

# Lab B on week 2:

## Complex numbers and rotation

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### Activity 1

Type the following code into Matlab (note that here and everywhere below you may copy and paste instead of typing).

```
a = [1 + i, -1 - i]
plot(a)
```

The variable  $a$  represents the line segment from the point with coordinates  $(1,1)$  to the point with coordinate  $(-1,-1)$  as shown in the plot. If we wish to plot more than one image on the same plot, we must tell Matlab to keep the current image using the command 'hold', before adding the new plot. Try adding the following commands:

```
hold
plot(a * i)
```

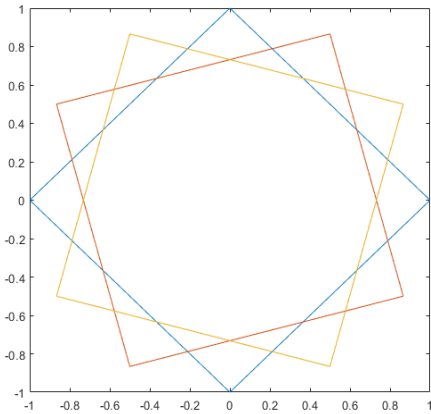
The command above plots the line  $a*i$  on the same plot as  $a$ . You can see that multiplying by  $i$  has resulted in a rotation of 90 degrees as we saw in the lecture. Note that, the 'hold' command will continue until the plot window is closed, so make sure you close the plot window between different activities.

### Activity 2

Begin by closing the plot window and try the following commands:

```
s = [i, i*i, i*i*i, i*i*i*i, i*i*i*i*i]
plot(s)
hold
plot(s*((1 + sqrt(3)*i) / 2))
plot(s*((sqrt(3) + i) / 2))
```

You should obtain the image below. Note that the horizontal and the vertical axes in Matlab plots might be not to the same scale, so you may wish to resize the plot window to get a better view (this applies to all activities below as well).



The blue square is exactly the image from Activity 6 in Lab A this week, where you used the following command:

```
plot([i, i*i, i*i*i, i*i*i*i, i*i*i*i*i])
```

Can you explain why you get the image above? You may find it useful to run the following commands to help your thinking:

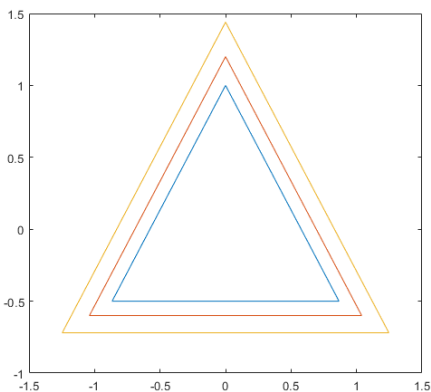
```
angle((1 + sqrt(3)*i) / 2)
rad2deg(ans)
angle((sqrt(3)+i) / 2)
rad2deg(ans)
```

### Activity 3

Begin by closing the plot window. For this exercise, consider the triangle you obtain from the commands:

```
t = [i, (sqrt(3) - i)/2, (-sqrt(3) - i)/2, i]
plot(t)
```

By multiplying the triangle by appropriate numbers, recreate the image below.



How would you write the multipliers you used in the form  $r\angle\theta$  to describe the transformation you see?

## Activity 4

Begin by closing the plot window. The following code builds on the code from Activity 1:

```
a = [1 + i, -1 - i]
plot(a)
hold
plot(a * i)
plot(a * i * i)
```

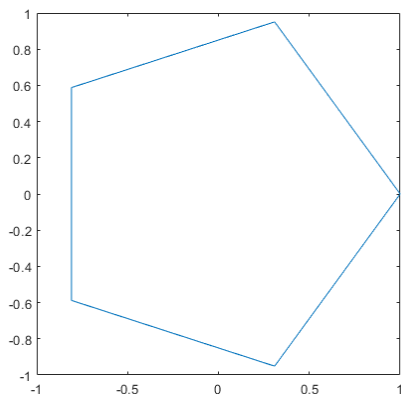
Try the above commands. Why do we see two lines instead of three?

## Activity 5

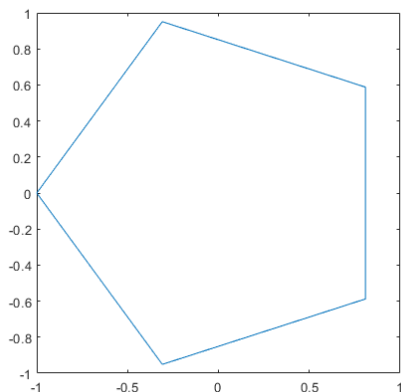
Begin by closing the plot window. The following code creates a regular pentagon with one vertex on the positive direction of the y axis:

```
b = (sqrt(5)*i)/4 + (sqrt(2)*sqrt(sqrt(5) + 5))/4 - i/4
c = sqrt(5)/4 + (sqrt(2)*sqrt(sqrt(5) + 5)*i)/4 - 1/4
f = [b, b*c, b*c*c, b*c*c*c, b*c*c*c*c]
plot(f)
```

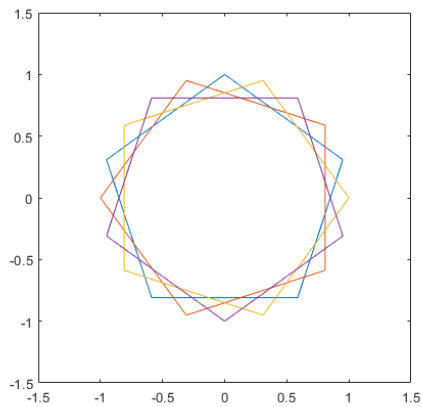
Can you change this pentagon to the one on the following graph (with one vertex on the positive direction of the x axis), by multiplying f by an appropriate complex number?



Again using multiplication by a complex number, can you change the pentagon to the one below (with one vertex on the negative direction of the x axis)?



Building on the code you have can you recreate the image below?



## Activity 6

Begin by closing the plot window. For the final exercise, consider:

$$g = [0, b, b*c, 0]$$

If you plot  $g$  you will see you get a triangle, which is one section of a regular pentagon. Can you multiple  $g$  by a series of appropriate complex numbers and plot your results together on a graph to recreate the pentagon in the image below?

