Gliwice, 10-11-2024

Mathematical modelling and computer simulations in theory and practice

Documentation of laboratory task no 1

Title: Complex Roots

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Field of studies: Informatics (sem.V)

Project Objective:
The project is calculating complex root of given number and of a given order.

Description:
For a given complex number (z=a+bi) program is calculating its roots of a given order according to formula presented in Figure 1: Formula for complex number roots calculation

$$z_k = \sqrt[n]{|z|}\left(\cos\frac{\varphi + 2k\pi}{n} + i\sin\frac{\varphi + 2k\pi}{n}\right),$$

where $k = 0, 1, 2, ..., n-1$, $|z| = \sqrt{a^2 + b^2}$ and φ is an argument of z, that is the angle for which $\sin\varphi = \frac{b}{|z|}$ and $\cos\varphi = \frac{a}{|z|}$.

Figure 1: Formula for complex number roots calculation

Input:
1. Real part of the given complex number - ‘a’
2. Imaginary part of the given complex number – ‘b’
3. Order of a root being cathelculated – ‘r’

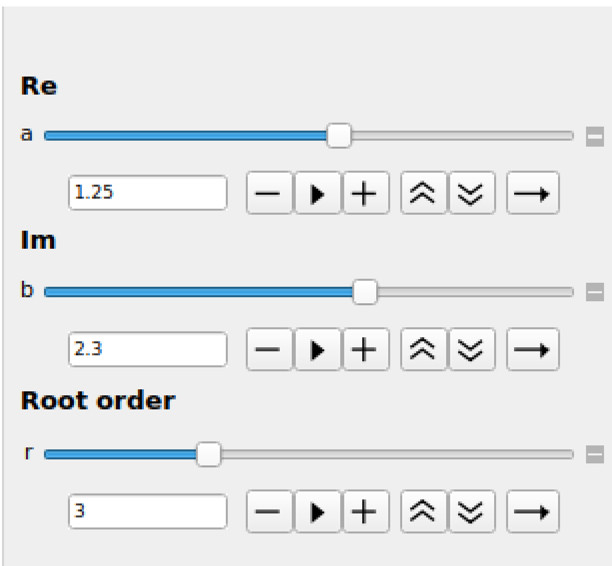
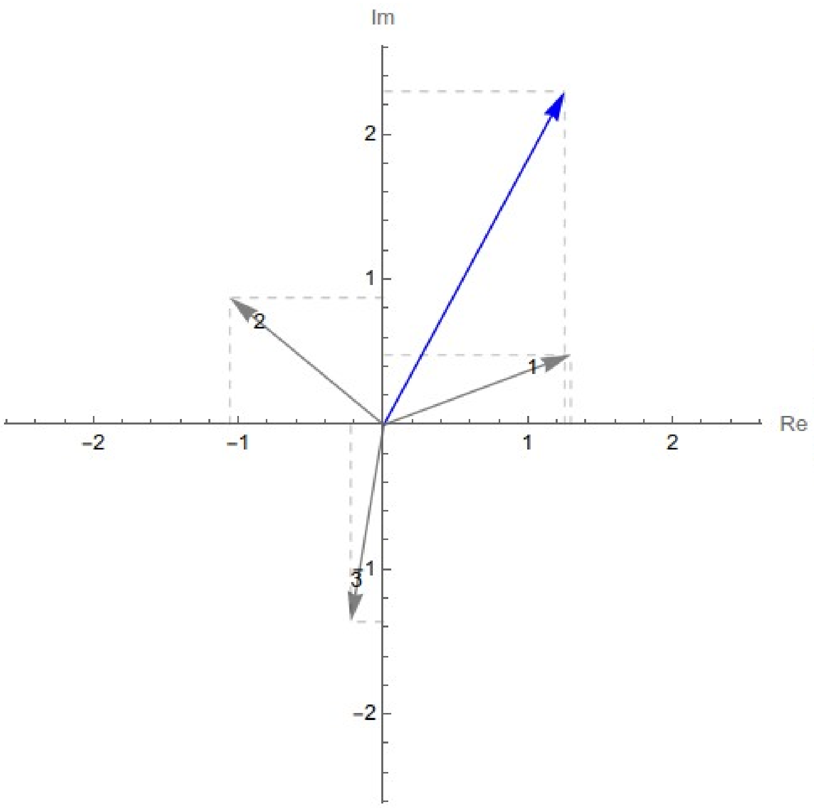


Figure 2: Input view

Output:

1. Visual representation of given number (blue arrow) and its root of a given order (grey arrows) on a complex plane.
2. Table with listed roots. They're enumerated so it's easy to find corresponding arrows.



1	1.29097 + 0.482478 i
2	-1.06333 + 0.876778 i
3	-0.227649 - 1.35926 i

Figure 3: Output view

It's worth noting that it's completly possible to change the range of a number that can be calculated by a program – in the given form they are limited in order to represent complex number that is being analysed, which is usualy much bigger than its roots. In order to change the ranges of posible inputs it's needed to edit numbers in code presented in Figure 4: Ranges of inputs.

```
Style["Re", 10, Bold],
styl               pogrubiony
    {a, -10, 10} ,
Style["Im", 10, Bold],
styl               pogrubiony
    {b, -10, 10},
Style["Root order", 10, Bold],
styl                       pogrubiony
     {r, 0, 10, 1}],
```

Figure 4: Ranges of inputs

In the figures below I present some examples of the solutions:

1. Figure 5: Square root of a real number - we can see 2 real solutions. One is positive and the second is negative.
2. Figure 6: Root of order 4 of a complex number - we can see a set of a diffrent roots where every one is complex.

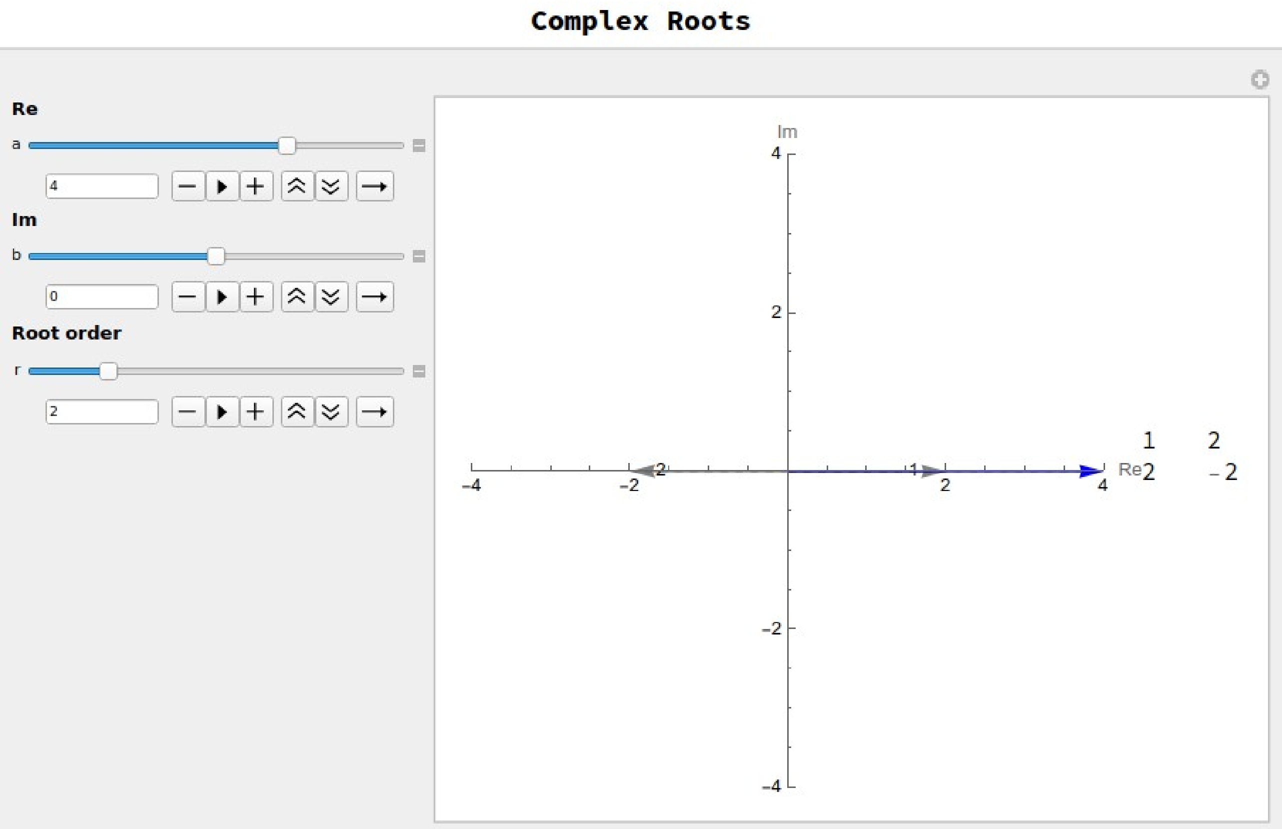


Figure 5: Square root of a real number

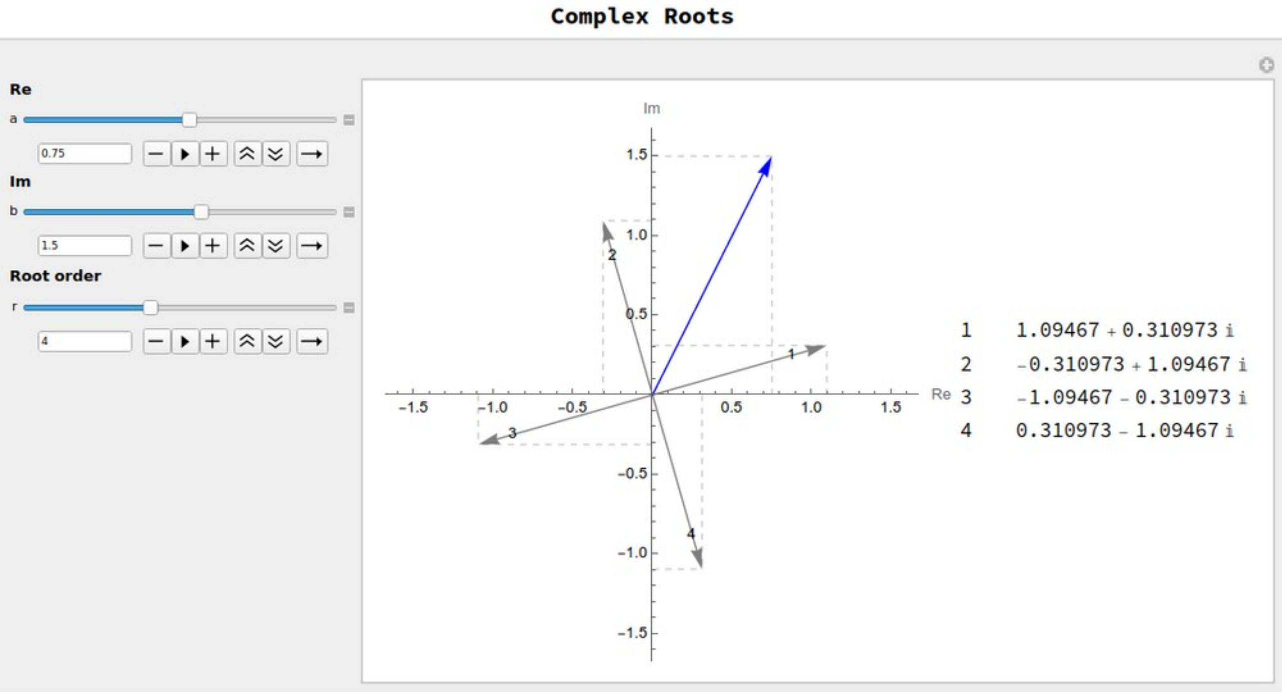


Figure 6: Root of order 4 of a complex number

Enclosures:

1. File with a program (IJędrzejczyk_Radosław_proj_1.nb)