

## 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
```