

## 1 | loose definition

$$\int \frac{d}{dx} f(x) dx = f(x)$$

## 2 | formal definition

The theorem comes in two parts, apparently

### 2.1 | part 1

If  $f(x)$  is continuous over an interval  $[a, b]$ , and the function  $F(x)$  is defined by

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

then  $F'(x) = f(x)$  over  $[a, b]$ .

#### 2.1.1 | intuition

Note that its  $\int_a^x f(t) dt$  because  $x$  is an argument to the function and  $t$  is just the iteration variable.

Note that the integral can start anywhere to the left (arbitrary  $a$ ) because that is removed as a constant when taking the derivative

Proof is by taking the limit form of a derivative of the integrals to  $x$  and  $x + h$ , and seeing that it collapses to the mean value. As the range of the mean value expression goes to zero, the value converges to itself.

#### 2.1.2 | results

1. any integrable function and any continuous function has an anti-derivative

## 3 | an example

Imagine a function that has the bound of an integral as an argument:

$$g(x) = \int_0^x t dt = \frac{x^2}{2}$$

$$\frac{d}{dx} g(x) = \frac{d}{dx} \int_0^x t dt = \frac{d}{dx} \frac{x^2}{2} = x$$