# Assignment 02: Complex Numbers

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## 1 Overview

### Purpose

The purpose of this assignment is as follows.

1. To learn how to use R as a calculator.
2. To learn basic properties of complex numbers.

### Instructions

In this assignment, you will

- clone the assignment repository and make a working branch (eg. `solution` branch);
- solve the problems in Section 3;
- write the solutions in `solution.Rmd` and knit it;
- commit `solution.Rmd` and `solution.pdf`; and
- open a Pull Request.

## 2 Exercise

Let

$$z_1 = 2 - i$$
$$z_2 = -1 + 2i.$$

1. Calculate $z_1 + z_2$, $z_1 - z_2$, $z_1 z_2$, $z_1 / z_2$ and $z_1^3$. Do it with pen and paper and write solutions with LaTeX syntax.

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2. Use R to check the above calculations are correct.

### Solution

1. $$\begin{aligned} z_1 + z_2 &= 1 + i, \\ z_1 - z_2 &= 3 - 3i, \\ z_1 z_2 &= 5i, \\ z_1 / z_2 &= -\frac{4}{5} - \frac{3}{5}i \\ z_1^3 &= 2 - 11i. \end{aligned}$$

2. Assignment:

```
z1 <- 2 - 1i
z2 <- -1 + 2i
```

Addition:

```
z1 + z2
```

```
## [1] 1+1i
```

Subtraction:

```
z1 - z2
```

```
## [1] 3-3i
```

Multiplication:

```
z1 * z2
```

```
## [1] 0+5i
```

Division:

```
z1 / z2
```

```
## [1] -0.8-0.6i
```

Power:

```
z1 ^ 3
```

```
## [1] 2-11i
```

# 3 Problems

## (1)

Let

$$z_1 = 3 + i$$
$$z_2 = 1 - i.$$

1. Calculate $z_1^2 z_2^3$. Do it with pen and paper and write solutions with LaTeX syntax.
2. Use R to check the above calculatons are correct.

## (2)

It is always advisable to put blank spaces around operators. For example, you should always write `x <- 1 + 2` not `x<-1+2`. Although the latter is a legal code, those esthetic spaces increase readability and reduce bugs.

The following code, however, is not allowed:

```
z <- 1 + 2 i
```

1. Guess what happens if you try to run this code.
2. Run this code and interpret the error message.
3. Report what happened and why.

## (3)

A general form of complex numbers is $a + bi$, $a, b \in \mathbb{R}$. When $b = 1$, we usually omit 1 and simply write as $a + i$; when $b = -1$ we write as $a - i$. In R, we cannot use such expressions as

```
z <- 1 + i
w <- 1 - i
```

1. Guess what happens if you try to run these codes.
2. Run these codes and interpret the error message.
3. Report what happened and why.