

## Module 2 - Non Linear Equations

ME3001 - Mechanical Engineering Analysis

Mechanical Engineering  
Tennessee Technological University

### Topic 3 - The Newton-Raphson Method

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- Analytical vs. Numerical
- A Shooting Method: Graphical Explanation
- Taylor Series Derivation
- A Better Hammer!

# Analytical vs. Numerical

## Theoretical/Analytical Solution Techniques

- solving the equation using exact mathematics
- leads to an exact or *analytical* solution

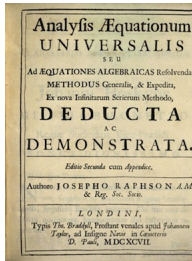
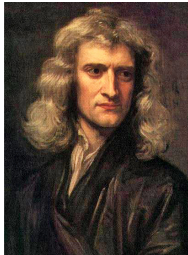
## Numerical Solution Techniques

- approximating the solution to the equation using varying methods, or *algorithms*
- leads to a approximate solution
- a.k.a. *Numerical Method*

# A Shooting Method: Graphical Explanation

These scientists changed the world forever.

- Isaac Newton, mathematician and physicist, 1642-1727
- Joseph Raphson, English Mathematician, 1648-1715



# A Shooting Method: Graphical Explanation

The Newton-Raphson method is a *shooting method*.



# Taylor Series Derivation

The method is derived from the Taylor series.

$$f(x) \approx f(a) + f'(a)(x - a) + \frac{f''(a)}{2!}(x - a)^2 + \dots + \frac{f^{(n)}(a)}{n!}(x - a)^{(n)}$$

## A Better Hammer!

Now you have much better hammer. However, must be used properly...

