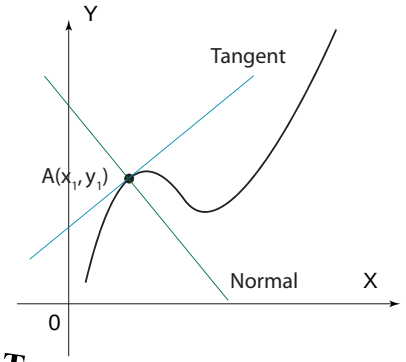
Differentiation

Tangent to a Curve



- Gradient
  - $\frac{dy}{dx}$ = gradient of tangent
- Equation
  - $y - y_1 = m_{tangent}(x - x_1)$
- Normal
  - $m_{normal} = -\frac{1}{m_{tangent}}$
  - $\frac{1}{-\frac{dy}{dx}}$ = gradient of normal

$$\frac{dy}{dx} = \lim_{\delta x \to 0}\left(\frac{\delta y}{\delta x}\right)$$

Small changes and Approximation

$$\frac{\delta y}{\delta x} \approx \frac{dy}{dx} \Rightarrow \delta y \approx \frac{dy}{dx} \times \delta x$$

$$y_{new} = y_{original} + \delta y$$

$$= y_{original} + \frac{dy}{dx} \times \delta x$$

Rates of Change

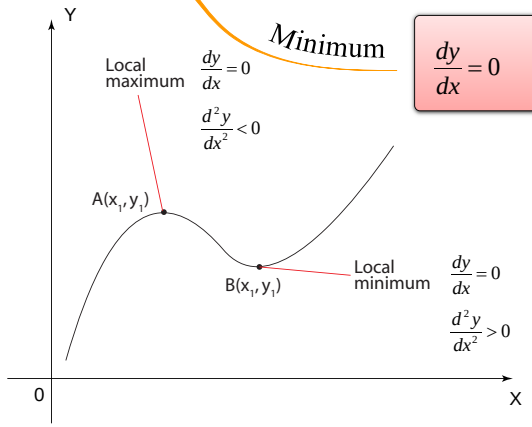
$$\frac{dA}{dt} = \frac{dA}{dr} \times \frac{dr}{dt}$$

Differentiation

- $y = ax^n$
  - $y = x^n$
  - $\frac{dy}{dx} = nx^{n-1}$
- Sum/Difference of Function
  - $y = u \pm v$ u and v are functions in x
  - $\frac{dy}{dx} = \frac{du}{dx} \pm \frac{dv}{dx}$
- Product of Function
  - $y = uv$ u and v are functions in x
  - $\frac{dy}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}$
- Quotient of Function
  - $y = \frac{u}{v}$ u and v are functions in x
  - $\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$
- Chai Rule
  - $y = u^n$ u and v are functions in x
  - $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

Second Order Diffrentiation

- Turning Point
  - Maximum
    - $\frac{dy}{dx} = 0$ $\frac{d^2y}{dx^2} < 0$
  - Minimum
    - $\frac{dy}{dx} = 0$ $\frac{d^2y}{dx^2} > 0$



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