Newton Raphson Method

$$\boxed{root = \frac{\left(x + \frac{N}{x}\right)}{2}}$$

where, root - Actual root
N - Number
x - Sqrt we guessed.

Why this formula works?

$$\sqrt{N} = \frac{\left(x + \frac{N}{x}\right)}{2}$$

* Imagine that our guess is correct
* Then $\sqrt{N} = \frac{\left(\sqrt{N} + \frac{N}{\sqrt{N}}\right)}{2}$ $\left[x = \sqrt{N}\right]$

$$\sqrt{N} = \frac{\left(\sqrt{N} + \frac{\sqrt{N} \times \cancel{\sqrt{N}}}{\cancel{\sqrt{N}}}\right)}{2}$$

$$= \frac{2\sqrt{N}}{2}$$

$$= \sqrt{N}$$

* If our guess is the actual answer, then the equation satisfies
* Try to minimize the error as minimal as possible

* If x is the square root we have assumed, is the actual square root, then what is the error.
* error = |root − x|
* Keep changing the value of x, till the error becomes minimal
* Steps :-

1. Assign x to N
2. Start a loop.
3. The answer will be found when error < 1
4. What if error is > 1, then update x.

Complexity : O((log N)F(N))

F(N) - Cost of complexity of calculating $\frac{f(x)}{f'(N)}$ with some n-digit precision