FTC Part I

$$\frac{d}{dx} \int_a^x f(s)\, ds = f(x)$$

FTC Part II

If $F'(x) = f(x)$,

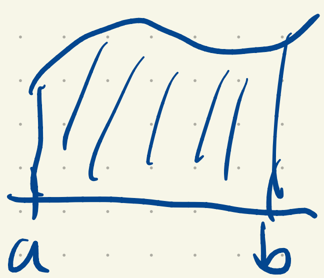
$$\int_a^b f(x)\, dx = F(b) - F(a)$$

Indefinite integral

$$\underbrace{\frac{d}{dx} f(x)}_{f'(x)}$$

$$\underbrace{\int f(x)\,dx = F(x)} \rightarrow F'(x) = f(x)$$

$$\underbrace{\int_a^b f(x)\,dx} \downarrow \text{number}$$



$$\underbrace{\int f(x)\,dx} \rightarrow \text{function}$$

$$\underbrace{\int \cos(x)\, dx}_{\text{family of functions}} = \sin(x) + C$$

$$\int_0^{\pi/2} \cos(x)\, dx \qquad \int \cos(x)\, dx = \sin(x) + C$$

$$= \sin(\pi/2) - \sin(0) = 1 - 0 = 1$$

Another perspective on FTC II

If $F'(x) = f(x)$ then

Net Change Theorem

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

$$\overbrace{\int_a^b \underbrace{F'(x)}_{\text{rate of change}}\,dx = \underbrace{F(b) - F(a)}_{\text{net change in } F}}^{\text{Net Change Theorem}}$$

If the height of a ball has a

rate of change $h'(t)$

then

$$\int_1^3 \underbrace{h'(t)}_{\substack{\text{rate of change} \\ \text{of height} \\ \text{of the ball}}} \, dt = \underbrace{h(3) - h(1)}_{\substack{\text{net change in height} \\ \text{of the ball}}}$$