Product rule

The *product rule* is a rule for differentiating a product of two functions.

If $y = uv$ is a product of two functions, then

$$\frac{dy}{dx} = \frac{du}{dx}v + u\frac{dv}{dx}.$$

This can be generalised to a product of more than two functions. If $y = uvw\ldots$, then

$$\frac{dy}{dx} = \frac{du}{dx}vw\ldots + u\frac{dv}{dx}w\ldots + uv\frac{dw}{dx}\ldots + \cdots.$$

The Leibniz rule is a generalisation of the product rule to second and higher derivatives:

$$\frac{d^n}{dx^n}(uv) = \sum_{k=0}^{n}\binom{n}{k}u^{(k)}v^{(n-k)},$$

where $u^{(k)}$ means the kth derivative of u.