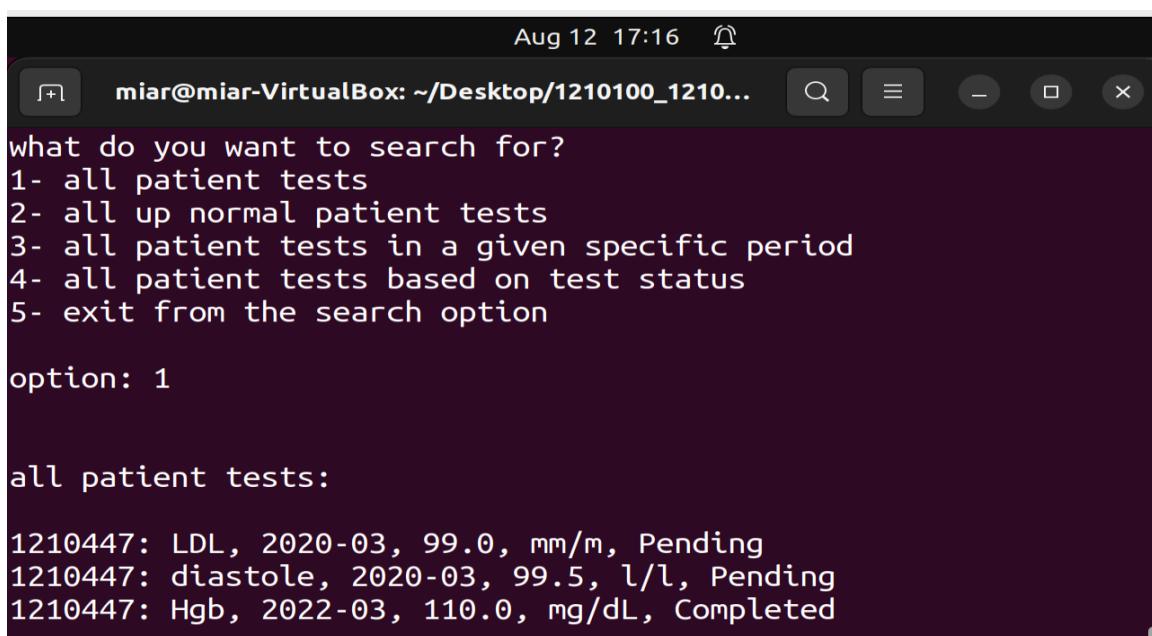
option: 2
The chosen option : Search for a Test by Patient_ID

Enter the Patient ID: 1210447
```

Figure [3.2.1]-: Choosing the search operation

- **All Patients Retrieved:**

An option menu then appears , then the “all patient tests ” option is chosen which retrieves all the records of that patient as viewed down below :



```
Aug 12 17:16
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
what do you want to search for?
1- all patient tests
2- all up normal patient tests
3- all patient tests in a given specific period
4- all patient tests based on test status
5- exit from the search option

option: 1

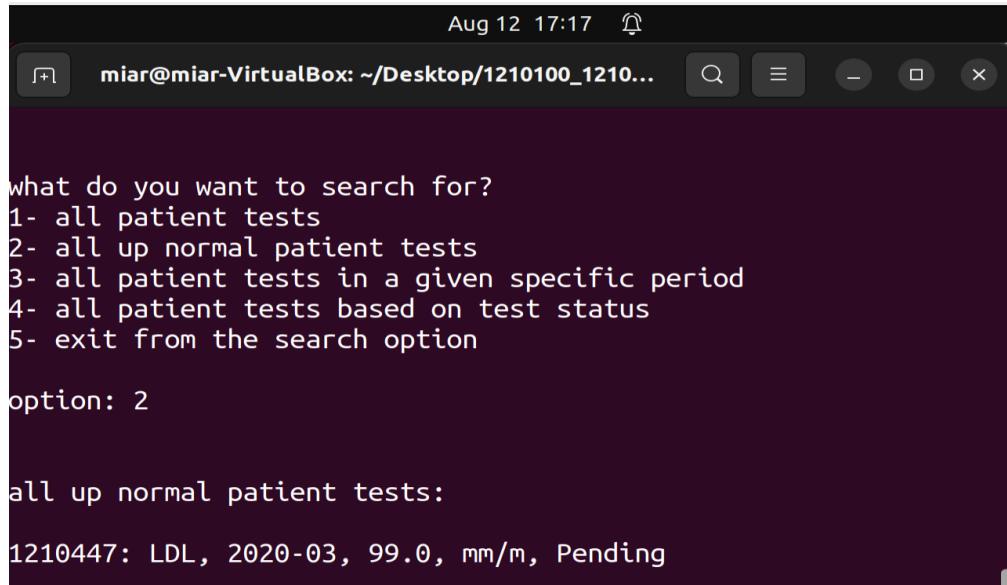
all patient tests:

1210447: LDL, 2020-03, 99.0, mm/m, Pending
1210447: diastole, 2020-03, 99.5, l/l, Pending
1210447: Hgb, 2022-03, 110.0, mg/dL, Completed
```

Figure [3.2.2]-: All records Retrieved

- **Normal Tests Retrieved:**

In this case , the second option is chosen from the menu , to only retrieve the normal tests of that patient:

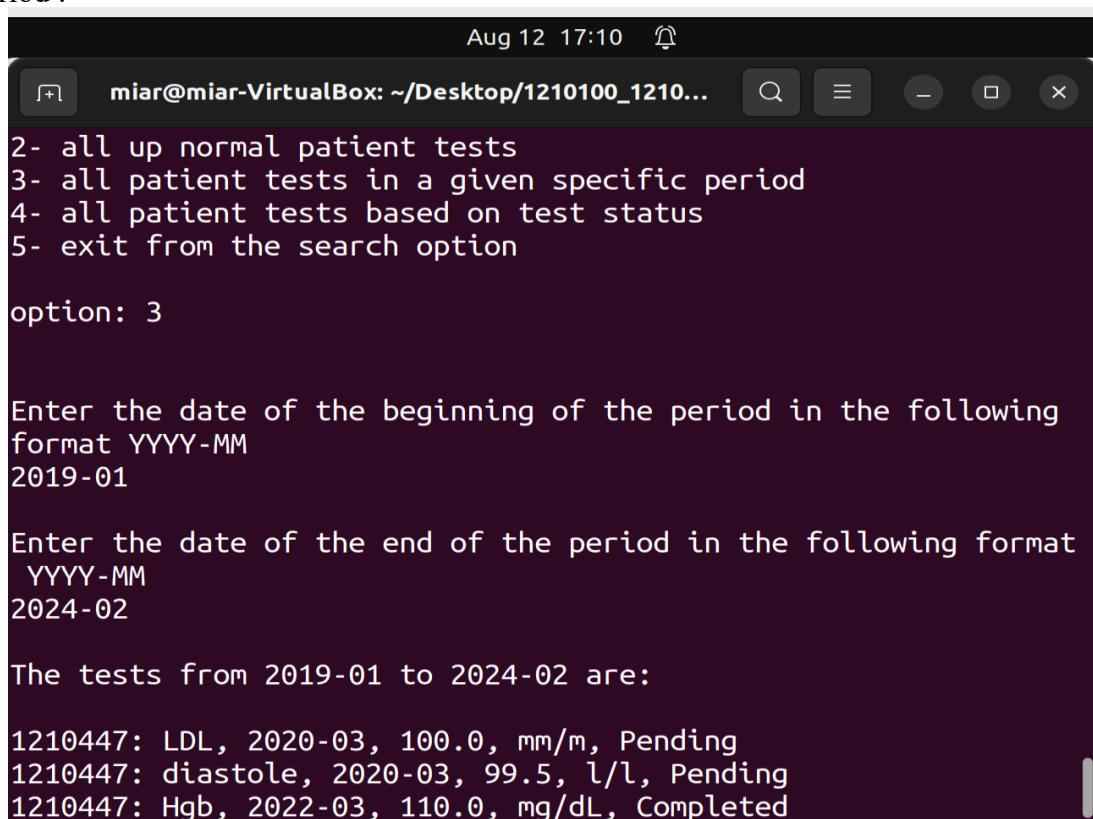


```
Aug 12 17:17 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
what do you want to search for?
1- all patient tests
2- all up normal patient tests
3- all patient tests in a given specific period
4- all patient tests based on test status
5- exit from the search option
option: 2
all up normal patient tests:
1210447: LDL, 2020-03, 99.0, mm/m, Pending
```

Figure [3.2.3]-: All normal records Retrieved

- **All Patients Retrieved in a specific period :**

In this case , the third option is chosen from the menu , to only retrieve tests in a inputted period :

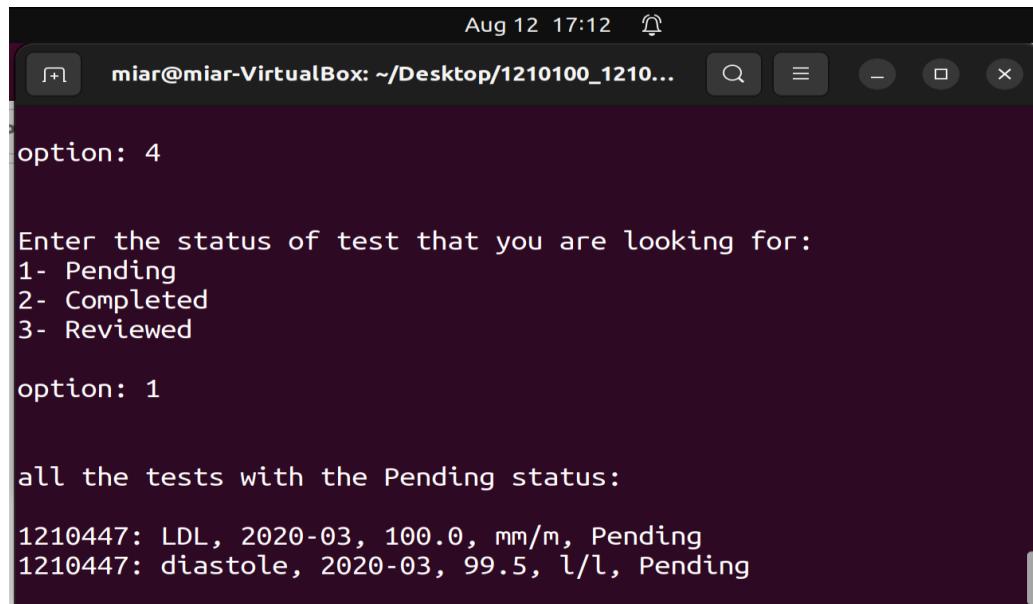


```
Aug 12 17:10 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
2- all up normal patient tests
3- all patient tests in a given specific period
4- all patient tests based on test status
5- exit from the search option
option: 3
Enter the date of the beginning of the period in the following
format YYYY-MM
2019-01
Enter the date of the end of the period in the following format
YYYY-MM
2024-02
The tests from 2019-01 to 2024-02 are:
1210447: LDL, 2020-03, 100.0, mm/m, Pending
1210447: diastole, 2020-03, 99.5, l/l, Pending
1210447: Hgb, 2022-03, 110.0, mg/dL, Completed
```

Figure [3.2.4]-: All records Retrieved in a specific period

- **All Patients Retrieved based on status:**

Here, the fourth option is chosen from the menu , to only retrieve tests with a specific status , in this case the “pending” status was chosen:



The screenshot shows a terminal window with a dark background and white text. At the top, it displays the date and time: Aug 12 17:12. The title bar shows the path: miar@miar-VirtualBox: ~/Desktop/1210100_1210... . Below the title bar, there are standard window control buttons for minimize, maximize, and close. The terminal output starts with "option: 4" followed by instructions to enter a status. It then lists three options: 1- Pending, 2- Completed, and 3- Reviewed. The user enters "option: 1". Next, it asks for the status and lists all tests with the "Pending" status. Two entries are shown: 1210447: LDL, 2020-03, 100.0, mm/m, Pending and 1210447: diastole, 2020-03, 99.5, l/l, Pending.

```
option: 4

Enter the status of test that you are looking for:
1- Pending
2- Completed
3- Reviewed

option: 1

all the tests with the Pending status:

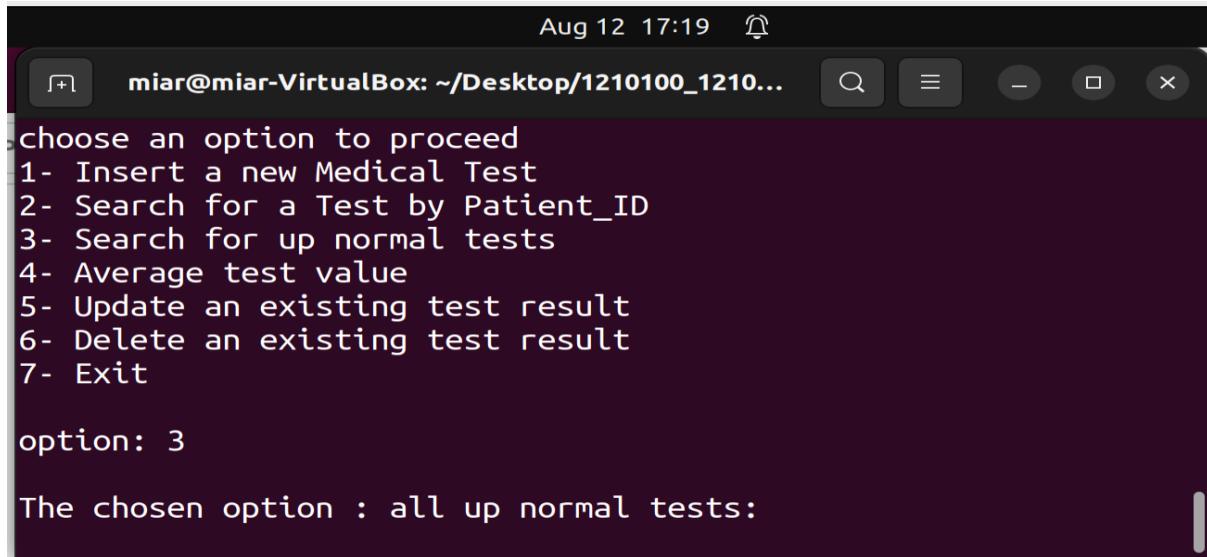
1210447: LDL, 2020-03, 100.0, mm/m, Pending
1210447: diastole, 2020-03, 99.5, l/l, Pending
```

Figure [3.2.5]-: All records Retrieved based on a status

3.3. Searching for all normal records:

The following images represent searching for all the normal records in the medical record file based on their type:

The operation starts by selecting the search for up normal tests option from the option menu:



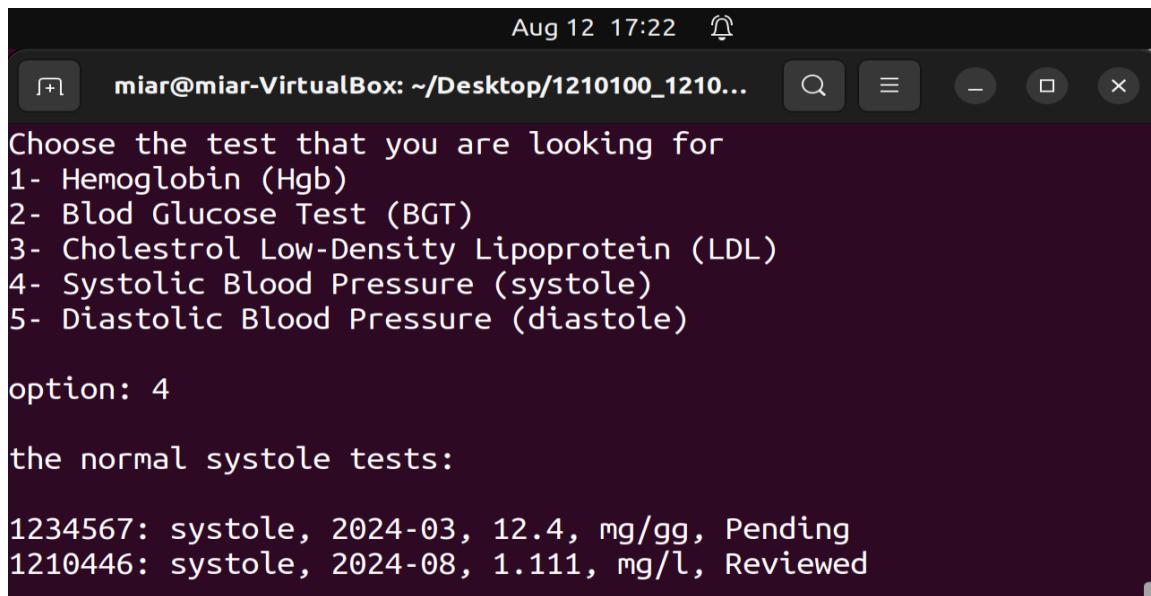
```
Aug 12 17:19 ⑧
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 3

The chosen option : all up normal tests:
```

Figure [3.3.1]-: Choosing the search for all operation

After Selecting the search option from the option menu, a valid test type is chosen from the test type menu to search for, which in this case is the systole test and as viewed in the image below all normal systole tests were retrieved successfully::



```
Aug 12 17:22 ⑧
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
Choose the test that you are looking for
1- Hemoglobin (Hgb)
2- Blood Glucose Test (BGT)
3- Cholesterol Low-Density Lipoprotein (LDL)
4- Systolic Blood Pressure (systole)
5- Diastolic Blood Pressure (diastole)

option: 4

the normal systole tests:

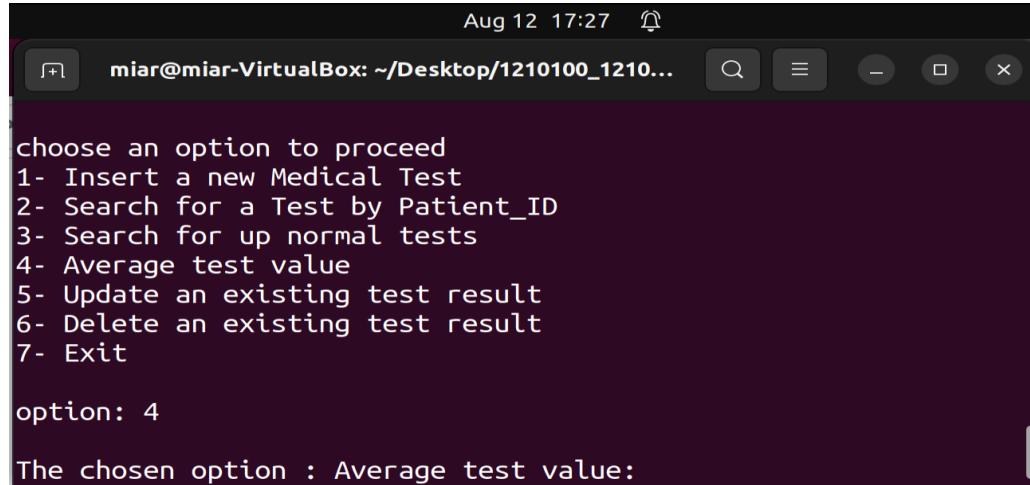
1234567: systole, 2024-03, 12.4, mg/gg, Pending
1210446: systole, 2024-08, 1.111, mg/l, Reviewed
```

Figure [3.3.2]-: Retrieving all normal systole tests

3.4. Average Test Values:

The following images represents calculating the average value of each test and printing them as viewed down below :

The operation starts by selecting the “Average test value ” option from the option menu:



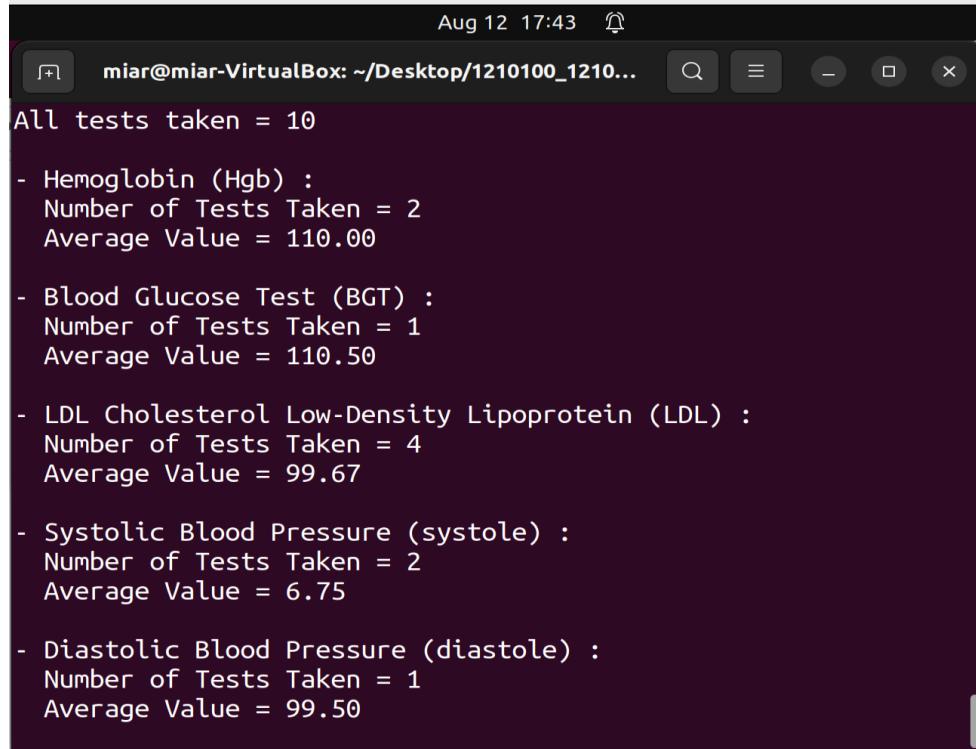
```
Aug 12 17:27
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 4

The chosen option : Average test value:
```

Figure [3.4.1]-: choosing average option

After Selecting the average option from the option menu, the average value of each test and its number of times taken is printed down below :



```
Aug 12 17:43
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
All tests taken = 10

- Hemoglobin (Hgb) :
  Number of Tests Taken = 2
  Average Value = 110.00

- Blood Glucose Test (BGT) :
  Number of Tests Taken = 1
  Average Value = 110.50

- LDL Cholesterol Low-Density Lipoprotein (LDL) :
  Number of Tests Taken = 4
  Average Value = 99.67

- Systolic Blood Pressure (systole) :
  Number of Tests Taken = 2
  Average Value = 6.75

- Diastolic Blood Pressure (diastole) :
  Number of Tests Taken = 1
  Average Value = 99.50
```

Figure [3.4.2]-: Average Test Values Results

3.5.Updating Test records:

The following images represents updating all the fields of a specific test record based on choice as viewed down below :

The operation starts by selecting update option from the option menu, then inserting an existing patient ID to update its record :

```
Aug 12 17:52  
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 5

The chosen option : Update an existing test result

Enter the Patient ID: 1210447

This Patients Records:

1. 1210447: LDL, 2020-03, 99.0, mm/m, Pending
2. 1210447: diastole, 2020-03, 99.5, l/l, Pending
3. 1210447: Hgb, 2022-03, 110.0, mg/dL, Completed

Choose which record to update :
```

Figure [3.5.1]-: Choosing the update operation

After inserting the patients ID , all the records of that patient is shown as viewed in the previous picture , thus one record must be chosen to update it .

After a record is chosen ,a menu is shown to let the user choose which aspect they should update :

```
Aug 12 17:57 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
This Patients Records:
1. 1210447: LDL, 2020-03, 99.0, mm/m, Pending
2. 1210447: diastole, 2020-03, 99.5, l/l, Pending
3. 1210447: Hgb, 2022-03, 110.0, mg/dL, Completed
Choose which record to update :2
Choose which aspect to update:
1.Test Type
2.Test Date
3.Test value
4.Test unit
5.Test Status
6.Quit updating this record
option: 1
```

Figure [3.5.2]-: Choosing an aspect to update

After choosing which aspect to update which in this case is the test type ,a new test type is chosen from its menu to update it , which then proceeds to replace the old value successfully as viewed down below:

```
Aug 12 17:59 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
option: 1
Choose a new test type:
1- Hemoglobin (Hgb) :
2- Blood Glucose Test (BGT) :
3- LDL Cholesterol Low-Density Lipoprotein (LDL) :
4- Systolic Blood Pressure (systole) :
5- Diastolic Blood Pressure (diastole) :
option: 4
systole
The Record has been updated successfully
1210447: systole, 2020-03, 99.5, l/l, Pending
```

Figure [3.5.3]-: Updating the test type

After updating the test type , the update menu reappears without the test type option since it already has been updated , then another aspect is chosen to be updated from :

```
Aug 12 18:21 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
The Record has been updated successfully
1210447: systole, 2020-03, 99.5, l/l, Pending
Choose which aspect to update:
1.Test Date
2.Test value
3.Test unit
4.Test Status
5.Quit updating this record
option: 2
Enter the New Test value: |
```

Figure [3.5.4]-: choosing another aspect

After entering a new test value to update and executing it successfully , to exit and save the new record the “Quit” option is chosen from the menu , as viewed down below :

```
Aug 12 18:33 ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
1210447: systole, 2020-03, 1.6, mm/m, Pending
Choose which aspect to update:
1.Test Date
2.Test unit
3.Test Status
4.Quit updating this record
option: 4
updated record saved successfully

choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
```

Figure [3.5.5]-: Saving and quitting

3.6.Deleting Test records:

The following images represents deleting a specific test record based on choice as viewed down below :

The operation starts by selecting delete option from the option menu, then inserting an existing patient ID to update its record :

```
Aug 12 18:55  ⓘ
miar@miar-VirtualBox: ~/Desktop/1210100_1210...
choose an option to proceed
1- Insert a new Medical Test
2- Search for a Test by Patient_ID
3- Search for up normal tests
4- Average test value
5- Update an existing test result
6- Delete an existing test result
7- Exit

option: 6

The chosen option : Delete a test:

Enter the Patient ID: 1210447

This Patients Records:

1. 1210447: systole, 2020-03, 1.6, mm/m, Pending
2. 1210447: systole, 2020-03, 1.5, l/l, Pending
3. 1210447: Hgb, 2022-03, 110.0, mg/dL, Completed

Choose which record to delete :|
```

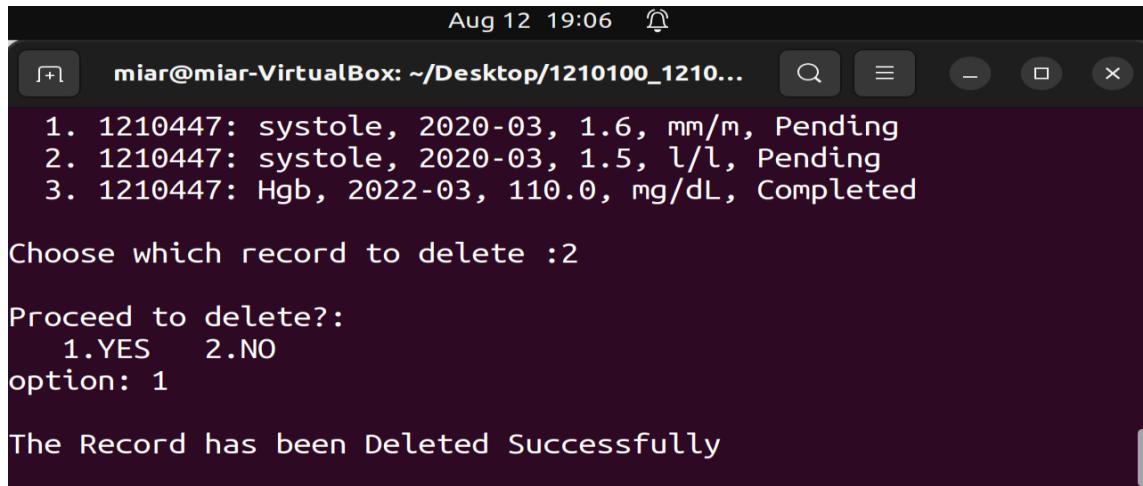
Figure [3.6.1]-: Choosing the delete operation

After inserting the patients ID , all the records of that patient is shown as viewed in the previous picture , thus one record must be chosen to delete it .

In this case, the second record was chosen to delete which represents :

1210477: systole, 2020-03, 1.5 ,l/l , Pending

As viewed in the following figure :



A terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The screen displays the following text:

```
Aug 12 19:06
1. 1210447: systole, 2020-03, 1.6, mm/m, Pending
2. 1210447: systole, 2020-03, 1.5, l/l, Pending
3. 1210447: Hgb, 2022-03, 110.0, mg/dL, Completed

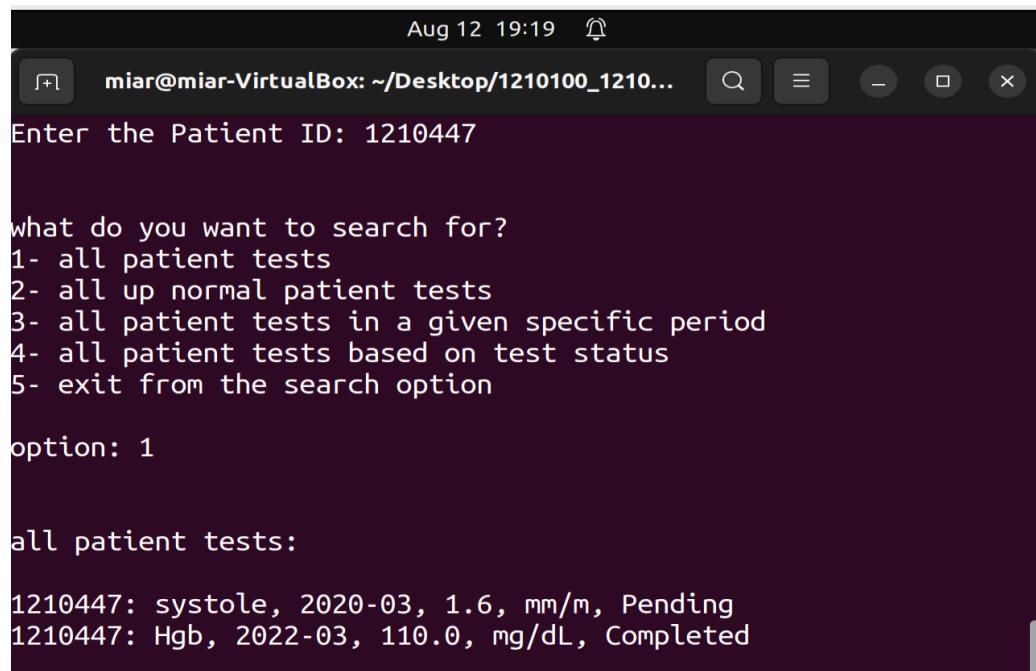
Choose which record to delete :2

Proceed to delete?:
 1.YES 2.NO
option: 1

The Record has been Deleted Successfully
```

Figure [3.6.2]-: the delete operation execution

- To check if the deleting occurred successfully , all the patients files are printed using the search operation:



A terminal window titled "miar@miar-VirtualBox: ~/Desktop/1210100_1210...". The screen displays the following text:

```
Aug 12 19:19
Enter the Patient ID: 1210447

what do you want to search for?
1- all patient tests
2- all up normal patient tests
3- all patient tests in a given specific period
4- all patient tests based on test status
5- exit from the search option

option: 1

all patient tests:

1210447: systole, 2020-03, 1.6, mm/m, Pending
1210447: Hgb, 2022-03, 110.0, mg/dL, Completed
```

Figure [3.6.3]-: the deletion output check

As viewed in the image , the deleted record no longer exists since it wasn't printed when retrieving all the records for that patient.