ECE 2305

Introduction to C Programming

Programming Project 04

Complex Numbers

Program Features: Looping structure, switch structure, variables, data input and output, mathematical operators, user-defined functions.

Write a C++ application that will perform the following operations on complex numbers. The application shall use a main function that presents the user with a display that resembles the following.

Name:

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Complex Number A: Real: _____ Imaginary: _____ Magnitude: _____ Angle: _____

Complex Number B: Real: _____ Imaginary: _____ Magnitude: _____ Angle: _____

Complex Number C: Real: _____ Imaginary: _____ Magnitude: _____ Angle: _____

1. Enter Complex Number A in Rectangular Form.

2. Enter Complex Number A in Polar Form.

3. Enter Complex Number B in Rectangular Form.

4. Enter Complex Number B in Polar Form.

5. Add the two Complex Numbers: C = A + B.

6. Find the Complex Conjugate: C = A*.

7. Multiply the two Complex Numbers: C = AB

8. Divide the two Complex Numbers: C = A / B.

9. End the program.

Select Option:

Write the main function in such a way that an improper response will cause the menu items to be repeated. The menu options are to continue until the user chooses to end the program.

Write a user-defined function to perform each of the operations shown in the Main Menu. Pass the arguments to the user-defined functions by reference.

The results shall immediately be updated after each menu selection.

All angles shall be stored and presented in degrees. Take care to determine the Phase Angle such that the complex number is located in the appropriate quadrant of the Complex Plane. Use double-precision floating-point numbers in performing the calculations. After each of the Complex Number Arithmetic Operations, present the result in Rectangular and in Polar form.

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Limit the numerical display to 3 decimal points. Take care to not allow a divide by zero error. Use the following structure for the program.

Provide the following documentation for the program in a PDF document.

A. A brief written description of the program including the purpose of the program and the structure and programming techniques used in the program.

This program is meant to present the user with a menu of options that allows him to insert imaginary numbers into the algorithm and the code fills out the table as directed by the user.

It uses global variables for both functions. It uses a user-defined function with a switch structure to allow the user to choose his input. The main input has a do while loop to allow the user to continue the program until he chooses to stop.

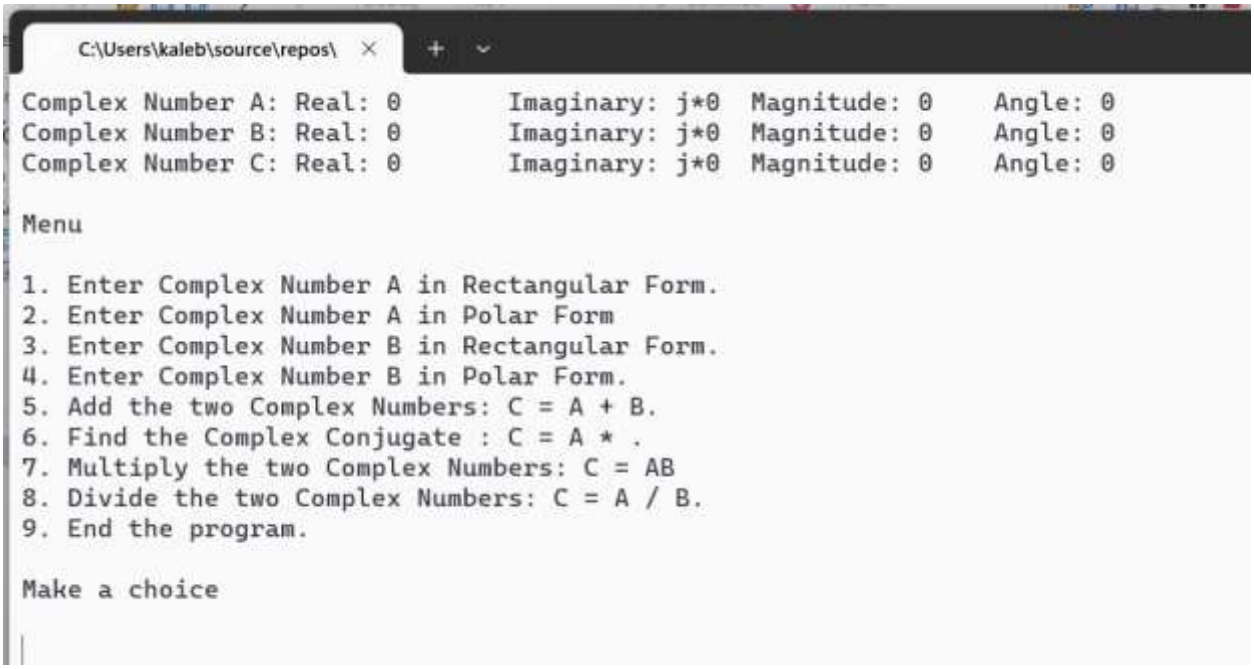
B. The code listing.

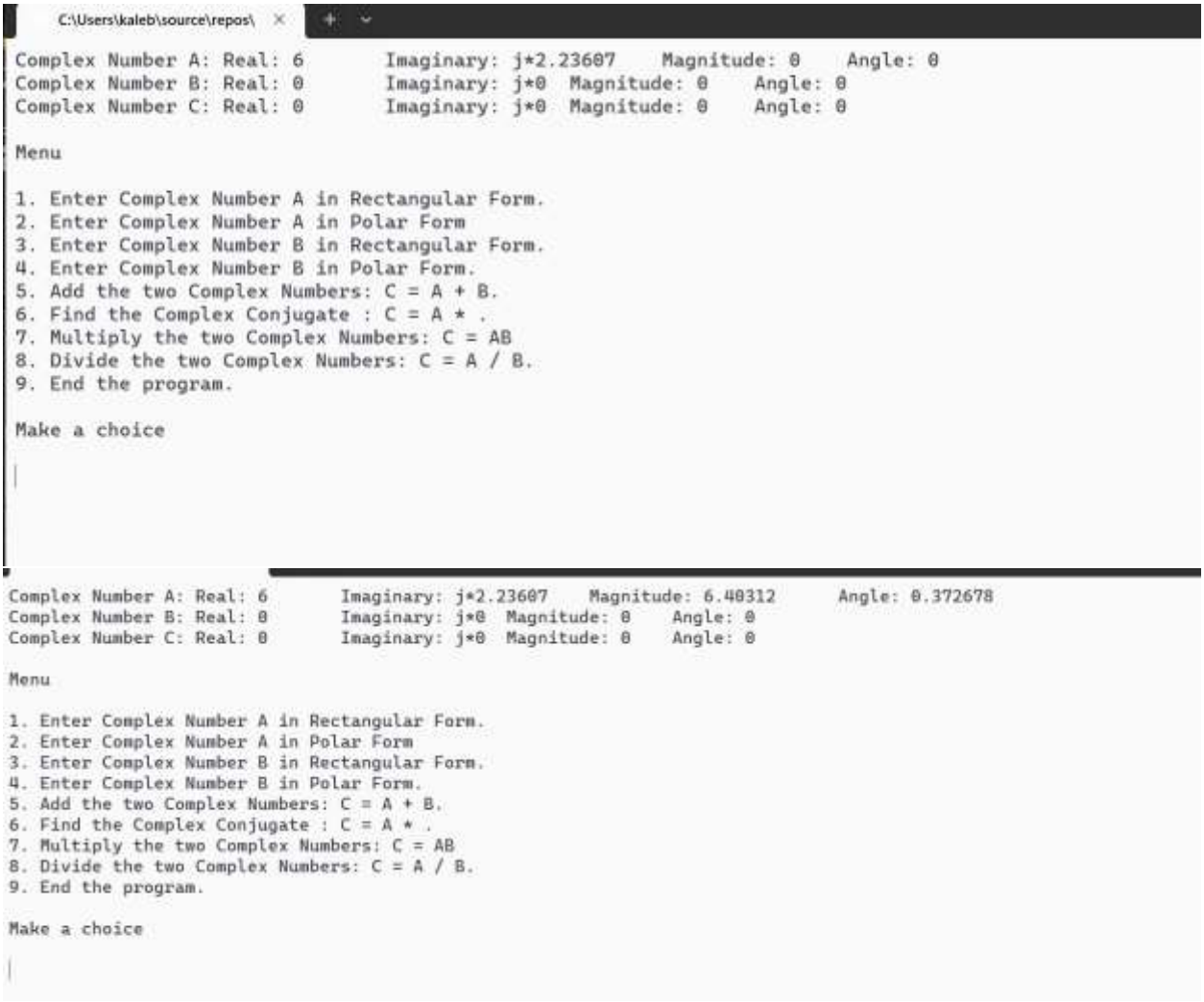
```cpp
//ECE Programming Project 4-Kaleb Badgett

#include <iostream>
#include <cmath>
using namespace std;

double realA = 0;
double imaginaryA = 0;
double magnitudeA = 0;
double angleA = 0;

double realB = 0;
double imaginaryB = 0;
double magnitudeB = 0;
double angleB = 0;

double realC = 0;
double imaginaryC = 0;
double magnitudeC = 0;
double angleC = 0; //Global constants

double UserChoice(int x)
{
    switch (x)//Switch statements for menu choices
    {
        case 1:
        {
            cout << "Give me the real part of complex number A" << endl;
            cin >> realA;
            cout << endl;

            cout << "Give me the imaginary part of complex number A without the i or the square root" << endl;
            cin >> imaginaryA;
            cout << endl;
            imaginaryA = sqrt(imaginaryA);
            return realA;

            system("pause");

            break;
```

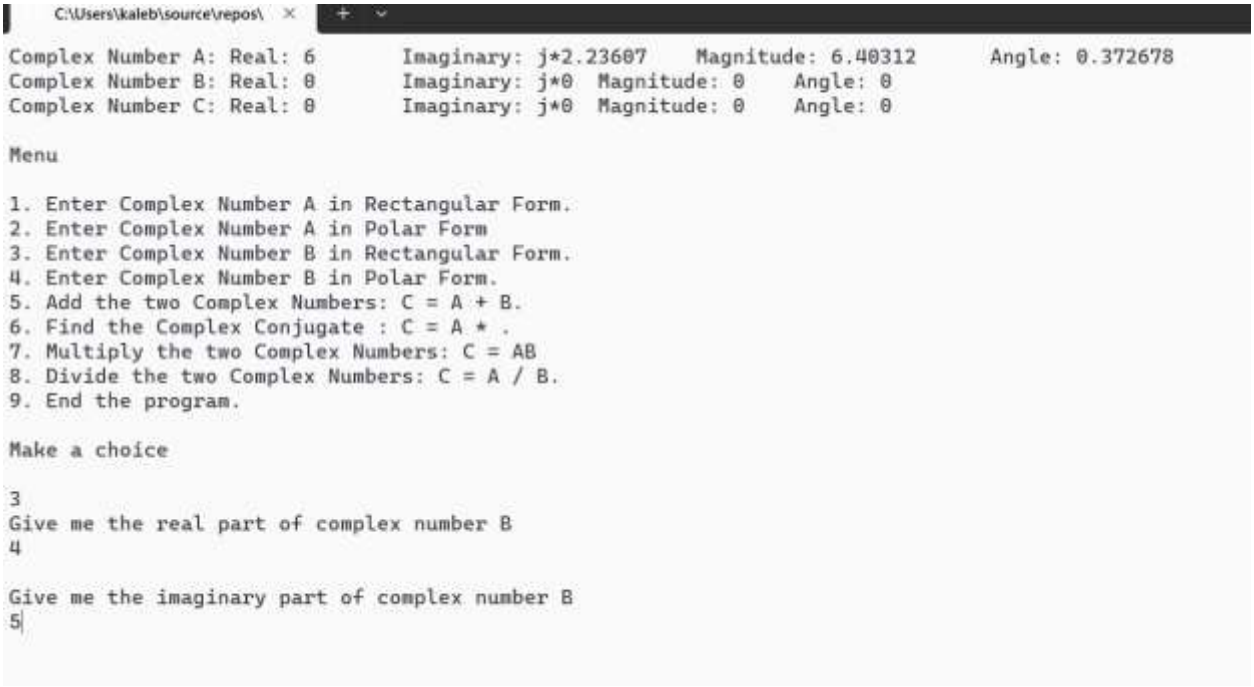
```cpp
        case 2:
        {
            magnitudeA = sqrt(pow(realA, 2) + pow(imaginaryA, 2));
            angleA = imaginaryA / realA;

            system("pause");
            break;
        }
        case 3:
        {
            cout << "Give me the real part of complex number B" << endl;
            cin >> realB;
            cout << endl;

            cout << "Give me the imaginary part of complex number B" << endl;
            cin >> imaginaryB;
            cout << endl;
            imaginaryB = sqrt(imaginaryB);

            system("pause");
            break;
        }
        case 4:
        {
            magnitudeB = sqrt(pow(realB, 2) + pow(imaginaryB, 2));
            angleB = imaginaryB / realB;

            system("pause");
            break;
        }
        case 5:
        {
            realC = realA + realB;
            imaginaryC = imaginaryA + imaginaryB;
            magnitudeC = sqrt(pow(realC, 2) + pow(imaginaryC, 2));
            angleC = imaginaryC / realC;
            system("pause");
            break;
```

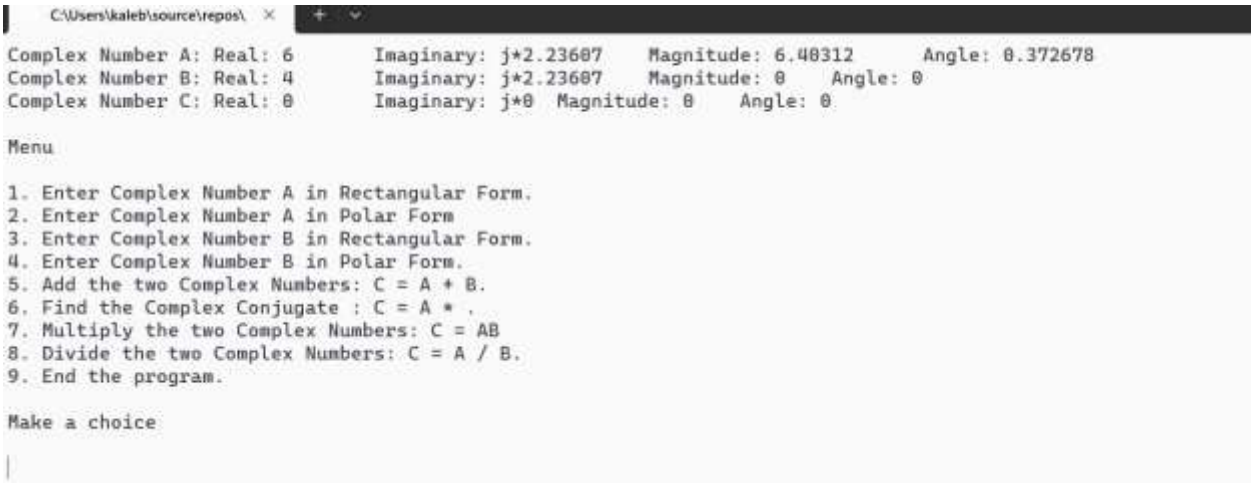
```
        }
        case 6:
        {
            realC = realA;
            imaginaryC = imaginaryA * -1;
            magnitudeC = sqrt(pow(realC, 2) + pow(imaginaryC, 2));
            angleC = imaginaryC / realC;
            system("pause");
            break;
        }
        case 7:
        {
            realC = realA * realB;
            imaginaryC = imaginaryA * imaginaryB;
            magnitudeC = sqrt(pow(realC, 2) + pow(imaginaryC, 2));
            angleC = imaginaryC / realC;
            system("pause");
            break;
        }
        case 8:
        {
            realC = realA / realB;
            imaginaryC = imaginaryA / imaginaryB;
            magnitudeC = sqrt(pow(realC, 2) + pow(imaginaryC, 2));
            angleC = imaginaryC / realC;
            system("pause");
            break;
        }
        case 9:
        {
            cout << "Goodbye" << endl;
            system("pause");
            break;
        }
        default:
        {
            cout << "Choose a valid option" << endl;
            system("pause");
            break;
        }

int main()
{
    int choice = 0;//User choice variable

    do
    {
        system("cls");
        cout << "Complex Number A: Real: " << realA << "\tImaginary: j=" << imaginaryA << "\tMagnitude: " << magnitudeA << "\tAngle: " << angleA << endl;
        cout << "Complex Number B: Real: " << realB << "\tImaginary: j=" << imaginaryB << "\tMagnitude: " << magnitudeB << "\tAngle: " << angleB << endl;
        cout << "Complex Number C: Real: " << realC << "\tImaginary: j=" << imaginaryC << "\tMagnitude: " << magnitudeC << "\tAngle: " << angleC << endl;//List for real and imaginary numbers

        cout << endl;
        cout << "Menu" << endl;
        cout << endl;

        cout << "1. Enter Complex Number A in Rectangular Form." << endl;
        cout << "2. Enter Complex Number A in Polar Form" << endl;
        cout << "3. Enter Complex Number B in Rectangular Form." << endl;
        cout << "4. Enter Complex Number B in Polar Form." << endl;
        cout << "5. Add the two Complex Numbers: C = A + B." << endl;
        cout << "6. Find the Complex Conjugate : C = A * ." << endl;
        cout << "7. Multiply the two Complex Numbers: C = AB" << endl;
        cout << "8. Divide the two Complex Numbers: C = A / B." << endl;
        cout << "9. End the program." << endl;
        cout << endl;
        cout << "Make a choice" << endl;//Menu
        cout << endl;

        cin >> choice;//User makes a choice

        UserChoice(choice);//call user defined function

    } while (choice != 9);//While loop to continue function until user stops it
    return 0;
}
```

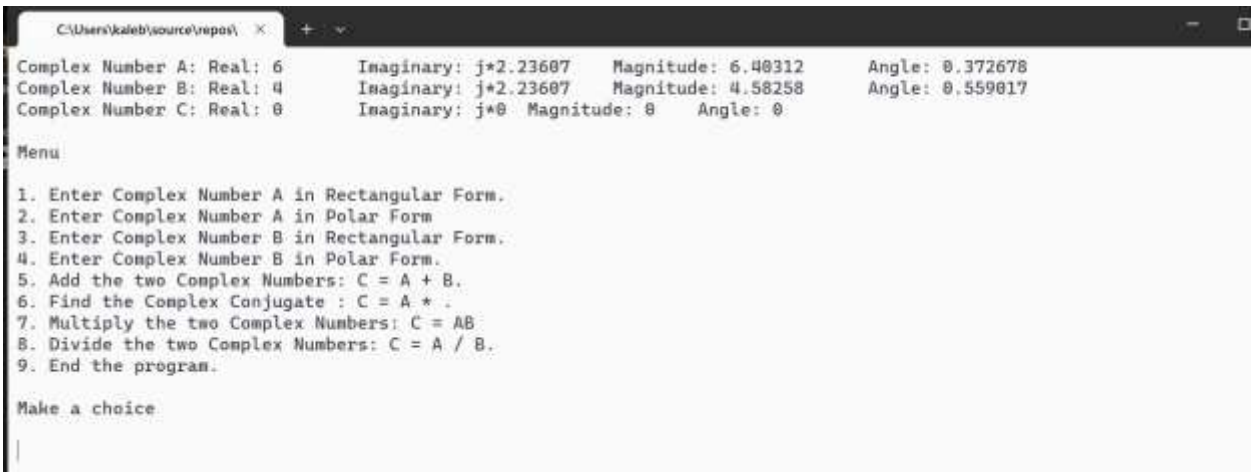
C. Screen captures that demonstrate that each operation is performed correctly.


C:\Users\kaleb\source\repos\
Complex Number A: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Complex Number B: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Complex Number C: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Menu
1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.
Make a choice


C:\Users\kaleb\source\repos\
Complex Number A: Real: 6 Imaginary: j*2.23607 Magnitude: 0 Angle: 0
Complex Number B: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Complex Number C: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Menu
1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.
Make a choice
Complex Number A: Real: 6 Imaginary: j*2.23607 Magnitude: 6.40312 Angle: 0.372678
Complex Number B: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Complex Number C: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Menu
1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.
Make a choice


C:\Users\kaleb\source\repos\
Complex Number A: Real: 6 Imaginary: j*2.23607 Magnitude: 6.40312 Angle: 0.372678
Complex Number B: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Complex Number C: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Menu
1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.
Make a choice
3
Give me the real part of complex number B
4
Give me the imaginary part of complex number B
5

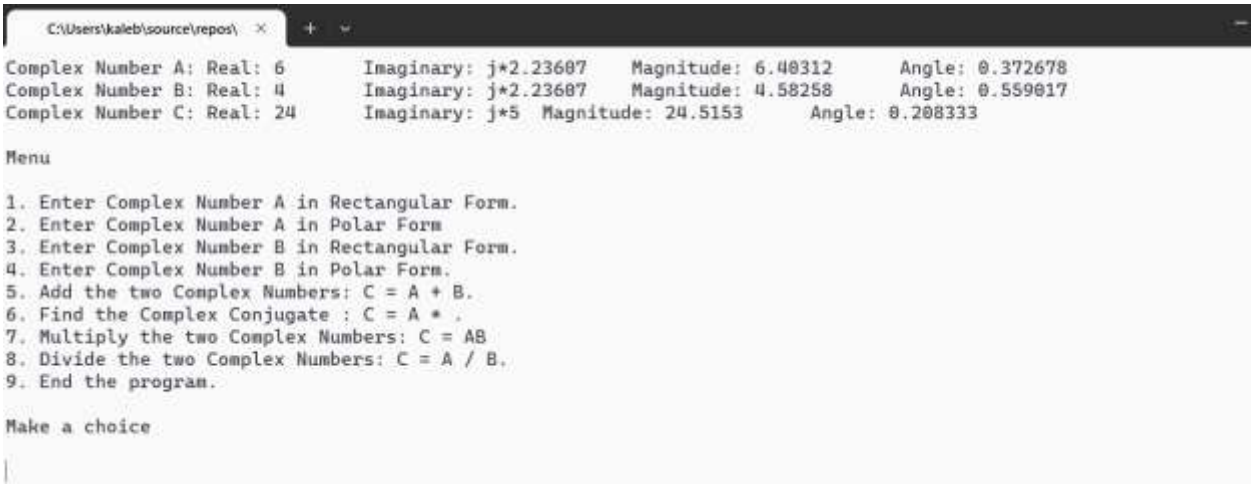

C:\Users\kaleb\source\repos\
Complex Number A: Real: 6 Imaginary: j*2.23607 Magnitude: 6.40312 Angle: 0.372678
Complex Number B: Real: 4 Imaginary: j*2.23607 Magnitude: 0 Angle: 0
Complex Number C: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Menu
1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.
Make a choice


C:\Users\kaleb\source\repos\
Complex Number A: Real: 6 Imaginary: j*2.23607 Magnitude: 6.40312 Angle: 0.372678
Complex Number B: Real: 4 Imaginary: j*2.23607 Magnitude: 4.58258 Angle: 0.559017
Complex Number C: Real: 0 Imaginary: j*0 Magnitude: 0 Angle: 0
Menu
1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.
Make a choice

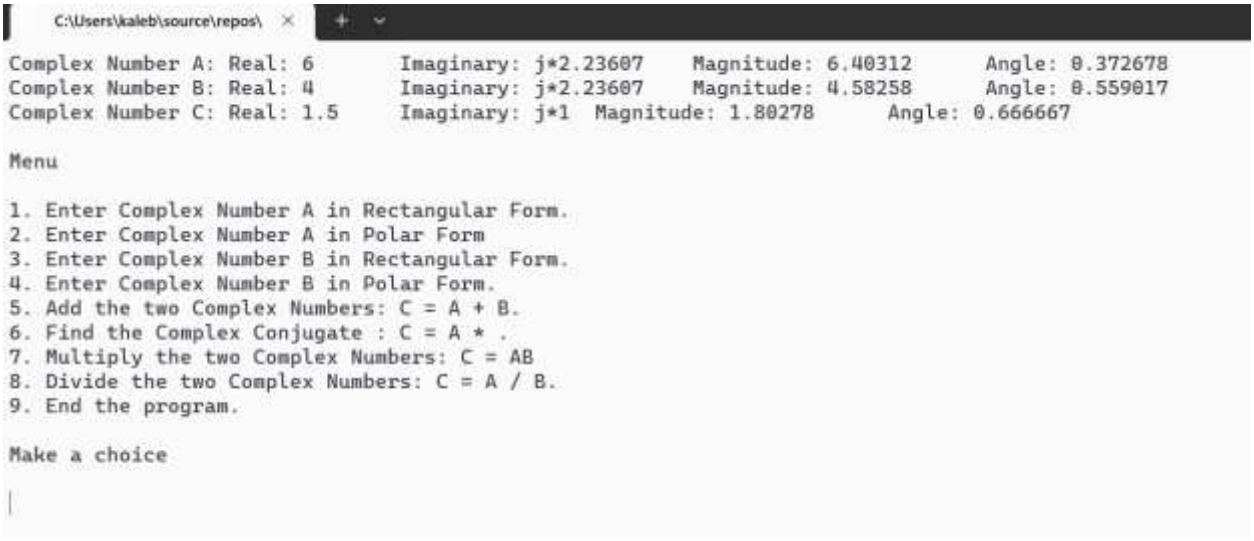
```
C:\Users\kaleb\source\repos\
Complex Number A: Real: 6       Imaginary: j*2.23607    Magnitude: 6.40312      Angle: 0.372678
Complex Number B: Real: 4       Imaginary: j*2.23607    Magnitude: 4.58258      Angle: 0.559017
Complex Number C: Real: 0       Imaginary: j*0  Magnitude: 0    Angle: 0

Menu

1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.

Make a choice

5
Press any key to continue . . .
```

```
C:\Users\kaleb\source\repos\
Complex Number A: Real: 6       Imaginary: j*2.23607    Magnitude: 6.40312      Angle: 0.372678
Complex Number B: Real: 4       Imaginary: j*2.23607    Magnitude: 4.58258      Angle: 0.559017
Complex Number C: Real: 10      Imaginary: j*4.47214    Magnitude: 10.9545      Angle: 0.447214

Menu

1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.

Make a choice
```

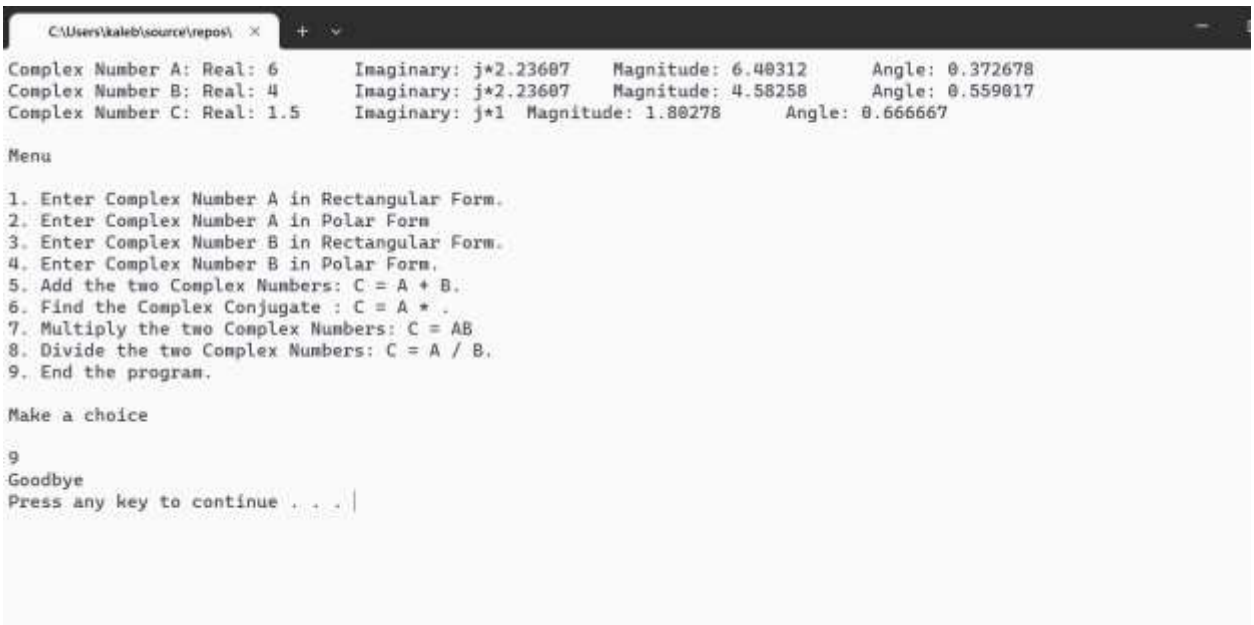
```
C:\Users\kaleb\source\repos\
Complex Number A: Real: 6       Imaginary: j*2.23607    Magnitude: 6.40312      Angle: 0.372678
Complex Number B: Real: 4       Imaginary: j*2.23607    Magnitude: 4.58258      Angle: 0.559017
Complex Number C: Real: 6       Imaginary: j*-2.23607   Magnitude: 6.40312      Angle: -0.372678

Menu

1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.

Make a choice
```



```
C:\Users\kaleb\source\repos\
Complex Number A: Real: 6       Imaginary: j*2.23607    Magnitude: 6.40312      Angle: 0.372678
Complex Number B: Real: 4       Imaginary: j*2.23607    Magnitude: 4.58258      Angle: 0.559017
Complex Number C: Real: 24      Imaginary: j*5  Magnitude: 24.5153      Angle: 0.208333

Menu

1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.

Make a choice
```



```
C:\Users\kaleb\source\repos\
Complex Number A: Real: 6       Imaginary: j*2.23607    Magnitude: 6.40312      Angle: 0.372678
Complex Number B: Real: 4       Imaginary: j*2.23607    Magnitude: 4.58258      Angle: 0.559017
Complex Number C: Real: 1.5     Imaginary: j*1  Magnitude: 1.80278      Angle: 0.666667

Menu

1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.

Make a choice
```



```
C:\Users\kaleb\source\repos\
Complex Number A: Real: 6       Imaginary: j*2.23607    Magnitude: 6.40312      Angle: 0.372678
Complex Number B: Real: 4       Imaginary: j*2.23607    Magnitude: 4.58258      Angle: 0.559017
Complex Number C: Real: 1.5     Imaginary: j*1  Magnitude: 1.80278      Angle: 0.666667

Menu

1. Enter Complex Number A in Rectangular Form.
2. Enter Complex Number A in Polar Form
3. Enter Complex Number B in Rectangular Form.
4. Enter Complex Number B in Polar Form.
5. Add the two Complex Numbers: C = A + B.
6. Find the Complex Conjugate : C = A * .
7. Multiply the two Complex Numbers: C = AB
8. Divide the two Complex Numbers: C = A / B.
9. End the program.

Make a choice

9
Goodbye
Press any key to continue . . .
```