- **Limit definition** of a derivative: $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$
- Derivatives are used to find the **instantaneous** rate of change of a function.
- Derivative is the **slope of the tangent line**
- Notation (most commonly used)
  - Leibniz:
    - $\frac{dy}{dx}$ or $\frac{d}{dx}$ for first derivative
    - $\frac{d^2y}{dx^2}$ or $\frac{d^2}{dx^2}$ for second derivative
    - $\frac{d^ny}{dx^n}$ or $\frac{d^n}{dx^n}$ for n^{th} derivative
  - Lagrange:
    - $f'(x)$ for first derivative
    - $f''(x)$ for second derivative
    - $f'''(x)$ for third derivative
    - $f^4(x)$ for fourth derivative
    - $f^n(x)$ for n^{th} derivative ($\{n \in \mathrm{Z} \mid n > 3\}$)
- A function is **differentiable** on an interval if its derivative exists on that interval.
  - Common examples of when a function is not differentiable:
    - Discontinuity
    - Vertical tangent lines
    - Sharp turns
  - If a function is differentiable, then it is continuous.
    - Converse of this statement is NOT true.
- Derivative of a constant is always 0 (constants do not change).
- Common application: motion
  - Let $r(t)$ be a **position function** of an object with respect to time t.
    - Velocity $v(t) = r'(t)$
    - Acceleration $a(t) = r''(t)$