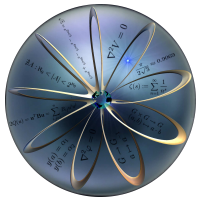

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fundamental theorems of calculus for Lebesgue integration

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Loosely, the *Fundamental Theorems of Calculus* serve to demonstrate that integration and differentiation are inverse processes. Suppose that $F(x)$ is an absolutely continuous function on an interval $[a, b] \subset \mathbb{R}$. The two following forms of the theorem are equivalent.

First form of the Fundamental Theorem:

There exists a function $f(t)$ Lebesgue-integrable on $[a, b]$ such that for any $x \in [a, b]$, we have $F(x) - F(a) = \int_a^x f(t)dt$.

Second form of the Fundamental Theorem:

$F(x)$ is differentiable almost everywhere on $[a, b]$ and its derivative, denoted $F'(x)$, is Lebesgue-integrable on that interval. In addition, we have the relation $F(x) - F(a) = \int_a^x F'(t)dt$ for any $x \in [a, b]$.