Derivative rules and properties

Tyreek Alexander

Basic derivative rules

- **Power rule:** $\frac{d}{dx}x^n = nx^{n-1}$
- **Constant rule:** $\frac{d}{dx}c = 0$ where c is a constant
- **Constant multiple rule:** $\frac{d}{dx}[cf(x)] = c\frac{d}{dx}f(x)$
- **Sum rule:** $\frac{d}{dx}[f(x) + g(x)] = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)$
- **Difference rule:** $\frac{d}{dx}[f(x) - g(x)] = \frac{d}{dx}f(x) - \frac{d}{dx}g(x)$

Product, quotient and chain rules

- **Product rule:** $\frac{d}{dx}[f(x)g(x)] = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$
- **Quotient rule:** $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)\frac{d}{dx}f(x) - f(x)\frac{d}{dx}g(x)}{[g(x)]^2}$
- **Chain rule:** $\frac{d}{dx}f(g(x)) = f'(g(x)) \cdot g'(x)$

Common derivatives

- $\frac{d}{dx}e^x = e^x$
- $\frac{d}{dx}a^x = a^x \ln(a)$ where $a > 0$ and $a \neq 1$
- $\frac{d}{dx}e^{u(x)} = e^{u(x)} \cdot u'(x)$
- $\frac{d}{dx}a^{u(x)} = a^{u(x)} \ln(a) \cdot u'(x)$
- $\frac{d}{dx} \ln(x) = \frac{1}{x}$
- $\frac{d}{dx} \log_a(x) = \frac{1}{x \ln(a)}$ where $a > 0$ and $a \neq 1$
- $\frac{d}{dx} \ln(u(x)) = \frac{u'(x)}{u(x)}$
- $\frac{d}{dx} \log_a(u(x)) = \frac{u'(x)}{u(x) \ln(a)}$ where $a > 0$ and $a \neq 1$