Quaternions

GOD TIER Complex Number tutorial
Quaternion Explanation

4 Dimensional extension of the complex numbers

- Where a complex number is of the form $a + bi$
  $a + bi + cj + dk$
- $a, b, c, d, \in R$
- i, j, k are called the fundamental Quaternion units

Complex Numbers

Multiplying 2 complex numbers with mag 1 results in a complex number with mag 1 with a different rotation

- Multiplying $x = a + bi$ by i gives $xi = ai + b(i^2)$ but $i^2 = -1$ then $xi = -b + ai$
- This is a counter clockwise rotation of 90 degrees.

Think of multiplying $x \cdot t$ where $x = a + bi$ and $t = r + si$

- Based on the previous fact, multiplying by $a + bi$ means scaling by a and rotating by bi where bi is some proportion of 90 degrees
- Final magnitude will be $|x| \cdot |t|$ = $\sqrt{(a^2 + b^2)} \cdot \sqrt{(r^2 + s^2)}$
- $arg(x) = arctan(\frac{a}{b})$
- $arg(t) = arctan(\frac{r}{s})$
- Final rotation will be the sum of the two angles above
- $x = cos(\theta) + isin(\theta)$ or j or k

Quaternions

- $i^2 = j^2 = k^2 = -1$
- $i \times j = k$ and $j \times i = -k$
- $j \times k = i$ and $k \times j = -i$

- $k \times i = j$ and $i \times k = -j$