Summer Coding Assignments

Assignment 3: Classes (Operator Overloading)

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In the previous assignments, you had to write functions - sum and product to perform addition and multiplication of complex numbers.

Wouldn't it have been better to be able to write `Complex s = a + b;` or `Complex prod = a x b;` ? This is exactly what we are going to do in this assignment. But you will have to study a little before we can do this. :)

Remember that in a class, you have to use `public:` keyword at the beginning to ensure you can access everything from outside.

```
class Complex {
 public:  //This line is extremely important
   int re;
   int im;
};   //Don't forget the semicolon at the end.
```

In addition to data members, we can also have functions in our classes. e.g.,

```
class Complex {
 public:  //This line is extremely important
   int re;
   int im;
   void getMagnitude() {
    double m = sqrt(re*re + im*im);
    cout<<"Magnitude: "<<m<<endl;
   }
   void getAngle() {
    double a = im*1.0/re;
    cout<<"Angle: "<<a<<endl;
```

```
   }
};   //Don't forget the semicolon at the end.
```

These functions can be called by simply using

```
Complex c1;
c1.re = 1;
c1.im = 1;
c1.getMagnitude();
c1.getAngle();
```

In addition to this, classes have one more wonderful trick up their sleeves, called **operator overloading**. A class is nothing but a user defined data type. In-built data types, eg, int, double, float, string have some operations defined over them. If we do c = a + b, where a and b are integers, we get their sum, if we do s3 = s1+s2, where s1 and s2 are strings, we get a string s3 which is a concatenation of s1 and s2. Similarly, for our complex class, we can define what `+ and x` etc. do, so that we can directly write `c3 = c1 + c2;`

Where to study from?

- Completely go through chapter 8 and 9 of this website. This will teach you all you need to know about Object Oriented Programming in C++. `http://www.learncpp.com/`

1 Problem Statement

You will be given two complex numbers:

$$a + bj, c + dj \tag{1}$$

Your task is to overload `+, x , < and > operators`. **There are several ways to overload operators. Implement the overloaded functions as member functions.** Use these overloaded functions to find the output of the following three operations:

1. c1 + c2;
2. c1 * c2;
3. Is (c1 < c2)? Output YES/NO. In case of equality, output NO.

and write the output to the file.

Now, complex numbers cannot directly be compared, so we define c1 < c2 iff magnitude(c1) < magnitude(c2).

You are expected to make a class - `Complex` - which will have two members: int `re`, and `int im` for storing real and imaginary parts of the complex number. Don't forget to make them public.

Use the following two functions that you implemented in the last assignment:

- string convertToString(Complex a) : Returns a string of the form "x+iy" when given an object "a" of Complex class.
- Complex convertToComplex(string s) : Takes a string of the form a+bj and returns a Complex number.

Save your C++ program as *FirstName_a3.cpp*

Input

The input will be read from a file called **input2**. The first line of the input file gives the number of test cases, T.

T test cases follow. Each test case consists of two complex numbers a+bj,c+dj separated by a comma.

Output

Write your output to a file and name it **output2**.

For each test case, output sum, product and YES/NO on a separate line. Thus, your output file must contain a total of 3 x T lines, where T is the number of test cases.

Limits

In the input, both the real and imaginary parts will be positive. However, in the output, some of them can become negative.

Sample

```
input2
--------
3
1+1j,2+2j
3+5j,5+1j
0+4j,4+0j
output2
---------
3+3j
0+4j
YES
8+6j
10+28j
NO
4+4j
0+16j
NO
```

2 Notes (Optional Reading)

C++ is much easier than C. We are going to use the website `http://www.learncpp.com/` and `https://www.tutorialspoint.com/cplusplus/index.htm` for learning C++. You only need to read the following if you are not familiar with C++. Otherwise, you can just go ahead with the assignment.

2.1 Opening File

```
#include <fstream>
#include <iostream>
#include <string>
using namespace std;

//Need to include the above statement in ALL C++ programs

int main() {
 fstream fin;
```

```
 fin.open("input1", ios::in); //Open file for reading
 fstream fout;
 fout.open("output1", ios::out); //Open file for writing
 cout<<"Both files opened"<<endl; //Print message to screen
}
```

2.2 How to read input in the given format?

- Read each line of the input file into a string s using the `getline` function of C++.

```
#include <fstream>
#include <iostream>
#include <string>
using namespace std;

int main() {
  fstream fin("input2", ios::in);
  int i, T; //for counting testcases
  fin>>T;
  for(i=0;i<T;i++) {
      string s;
      getline(fin, s);
      //do other things
  }
}
```

- Find the position of comma in this string s. Get two substrings s1 and s2.
- Use the convertToComplex function you wrote to get complex numbers from strings.
- In C++, you have some functions like `atoi, stoi` etc. which can convert string to integer.