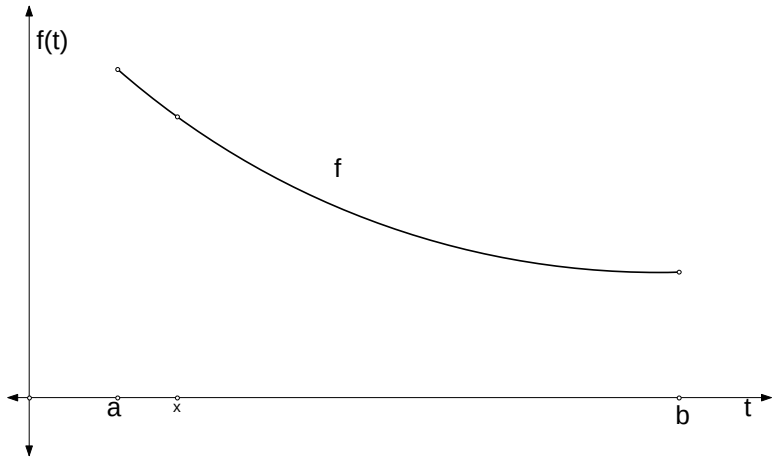
$$\int_{\pi}^{\ln(x)} \cos\left(e^{t}\right) dt$$

We would like to differentiate the above function with respect to x

Recall the fundamental theorem of calculus which goes like

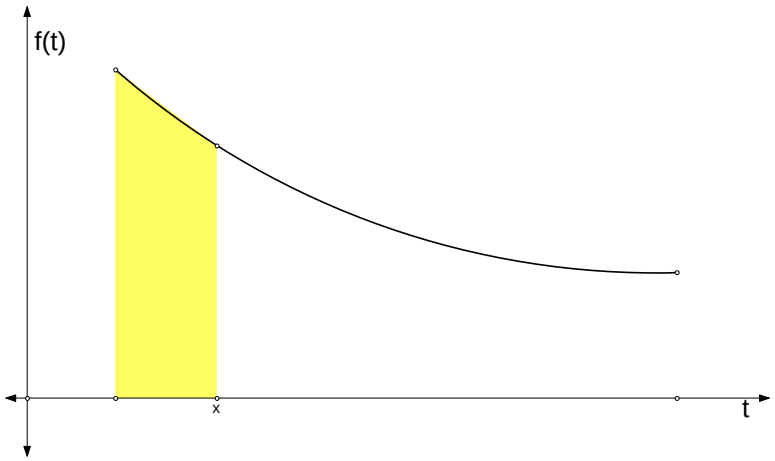
(page 289 in the text)

If we have a function f that is continuous on the interval [a,b] as shown below,



Then we can define a function

$F(x) = \int_{a}^{x} f(t)dt$, F is a differentiable function of x



and

$$F(x) = \int_a^x f(t)dt$$

$$\frac{dF}{dx} = f(x)$$

Example1:

Find $\frac{dF}{dx}$ if $F(x) = \int_3^x \frac{dx}{1+t^2}$

$$\frac{dF}{dx} = \frac{1}{1+x^2}$$

Example 2:

Find $\frac{dF}{dx}$ if $F(x) = \int_\pi^{\ln(x)} \cos\left(e^t\right)dt \qquad , u = \ln x$

$$F(u) = \int_\pi^u \cos\left(e^t\right)dt$$

$$\frac{dF}{dx} = \frac{dF}{du}\frac{du}{dx} = (\cos(e^u))\frac{1}{x} = \frac{\cos(e^u)}{x} = \frac{\cos\left(e^{\ln x}\right)}{x} = \frac{\cos x}{x}$$