Problem Set 4 Exercise #12: Complex Numbers

Reference: Lecture 11 notes

Learning objective: Structures

Estimated completion time: 30 minutes

Problem statement:

In mathematics, A **complex number** has the form **`a + bi`** where **`a`** is the real part, **`b`** is the imaginary part and **`i = sqrt(-1)`**.

Complex numbers are a field, and thus have addition, subtraction, multiplication and division operations as listed below:

- Addition: **`(a + bi) + (c + di) = (a + c) + (b + d)i`**
- Subtraction: **`(a + bi) - (c + di) = (a - c) + (b - d)i`**
- Multiplication: **`(a + bi) * (c + di) = (a*c – b*d) + (b*c + a*d)i`**
- Division: **`(a + bi) / (c + di) = ( (a*c + b*d)/(c*c + d*d) ) +`**
  `( (b*c - a*d)/(c*c + d*d) )i`

Write a program **complex_number.c** to

(1) define a structure type **`complex_t`** for complex number which is composed of two members: **`a`** (real part) and **`b`** (imaginary part);

(2) read in a complex number from user input, followed by a series of commands ('+', '-', '*' or '/') each with another complex number;

(3) perform corresponding arithmetic calculations as defined above and report the result.

(4) terminate the program when 'q' is inputted.

For example, in the sample run #1 on the next page, a complex number **`8+9i`** is first inputted, it is then subtracted (-) by the second inputted complex number **`4+4i`** which gives the result of **`4+5i`**.

Note:

This question can be done without creating a structure. However, let's take this question as a chance to practice the use of structures.

Sample run #1:

```
8 9
Complex number (8 + 9i) created
- 4 4
After subtraction: (4 + 5i)
q
```

Sample run #2:

```
4 5
Complex number (4 + 5i) created
+ 4 5
After addition: (8 + 10i)
- 4 5
After subtraction: (4 + 5i)
* 4 5
After multiplication: (-9 + 40i)
/ 4 5
After division: (4 + 5i)
q
```

Sample run #3:

```
4 5
Complex number (4 + 5i) created
+ 1 2
After addition: (5 + 7i)
- 3 4
After subtraction: (2 + 3i)
* 5 6
After multiplication: (-8 + 27i)
/ 7 8
After division: (1 + 2i)
q
```

Sample run #4:

```
0 0
Complex number (0 + 0i) created
* 2 3
After multiplication: (0 + 0i)
/ 4 5
After division: (0 + 0i)
+ 2 5
After addition: (2 + 5i)
q
```