Lecture Module - Non-Linear Equations

ME3001 - Mechanical Engineering Analysis

Mechanical Engineering

Tennessee Technological University

Topic 1 - Solving Non-Linear Equations

Topic 1 - Solving Non-Linear Equations

- What is a Non-Linear Equation ?
- Solving Non-linear Equations
- Analytical vs. Numerical Methods
- Example

What is a Non-Linear Equation ?

" an equation whose graph does not form a straight line"

What is a Non-Linear Equation ?

Different Types of Non-Linear Equations

- **Polynomials (excluding first order)**
- **Transcendentals**

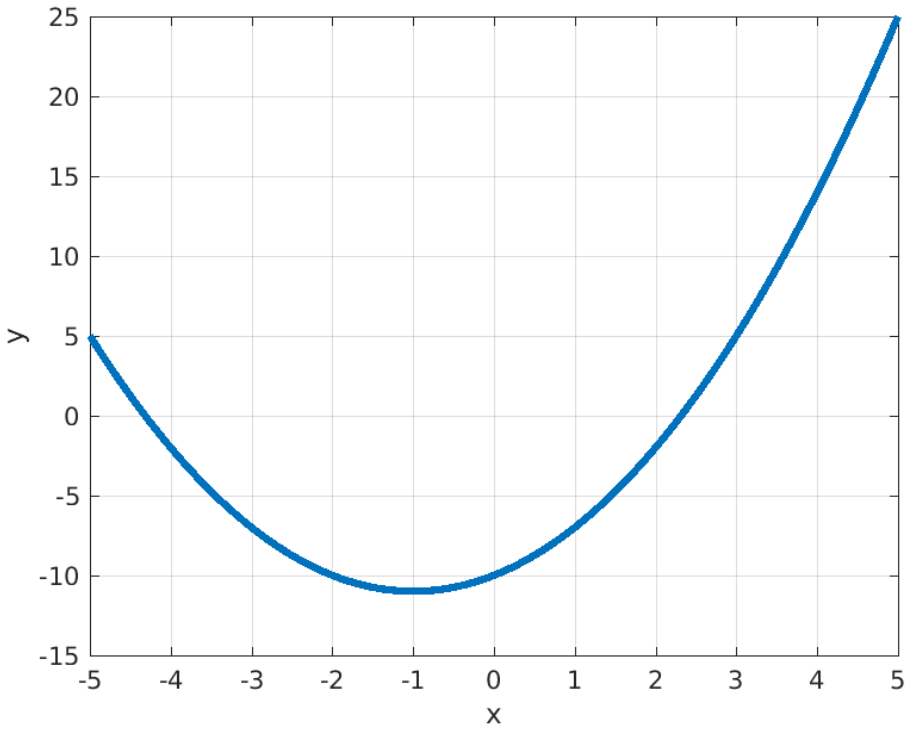
  " a transcendental function "transcends" algebra in that it cannot be expressed in terms of a finite sequence of the algebraic operations of addition, multiplication, and root extraction. Examples of transcendental functions include the exponential function, the logarithm, and the trigonometric functions. "

  - Exponentials
  - Logarithms
  - Trigonometrics

Solving Non-linear Equations

What does *Solve the Equation* mean?

Example: $y = x^2 + 2x - 10$



Analytical vs. Numerical Methods

Analytical

- solution to a problem that can be written in **closed form**
- solution in terms of known functions, constants, etc.
- gives an **exact answer**

Numerical

- an **approximation** to the solution of a mathematical equation
- iterative procedure or algorithm
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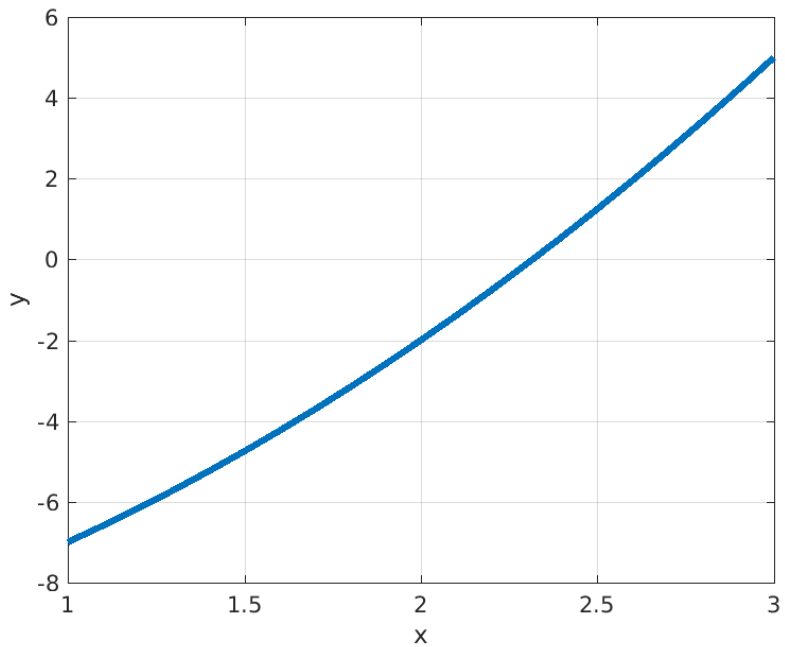
Example

Method 1 - *Algebra*

We are looking for where the line crosses the x-axis, so how can we tell where this happens?

$$y = x^2 + 2x - 10$$



Example

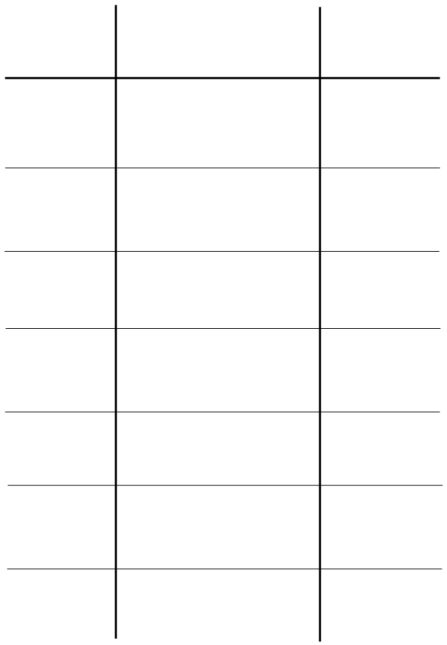
Method 1 - *Algebra*

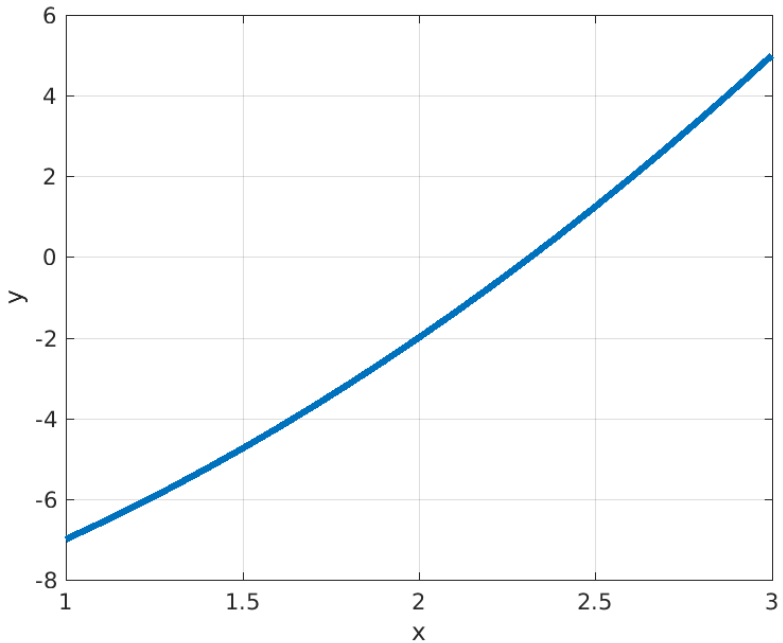
Example

Method 2 - *The Incremental Search*

We are looking for where the line crosses the x-axis, so how can we tell where this happens?

$$y = x^2 + 2x - 10$$





Example

Method 2 - *The Incremental Search*