- Differential equations are used to model different types of phenomena.
- Applications:
    - Engineering
        - Especially useful in fluid dynamics, thermodynamics, and mass transfer
    - Physics
        - Differential equations model motion and response to forces
        - Flow of charge in a circuit
    - Economic models
    - Statistical analysis
    - Psychology and Sociology
        - There are mathematical models as to how people behave.
- **Ordinary Differential Equation** vs. **Partial Differential Equation**
    - Ordinary differential equations involve only ordinary derivatives.
    - Partial differential equations involve partial derivatives.
- **Linear** vs. **Nonlinear**
    - Linear means linear in its orders of derivatives
    - Example: $y''+2x^2 y = 7x^3 + 5$ is linear.
    - Example: $y''+2x^2 y^2 = 7x^3 + 5$ and $(y'')^2 + 2x^2 y = 7x^3 + 5$ are not linear.
- **Homogeneous vs. Nonhomogeneous**
    - Homogeneous means that there is no term that does not involve y or any derivative of y in any way.
    - Example: $y''+2x^2 y^2 = 0$ is homogeneous
    - Example: $y''+2x^2 y^2 = 7x^3 + 5$ is not homogeneous
- **Initial Value Problem**: Solve a differential equation given conditions at one point.
    - Example: Solve $\dfrac{dy}{dx} = f(x, y)$ given $y(x_o) = y_o$
    - Substitute initial conditions to find the solution to an initial value problem
- **Boundary Value Problem**: Solve a differential equation given conditions at the ends of an interval.
    - Example: Solve $ay''+by'+cy = f(x)$ given $y(x_1) = y_1$ and $y(x_2) = y_2$
    - Substitute boundary conditions to find the solution to a boundary value problem.