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Differentiable Integrals and Discontinuous Integrands

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George Bridgman

One version of the Fundamental Theorem of Calculus states that if f is Riemann integrable on [a, b], if f is continuous at x_0 , and if $F(x) = \int_a^x f(t) \, dt$, then $F'(x_0)$ exists and equals

 $f(x_0)$. This paper discusses the differentiability of the integral F at a point x_0 where the integrand f is discontinuous. If f has a removable discontinuity at x_0 , then $F'(x_0)$ exists, while for a jump discontinuity, $F'(x_0)$ does not exist. If the discontinuity is of neither type, then $F'(x_0)$ may or may not exist, and this paper presents examples illustrating each possibility.

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