Complex Roots.

Recall that a root is a location where your polynomial touches or crosses the x-axis (or where $y=0$).

In other words, x is a root if $f(x)=0$.

We also learned that each root of a polynomial corresponds to a factor.

Ex] The polynomial $p(x)$ has roots at $x=-3$, $x=-1$, & $x=2$.

So, $p(x)=a(x+3)(x+1)(x-2)$

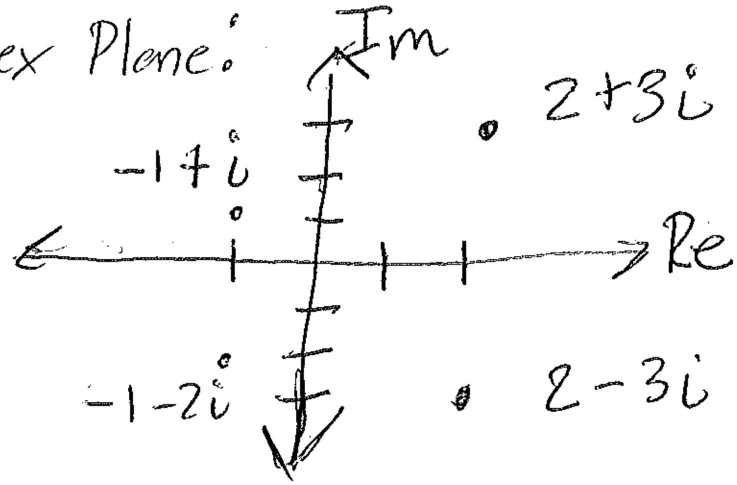
If I have any other point on the graph, I can plug it in to solve for "a".

Remember that "a" determines the stretch & orientation of a polynomial.

We have now extended the real numbers into the complex numbers.

This gets into 3D, so you need to graph different views of the function.

First, the complex plane has the x-axis as real numbers and the y-axis as imaginary numbers, Complex Plane:



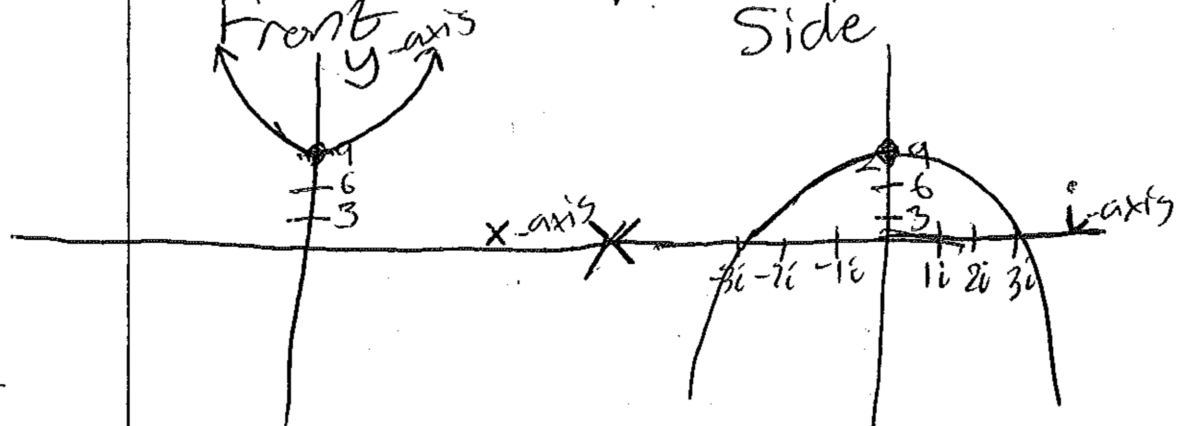
Just plot the complex roots like xy points.

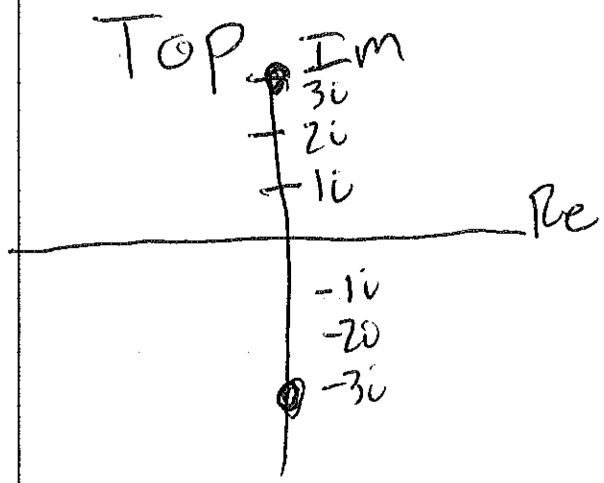
The other two views are the "front" and "side" views. I'll show you with an example.

Ex) The polynomial $p(x)$ has roots of $3i$ & $-3i$. What is $p(x)$?
Assume $a=1$.

$$p(x) = 1(x-3i)(x+3i)$$
$$p(x) = x^2+3ix-3ix-9i^2$$
$$p(x) = x^2-9(-1)$$
$$p(x) = x^2+9$$

Here are 3 graphs of $p(x)$.





Notice that I am only graphing the roots. It's like a floorplan for a house: You don't see the walls, just the foundation.

On a normal xy graph there are only 2 dimensions. To visualize the imaginary numbers, think of a number line coming perpendicularly out of the graph. That 3^{rd} perpendicular axis is the imaginary axis.

Here's another representation of the example $p(x) = x^2 + 9$.