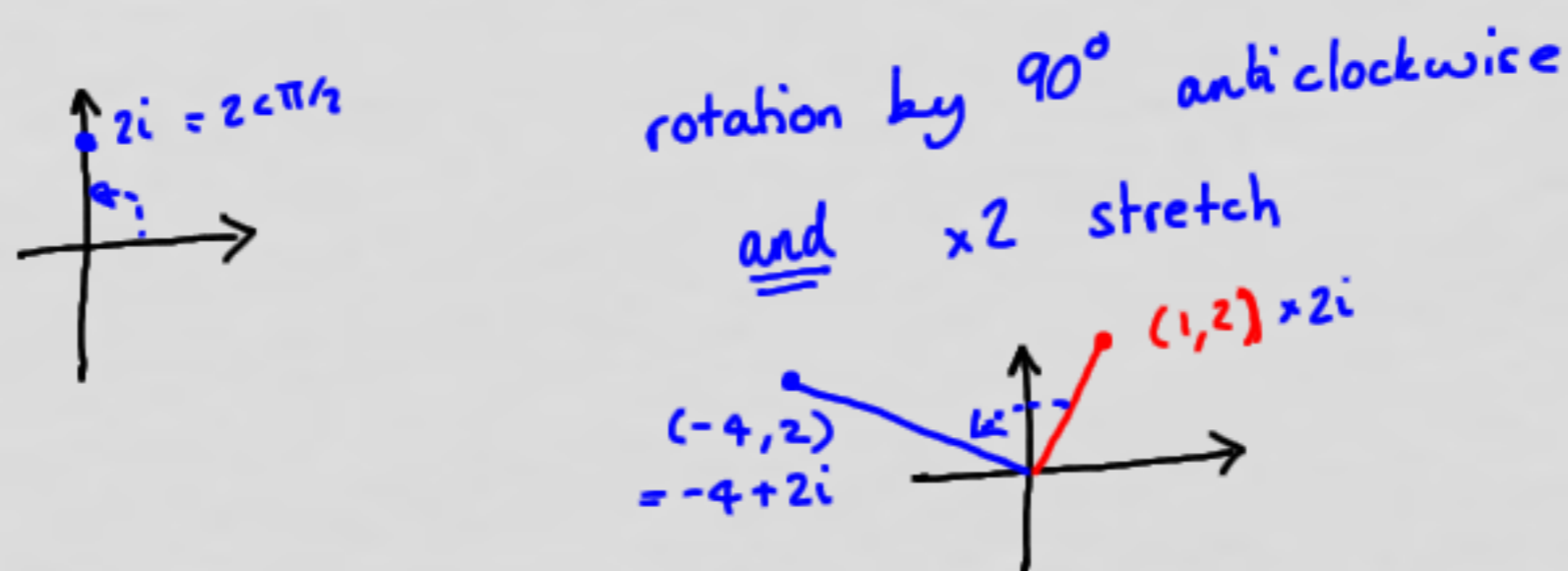
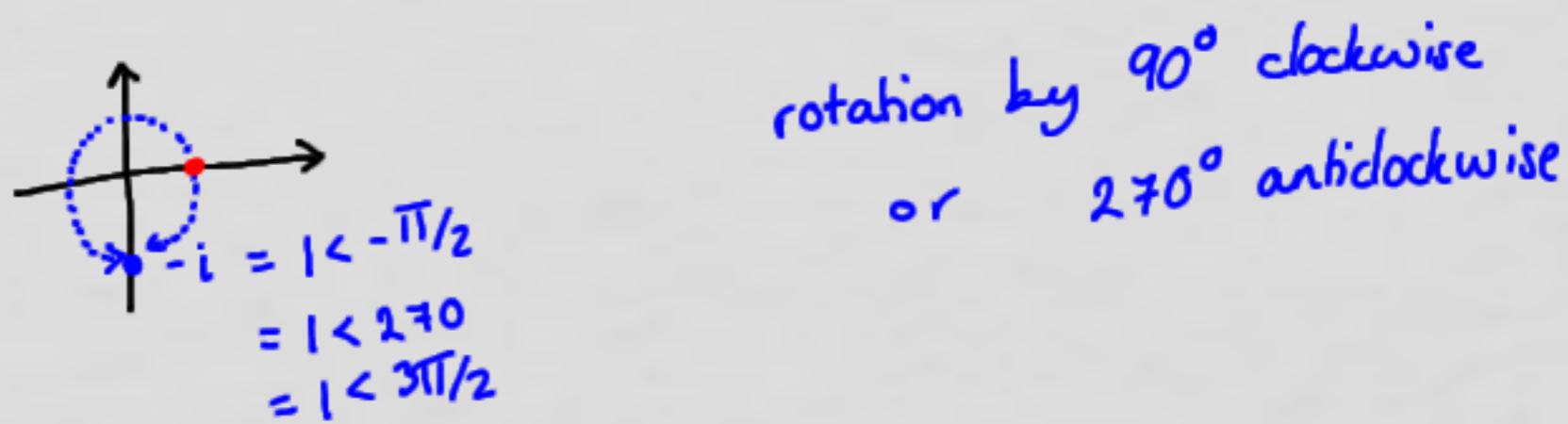
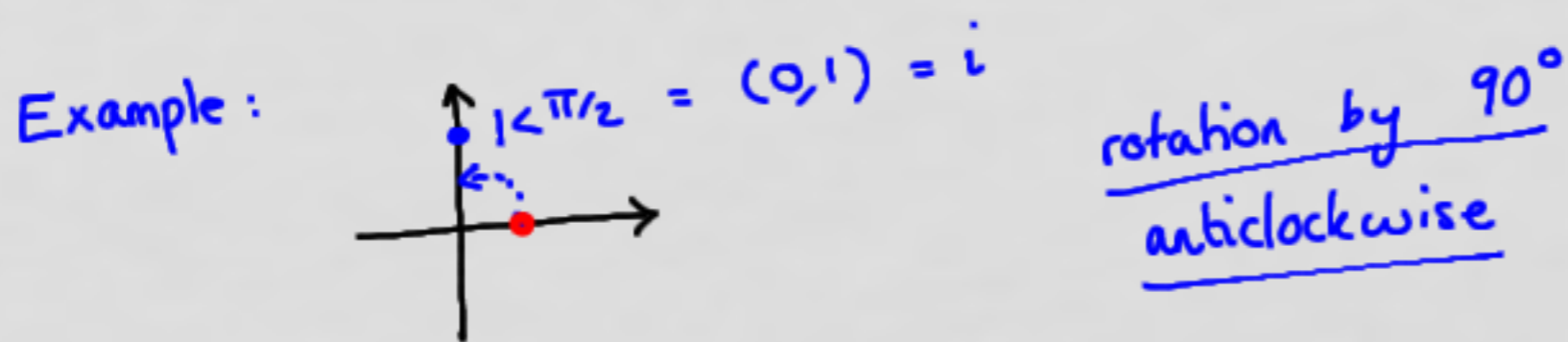
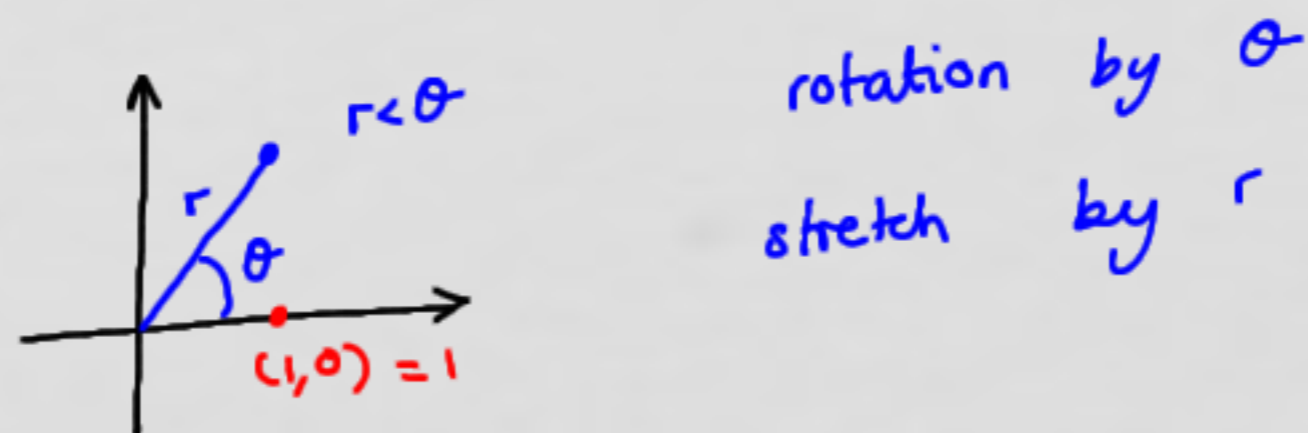
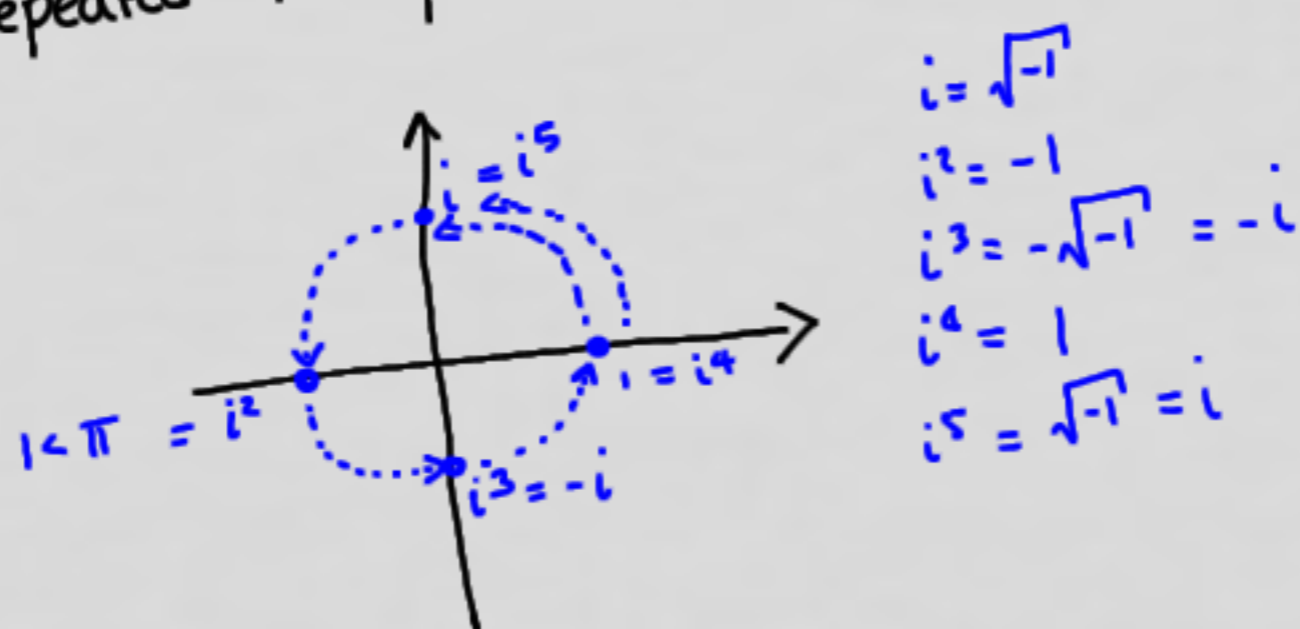


# MA114 : Multiplication with complex numbers



## Repeated multiplication



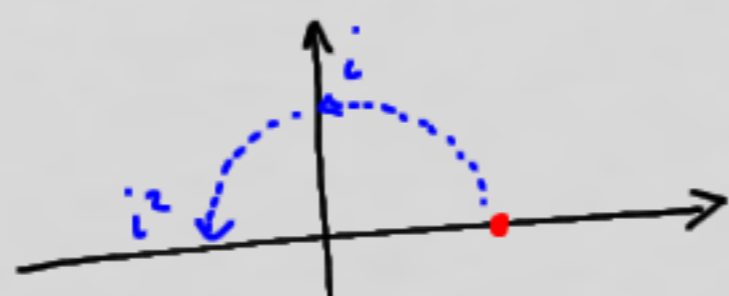
$$\begin{aligned} i &= \sqrt{-1} \\ i^2 &= -1 \\ i^3 &= -\sqrt{-1} = -i \\ i^4 &= 1 \\ i^5 &= \sqrt{-1} = i \end{aligned}$$

$$i = i^5$$

$$\dots 1 < \pi/2 = 1 < 5\pi/2 = 1 < 9\pi/2 \dots$$

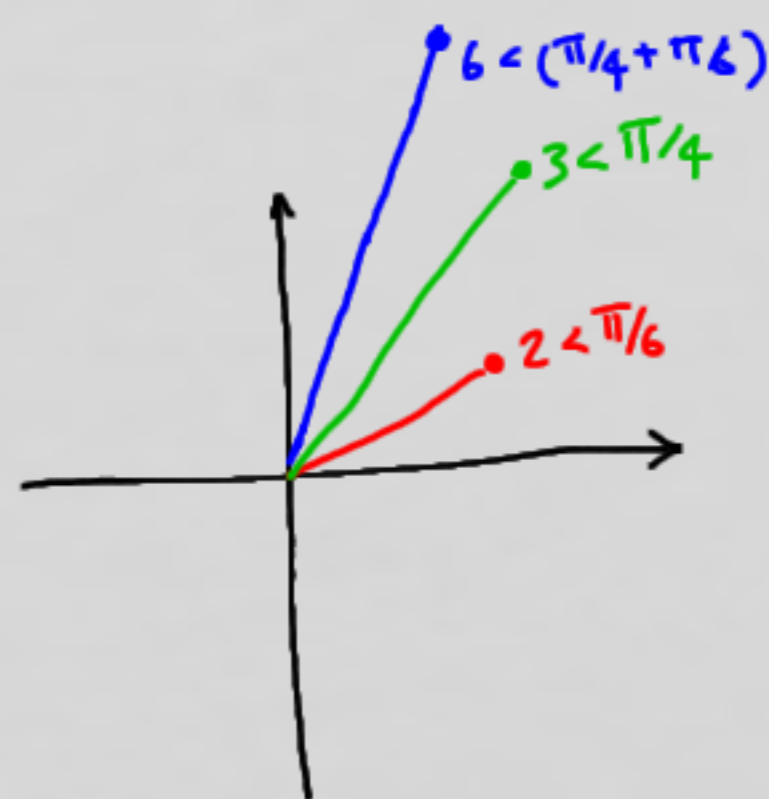
The Argument, or angle of a complex number is not unique.  
(Because rotating by  $2\pi$  doesn't change anything).

## A rule for multiplication



$$\begin{aligned} i^2 &= (1 < \pi/2) (1 < \pi/2) \\ &= 1 < \pi \end{aligned}$$

Add arguments / angles



Multiply the absolute values.

$$(r_1 < \theta_1) (r_2 < \theta_2) = r_1 r_2 < (\theta_1 + \theta_2)$$