

ME 3001 Lecture, Roots of Non-Linear Equations

- **Theoretical 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*

- **Method 3** - *Newton -Raphson Method*

- Isaac Newton, mathematician and physicist, 1642-1727

- Joseph Raphson, English Mathematician, 1648-1715

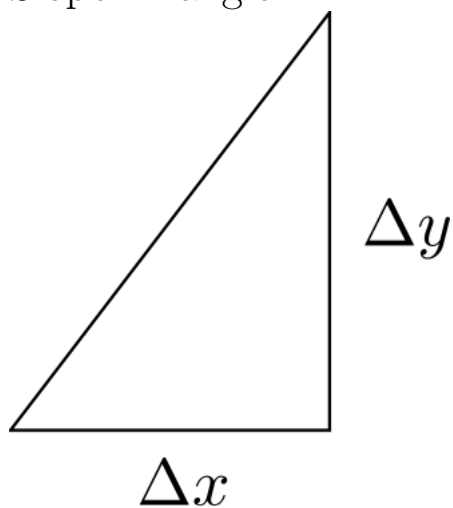
- Taylor Series Derivation:

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

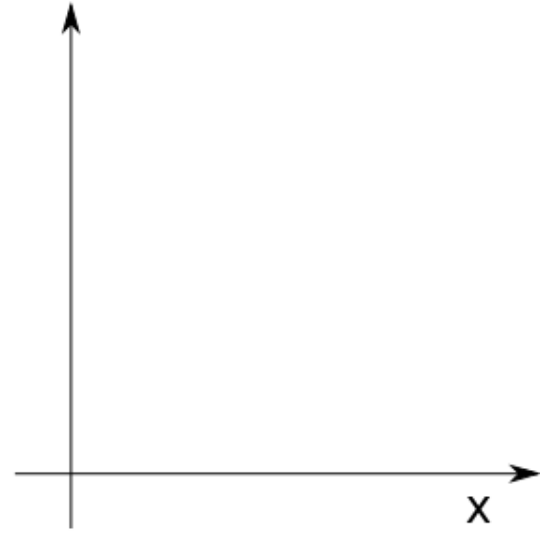
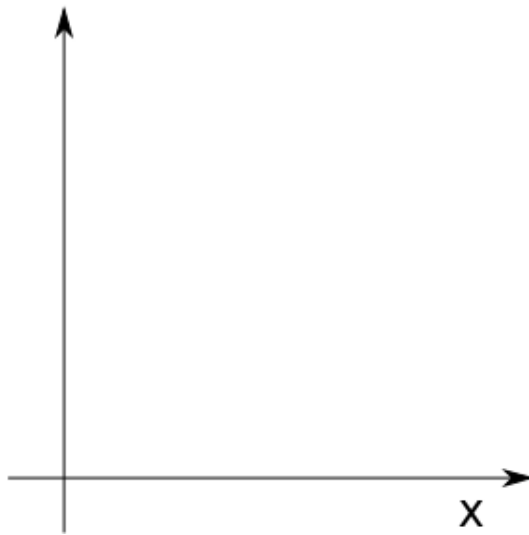
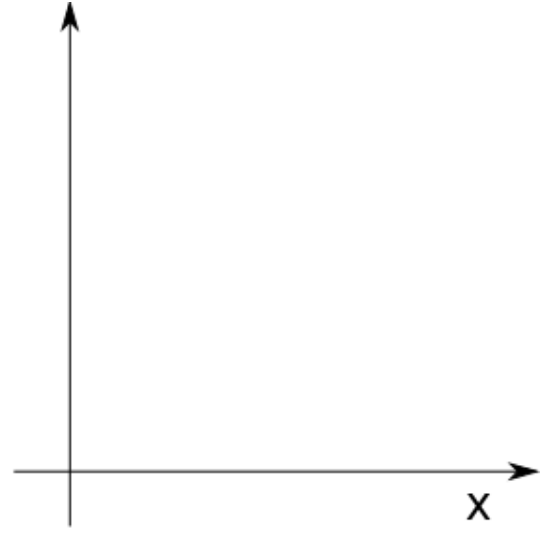
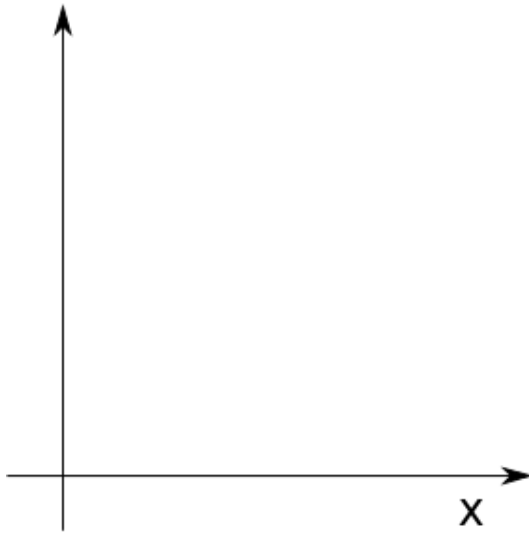
– Graphical Explanation:



– Slope Triangle:



– sign is handled !



– Issues with the *Newton - Raphson* Method



- **Method 4** - *Secant Method (modified Newton-Raphson)*

- Forward Difference



- Backwards Difference



- Central Difference



- These are known as *Finite Difference Approximations*
- When used in the *Newton-Raphson* equation this becomes the *Secant Method*

- REMINDER - Homework 1 is due Friday
- REMINDER - MATLAB script from today's lecture will be posted on ilearn.