Proof 1.4 — Distance Formula for z_n in the Complex Plane

Let $\mathbf{z_n = z_a + i\, z_b}$. Its distance from the origin (modulus) is:

$$|z_n| = \text{sqrt}\,(z_a^2 + z_b^2)$$

From **Proof 1.3**, we see that if $|z_n| > 2$, the point will escape to infinity.
This means it **cannot belong to the Mandelbrot set**.

Therefore, only points with $|z_n| \leq 2$ may belong to the Mandelbrot set.

$$\text{sqrt}\,(z_a^2 + z_b^2) <= 2$$

Squaring both sides to avoid the square root gives:

$$z_a^2 + z_b^2 <= 4$$

Code Equivalent:

Distance test: for **z_n = z_a + i*z_b**

|z_n| = sqrt (z_a * z_a+ z_b* z_b).

If **|zn| >2** then z_n will not be in the Mandelbrot set.

sqrt (z_a * z_a+ z_b* z_b) >2

Squaring both sides gives: **(z_a*z_a) + (z_b*z_b) > 4**

```
So if ((z_a * z_a + z_b * z_b) <= 4) {
   // z_n may still belong to the Mandelbrot set
} else {
   // z_n has escaped, stop iteration
}
```