FTC - 2

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FTC - 1 $\quad \int_a^b f(x)\,dx = F(b) - F(a)$

$$\int_a^b f(t)\,dt = F(b) - F(a)$$

$$\int_{a(x)}^{b(x)} f(t)\,dt = F(b(x)) - F(a(x))$$

$$\frac{d}{dx}\int_{a(x)}^{b(x)} f(t)\,dt = \left(F(b(x))\right)' - \left(F(a(x))\right)'$$

$$= f(b(x)) \cdot b'(x) - f(a(x)) \cdot a'(x)$$

Leibniz Rule.

$$I = \frac{d}{dx}\int_2^x e^{-t^2}\,dt$$

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Leibniz Rule

$$I = \frac{d}{dx}\int_2^x e^{-t^2}\,dt$$

$$f(t) = e^{-t^2}$$

$a(x) = 2$ $\quad$ $b(x) = x$

$a'(x) = 0$ $\quad$ $b'(x) = 1$

So, $I = e^{-(x)^2} \cdot (1) - \underline{e^{-(2)^2} \cdot (0)}$

$$= e^{-x^2}$$

Eval $\dfrac{d}{dx} \displaystyle\int_{1-x^2}^{4} \cos(t^2 \ln t)\,dt$

$\underline{f(t) = \cos(t^2 \ln t)}$

$a(x) = 1 - x^2$ $\quad$ $b(x) = 4$

$a' = -2x$ $\quad$ $b' = 0$

So, $I = f(4) \cdot (0) - f(1-x^2) \cdot (-2x)$

$= 0 - \cos\left((1-x^2)^2 \ln(1-x^2)\right) \cdot (-2x)$

$= 2x \cos\left((1-x^2)^2 \ln(1-x^2)\right)$

Eval $\frac{d}{dx}\int_{x^2}^{\sin x} 3t^2\,dt$

$f(t) = 3t^2$

$a(x) = x^2$ $\quad$ $b(x) = \sin x$

$a' = 2x$ $\quad$ $b' = \cos x$

$= f(\sin x)\cdot\cos x - f(x^2)\cdot 2x$

$= 3(\sin x)^2\cdot\cos x - 3(x^2)^2\cdot 2x$

$= 3\sin^2 x\cos x - 6x^5$

$$\boxed{I = \frac{d}{dx}\int_{a(x)}^{b(x)} f(t)\,dt = f(b)\cdot b' - f(a)\cdot a'}$$