

Eng2002 Computer Programming(ENG2002_20211_E) Class 5 C++ Application Development Assignment

No. of Assignment: 3. Complex Number Clase: 5

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1. Abstract

In ADA, our team mainly have 4 objectives to achieve as follow,

1. build up the main console application
2. build up the class object and its function with a separate static library
3. able to execute required task (4)
4. complete extra missions like credit and distinction

In fact, we have hit the 3.5 targets through the works, including 1,2,3 and half of 4(square root only).

To make a quick review of the product, it has a good interface and reaches the needed requirements since it could be run and also be able to outcome what we want except for the login system.

2. Introduction

Through ADA, students are required to create an object-oriented console application with using Microsoft Visual Studio Community 2019. The object-oriented console application will perform calculations on complex number.

With the assignment's objectives and requirements, there are mainly 4 targets for students.

Firstly, the class, as well as the implementation of its member, must be produced as a separate static and included into the console program.

Secondly, student's console application should include a text-mode user interface that allow users to continually display and enter complex number (by inputting the values of x and y), as well as perform operation on various complex numbers, until the user exits the program. To be noted that, the console program must test all of the member functions declared in the class complexNum.

"Since Team 24 was assigned as a one student team, the following two objective noted in the assignment requirement is supposed to be a extra work or a not required work for Team 24. However, I would like to still mention it here to complete the report and also because I have challenged part of the extra works which is only the distinction part"

Thirdly, students are encouraged to gain credit with building the program such that when a user wants to use it, they must first login with a username, which will be verified to the contents of a file holds username-password pairs. While the username is new, the program prompts the user for a password, which will be saved in the file. If that file contains the username, the application will only run if the password is accurate. When the user fails to sign process three times in a row, the program will be terminated.

Lastly, students could get a distinction with implementing a member function to the class that can compute the square root of the complex number $(x + yi)$, which

is $\pm(\gamma + \delta i)$, where $\gamma = \sqrt{\frac{x + \sqrt{x^2 + y^2}}{2}}$ and $\delta = \text{sgn}(y) \sqrt{\frac{-x + \sqrt{x^2 + y^2}}{2}}$

2. Introduction (Con't)

$\text{sgn}(\cdot)$ is the signum function defined as follows,

$$\text{sgn}(y) = \begin{cases} -1, & \text{if } y < 0 \\ 0, & \text{if } y = 0 \\ 1, & \text{if } y > 0 \end{cases}$$

The square root of a real number can be obtained by including the header file , and call the following library function:

```
double sqrt(double);
```

For example, calling `sqrt(9)` will return the double value of 3.

This is the end of describing the assignment's objectives and requirements in detail. The leaving part of this section is giving a brief account of the methodology.

Brief accounting of methodology:

It contains 4 chapters for methodology

1. the schedule and step of developing the project
2. the detail of the developed application including the specifications of the classes defined and the flow of execution
3. the problems team encounter, and how to solve it
4. the way to validate the application

3.Methodology

For the step of developing the project, there are step by step to make it.

1. think the whole flow of the program
2. decide to make all code in one project file/solution code first for easily editing
3. build the menu loop structure in the main source code
4. define class object and its public functions and its private variable in header file
5. set up the class function detail in the same header file
6. back to the source code and add the class function to fulfil the empty loop of menu
7. start to begin build the library
8. copy the class object only to library's header file
9. copy the class function to library source code
10. build up the library file
11. let the main project source code include the library file
12. programs complete basically
13. add the element like better interface and new function.

These are the full step flow with developing ADA.

3.Methodology(con't)

The detail of the developed application:

```
1  #include <iostream>
2  #include <string.h>
3  #include <math.h>
4  using namespace std;
5
6  class complexNum // declare the class object
7  {
8  public:
9      complexNum(int realno, int imagineno); // Constructor of complex number
10     ~complexNum(); // Destructor of complex number
11     void display(); // public function for show the present complex number
12     void setno(); //public function for customize the complex number
13     void reciprocal(); //public function for reciprocal function (task 4)
14     void sqrtNum(); //public function for square root function (last part of credit)
15     bool geterr(); //public boolean function for send message to notice error
16     void information(); //public function for information article
17 private:
18     double realno; //member variable for real no
19     double imagineno; //member variable for imagine number
20     bool errNumber; //member variable for error message
21 };
22
```

This is the content of header file in library which is contain the public/private member functions/variables inside.

For the privates variable ,

realno is stay for the real number for the complex number

Imagineno is stay for the imaginary number for the complex number.

errNumber is stay for to detect errNumber when user input zero number for complex number which our ada is not allow the zero complex number to launch through the program.

```
complexNum::complexNum(int initrealno, int initimagineno)
{
    realno = initrealno; //set the initial value for realno(real number)
    imagineno = initimagineno; //set the initial value for the coefficient of imaginry number
    //cout << "Constructor runs.\n youit iniial complex number is /t("<< realno <<")"+"<< imaginno<<"i";
}
```

This is the constructor for the class to do the works we have set when we define a new class. In this project, we set the variables required for the class so that it can define the initial value with two class variable which the project requirement that real number and imaginary number.

```
complexNum::~complexNum()
{
    cout << "Run destructor.\n"; // running a destructor, in case of when detele the pointer value to release the memory
}
```

Destructor in the class. It is used to delete the pointer values at end of the program for releasing the memory. In our program, it actually is a useless function created.

3.Methodology(con't)

```
void complexNum::display()
{
    cout << "Your current complex number is\t " << realno << "+" << imagineno << "i" << endl;
    // display the current complex number
}
```

A display function specify made for option 1 to show the text and also the current class variables realno and imagineno.

```
bool complexNum::geterr()
{
    return errNumber;
    //in order to prevent the situation that 0+0i complex number, this is the boolean function set to correct the error input(0+0i)
}
```

In order to prevent the situation that 0+0i complex number, this is the bool function set to correct the error input(0+0i)

```
void complexNum::setno()
{
    int x, y; // set up local variables x and y
    cout << "please enter your new real number: "; // ask for input x
    cin >> x; // user enter x
    cout << "please enter your new imagine number: "; // ask for input y
    cin >> y; //user enter y
    if (x== 0 && y == 0) //preventing user input (0+0i) situation
    {
        errNumber = true; // making a loop for asking user to input none zero number
    }
    else // correct situation
    {
        realno = x; // set up input x = realno(real number)
        imagineno = y; // set up input y = imagineno (the coeffiecent of imaginry number)
        cout << "Your new complex number is\t" << realno << "+" << imagineno << "i" << endl; // show the new result that user just enter
        errNumber = false; // no error then no loop for asking correct since already correct
    }
}
```

Class function for option 2.edit the complex number. After user input the 2 variable, the program will ensure both of them would not be zero coefficient at the same time the complex number in order to set a none-zero complex number environment for this program . so there are a if loop to keep checking and ask user to input correct input.

```
void complexNum::reciprocal() //task 4
{
    double st_part; // st_part variable refer to 1 st part that example show that  $(5/(5^2+7^2))$  == x part of task 4
    double nd_part; // nd_part variable refer to 2 nd part that example show that  $(-7/(5^2+7^2))$  == y part of task 4
    double r = realno; // set up local variable r = class variable realno
    double i = imagineno; // set up local variable i = class variable imagineno
    st_part = r / (r * r + i * i); // make the formula of example :  $(5/(5^2+7^2))$ 
    nd_part = -i / (r * r + i * i); // make the formula of example :  $(-7/(5^2+7^2))$ 
    realno = st_part; // save the 1st result into realno
    imagineno = nd_part; // save the 2nd result into imagineno
    cout << "Your reciprocal complex number is\t" << realno << " + " << imagineno << "i" << endl; // show the result to user
}
```

This is the class function for option 3 which the basic task of each team assigned. For team 24, we are required to do (24%5=4) task 4 which is the reciprocal for the input complex number. Since the formula of the reciprocal has given from the note sheet. It just simply calculates the outcome and save it to the updated value of the real no. and imaginary no. .

3.Methodology(con't)

```
void complexNum::sqrtNum() // last part of the credit == find the square root of the complex number
{
    double a = sqrt(realno * realno + imagineno * imagineno);
    // it is the local variable that represent sqrt(x^2+y^2) ,
    //reduce the reaped work ~x~ since it could be share the same with both x and y
    double v = sqrt((realno + a) / 2); // v is the real number part
    double pre_s = sqrt((-realno + a) / 2); // local variable pre_s mean to the s not multi with sgn(y) yet
    int sgn_y;
    if (imagineno == 0) { // define 3 situations with 3 values for sgn(y)
        sgn_y = 0;
    }
    if (imagineno > 0) {
        sgn_y = 1;
    }
    if (imagineno < 0) {
        sgn_y = -1;
    }
    double s = sgn_y * pre_s;
    realno = v; //save the result to be new realno
    imagineno = s; // save the result to be new imagineno
    cout << "Your squt complex number is\t" << realno << " + +(" << imagineno << "i) " << endl;
}
```

This is the class function build for distinction and get the square root. Just follow the formula given by the work sheet. For sgn(y), there 3 values for 3 situations of y so there are a if loop.

```
void complexNum::information()
// just make the detail information for user that do not know what's going on which is a design for user.
{
    cout << endl << endl;
    cout << "-----Information of ADA-----" << endl;
    cout << "This is an object-oriented console application that perform calculations on complexnumber." << endl;
    cout << "(x+yi) <----- x is the real number part, and y is the coefficient part of *i(imaginary unit)" << endl;
    cout << " *note: square of i is -1 // i^2 = -1 " << endl;

    cout << endl << "I was assign to complete task 4" << endl;
    cout << "Team 24 ==> 24XS = 4 ==> Do Task 4" << endl;

    cout << endl << "-----Detail of Task 4-----" << endl;
    cout << "Here is the detail to introduce menu option 3.Calculate the reciprocal of your complex number" << endl;
    cout << "The option 3 is the function that finds thereciprocal of the complex number " << endl;
    cout << "and return the result as complex number." << endl;

    cout << endl << "For exasple:" << endl;
    cout << "our defaulted complex number is 5+7i" << endl;
    cout << "the function will return x = 0.0676-(5/(5^2+7^2)) , y = -0.0946-(-7/(5^2+7^2))" << endl;
    cout << "then we solve the reciprocal of (5+7i) and also save automatically this reciprocal as our new complex number" << endl;
    cout << "The new saved complex number is : 0.0676 + -0.0946i" << endl;

    cout << endl << "-----Detail of square root-----" << endl;
    cout << "Here is the detail to introduce menu option 4.Get the square root" << endl;
    cout << "The option 4 is the function that implement a member function to the class that can compute " << endl;
    cout << "the square root of the complex number(x + yi) " << endl;

    cout << endl << "For exasple:" << endl;
    cout << "our defaulted complex number for this case is 9+0i" << endl;
    cout << "the function will return x = 3- sqrt((9+sqrt(9^2+0^2))/2) , y = 0 = *sgn(0) sqrt((-9+sqrt(9^2+0^2))/2)" << endl;
    cout << "then we solve the square root of (9+0i) and also save automatically this reciprocal as our new complex number" << endl;
    cout << "The new saved complex number is : 3 + 0i" << endl;
    cout << " *note: sgn(y) is the signum function defined as follow," << endl;
    cout << "sgn(y) = -1 , when y <0" << endl;
    cout << "sgn(y) = 0 , when y =0" << endl;
    cout << "sgn(y) = 1 , when y >0" << endl;

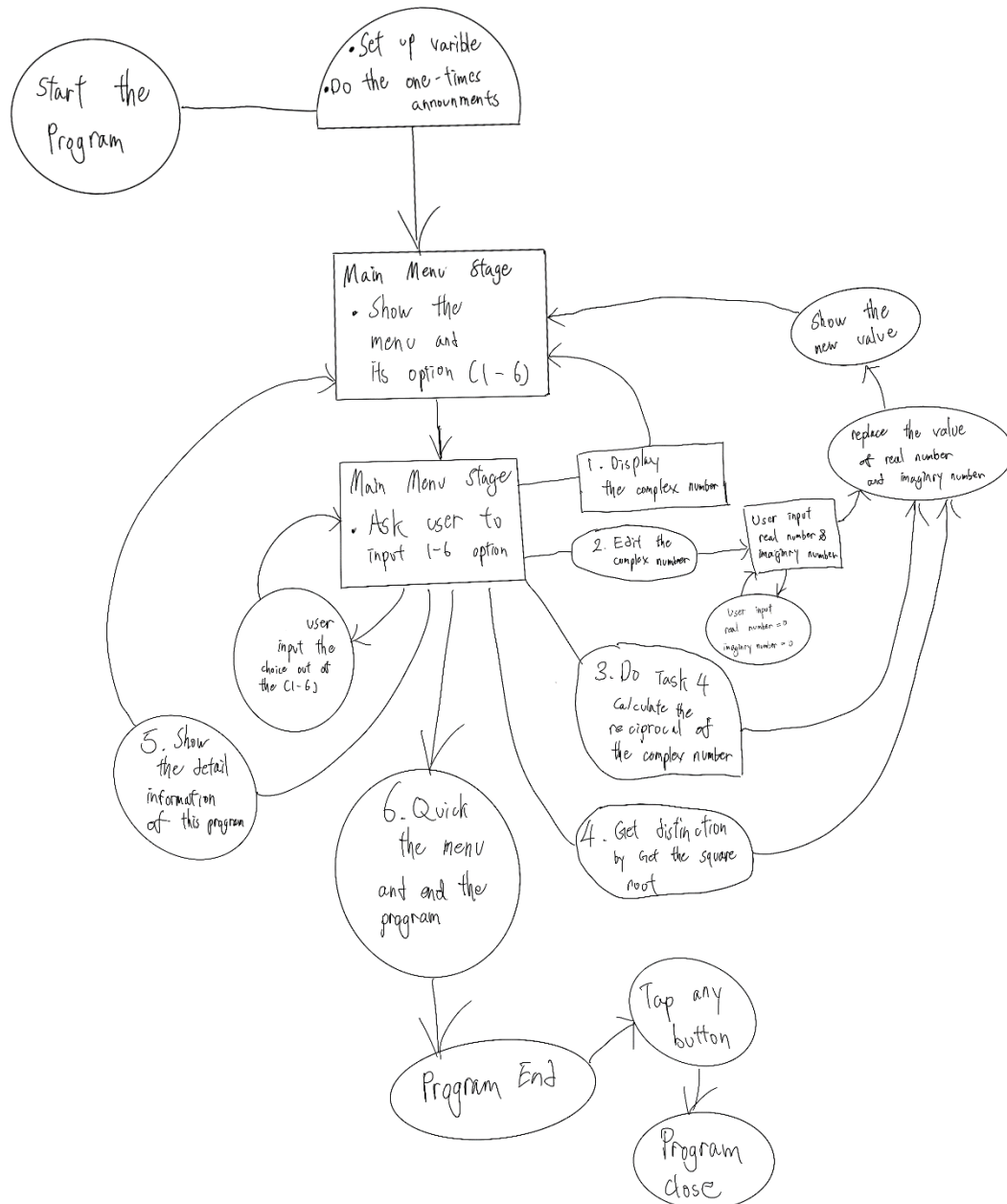
    cout << "-----Credit-----" << endl;
    cout << "Team 24 --- Kwok Kevin" << endl;
    cout << endl << endl << "BACK TO THE MENU" << endl;
}
```

Just a class function to cout sea of text for providing the information/detail of what the program is doing

3.Methodology(con't)

The flow of execution

Flow chart of
Ada program of
Team 24 - Kwok Kevin



3.Methodology(con't)

The problems your group encounters, and how your group solves the problems

I have faced the problem like forgot what lecture taught about making library. Also some trouble with how to make a switch loop inside the do while loop.

The way that I solve it is firstly back to the lecture notes find the answers. Recall the usage of the needed item then back to the past paper of quiz/program test find similar case of the function that I need, then take the reference and create the most suitable program I need to solve.

For example, I forgot how to set up the loop menu. I remember loop menu is one section of the first program test. Therefore I go back to past paper program test, to find most suitable loop menu for this ada

The way to validate your application, i.e., confirm that the solution is correct.

Build the solution, then come out the tones of error, and then debug.

Loop the step above until no bug. And then keep try all possibility of the function and menu loop is happened what I expect.

For example , I have to set up the bool variable for getting none zero complex number. I tried two time with two zero input and also normal input. Normal people suppose to continue other job. But I was insane to input other character like "a","z". This input directly collapse the program and make the program go into the dead loop. This helps me to find out a hidden bug and also find a way to fix it ie. Adding needed command into default, return the bool false/true.

4.Results

Stage 1: begin

In this stage, show the notice before the menu loop, then show the menu and ask user to input 1-6 choice.s

```
Welcome to ADA
Notice: Your default complex Number is 5 + 7i
Option 5 of the menu is a LONG article !!! becarefull to click in !!!
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文慎入)
6.Quit
Enter your choice (1,2,3,4,5,6):_
```

For input choice 1, we choose to display the value of the complex number.

Since we still are using the default complex number (5+7i)

So it shows us the default complex number value

```
Enter your choice (1,2,3,4,5,6):1
Your current complex number is 5+7i
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文慎入)
6.Quit
Enter your choice (1,2,3,4,5,6):_
```

4.Results(con't)

For option 2, we try to input two zero coefficient for the complex number

There is a message shown that 0 complex number is not accepted

Then we input (7+5i) as our new complex number. And try to display the new value with option 1. It works and also back to menu again.

```
6.Quit
Enter your choice (1,2,3,4,5,6):2
please enter your new real number: 0
please enter your new imagine number: 0
0 complex number is not accepted! Please enter again!!!
please enter your new real number: 7
please enter your new imagine number: 5
Your new complex number is 7+5i
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文填入)
6.Quit
Enter your choice (1,2,3,4,5,6):1
Yout current complex number is 7+5i
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文填入)
6.Quit
```

For option 3, it's the task 4 function to caluate reciprocal complex number to

```
Enter your choice (1,2,3,4,5,6):3
Your reciprocal complex number is 0.0945946 + -0.0675676i
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文填入)
6.Quit
Enter your choice (1,2,3,4,5,6):4
Your squt complex number is 0.324686 + +(-0.104051i)
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文填入)
6.Quit
Enter your choice (1,2,3,4,5,6):
```

4.Results(con't)

Google show the ans same as it



A screenshot of a Google search interface. The search bar contains the text "reciprocal of (7+5i)". Below the search bar, there are navigation links: "全部" (All), "圖片" (Images), "新聞" (News), "購物" (Shopping), "影片" (Videos), and "更多" (More). The search results show "約 608,000 項搜尋結果 (0.46 秒)". The main result displays the calculation "reciprocal of(7 + (5 * i)) =" followed by the result "0.0945945946 - 0.0675675676 i".

Google

reciprocal of (7+5i)

全部 圖片 新聞 購物 影片 更多

約 608,000 項搜尋結果 (0.46 秒)

reciprocal of(7 + (5 * i)) =

0.0945945946 - 0.0675675676 i

For option 4 , since it uses the value produced from option 3



A screenshot of a Google search interface. The search bar contains the text "the square root of 0.0945945946 - 0.0675675676 i". Below the search bar, there are navigation links: "全部" (All), "地圖" (Maps), "圖片" (Images), "影片" (Videos), "新聞" (News), and "更多" (More). The search results show "約 8 項搜尋結果 (0.45 秒)". A message in Chinese says "提示：只顯示香港繁體中文搜尋結果。您可以在 使用偏好 中指定搜尋語言". The main result displays the calculation "square root(0.0945945946) - (0.0675675676 * i) =" followed by the result "0.307562343 - 0.0675675676 i".

Google

the square root of 0.0945945946 - 0.0675675676 i

全部 地圖 圖片 影片 新聞 更多

約 8 項搜尋結果 (0.45 秒)

提示：只顯示香港繁體中文搜尋結果。您可以在 使用偏好 中指定搜尋語言

square root(0.0945945946) - (0.0675675676 * i) =

0.307562343 - 0.0675675676 i

Same as google calculation

4.Results(con't)

This is option 5 to show the very long information to introduction that what the program is going and also credit team. Similar to the game credit, it's as same as long that people don't want to pay attention what they write on it.

```
Enter your choice (1,2,3,4,5,6):5

=====Information of ADA=====
This is an object-oriented console application that perform calculations on complexnumber.
(x+yi) <----- x is the real number part, and y is the coefficient part of *i(imaginary unit)
*note: square of i is -1 // i^2 = -1

I was assign to complete task 4
Team 24 ==> 24%5 = 4 ==> Do Task 4

=====Detail of Task 4=====
Here is the detail to introduce menu option 3.Calculate the reciprocal of your complex number
The option 3 is the function that finds thereciprocal of the complex number
and return the result as complex number.

For example:
our defaulted complex number is 5+7i
the function will return x = 0.0676=(5/(5^2+7^2)) , y = -0.0946=(-7/(5^2+7^2))
then we solve the reciprocal of (5+7i) and also save automatically this reciprocal as our new complex number
The new saved complex number is : 0.0676 + -0.0946i

=====Detail of square root=====
Here is the detail to introduce menu option 4.Get the square root
The option 4 is the function that implement a member function to the class that can compute
the square root of the complex number(x + yi)

For example:
our defaulted complex number for this case is 9+0i
the function will return x = 3= sqrt((9+sqrt(9^2+0^2))/2) , y = 0 = *sgn(0) sqrt((-9+sqrt(9^2+0^2))/2)
then we solve the square root of (9+0i) and also save automatically this reciprocal as our new complex number
The new saved complex number is : 3 + 0i
*note: sgn(y) is the signum function defined as follow,
sgn(y) = -1 , when y <0
sgn(y) = 0 , when y =0
sgn(y) = 1 , when y >0
=====Credit=====
Team 24 --- Kwok Kevin

BACK TO THE MENU
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文慎入)
6.Quit
Enter your choice (1,2,3,4,5,6):
```

With option 6 which end the loop and also close the program

```
=====Detail of square root=====
Here is the detail to introduce menu option 4.Get the square root
The option 4 is the function that implement a member function to the class that can compute
the square root of the complex number(x + yi)

For example:
our defaulted complex number for this case is 9+0i
the function will return x = 3= sqrt((9+sqrt(9^2+0^2))/2) , y = 0 = *sgn(0) sqrt((-9+sqrt(9^2+0^2))/2)
then we solve the square root of (9+0i) and also save automatically this reciprocal as our new complex number
The new saved complex number is : 3 + 0i
*note: sgn(y) is the signum function defined as follow,
sgn(y) = -1 , when y <0
sgn(y) = 0 , when y =0
sgn(y) = 1 , when y >0
=====Credit=====
Team 24 --- Kwok Kevin

BACK TO THE MENU
===== MENU =====
1.Show your now statue of complex number
2.Edit your complex number
3.Calculate the reciprocal of your complex number
4.Get the square root
5.Information of this ADA(長文慎入)
6.Quit
Enter your choice (1,2,3,4,5,6):6
Run destructor.

D:\c++ class exe\ada_project\Debug\ada_project.exe (process 49960) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

5.Conclusion and further development

Summarize the experience gained in the assignment

To summarize the experience gained in the assignment, it is a good experience for me as a c++ rookie to hard study from the lecture note and also take the application with complex number. It could be understand as a very beginning task/project for c++ user. However , it is a good practice to test my creative with program managing and also program design with function. Although I have skipped the most difficult part of the project--- login system. I believe it should be the most challenging part for me. I would like to complete all the task if I could. I did the distinction but not login system. It is because login system requires the usage of pointer and also saving data into the txt file. As a c++ rookie, as a one-man team, I think I had tried my best to do the task requirements. Just sadly I cannot complete all function that project given and also that brainstormed from my mind.

Indicate how your program can be extended and improved if more time is allowed.

If I have more time, I would like to continue the login system with familiar with using pointer and saving data into txt file. Also I would like to add more detail interface. For example, option 5 is a long article to introduce option 3(reciprocal) , option 4(distinction) and the credit developing team as the same time by using "cout". It's obvious that I could improve the information when user make choice that which option user want to understand, in stead of just throw all information to user read. And for program editing, I think there is a way for c++ to read the message in the txt file the print it out so that I could save the energy that not type every text in the function with the class function complexNum::information.