1 Complex Number 1

Addition

$$\begin{aligned}
\text{let } z_1 &= x_1 + y_1 i \\
\text{let } z_2 &= x_2 + y_2 i \\
z &= z_1 + z_2 \\
z &= (x_1 + x_2) + (y_1 + y_2)i
\end{aligned}$$

Multiplication

$$\begin{aligned}
z &= z_1 z_2 \\
z &= (x_1 + y_1 i)(x_2 + y_2 i) \\
z &= (x_1 y_2 + x_2 y_1) + (x_1 x_2 - y_1 y_2)i
\end{aligned}$$

Division

$$\begin{aligned}
z &= \frac{z_1}{z_2} \\
z &= \frac{x_1 + y_1 i}{x_2 + y_2 i} \\
z &= \frac{(x_1 + y_1 i)(x_2 - y_2 i)}{(x_2 + y_2 i)(x_2 - y_2 i)} \\
z &= \frac{(x_1 x_2 + y_1 y_2) + (-x_1 y_2 + x_2 y_1)i}{x_2^2 + y_2^2} \\
z &= \frac{(x_1 x_2 + y_1 y_2)}{x_2^2 + y_2^2} + \frac{(-x_1 y_2 + x_2 y_1)}{x_2^2 + y_2^2} i
\end{aligned}$$

Conjugation

$$\begin{aligned}
\overline{z} &= x_1 - y_1 i \\
z\overline{z} &= (x_1 + y_1 i)(x_1 - y_1 i) \\
z\overline{z} &= x_1^2 + y_1^2 \\
z\overline{z} &= |z|^2
\end{aligned}$$

Modulo

$$r = \sqrt{x^2 + y^2}$$

Polar form

$$(r, \beta) = (\sqrt{x^2 + y^2}, \cos^{-1} \frac{x}{r})$$