# Calculus Derivatives Chain Rule

Consider the equation $y=x$ .

Differentiating $y$ with respect to (w.r.t.) $x$ , we get $\frac{dy}{dx}$ .

Consider the equation $s^2=x^2+y^2$ .

Differentiating the equation w.r.t. $t$ , we get $2s(\frac{ds}{dt})=2x(\frac{dx}{dt})+2y(\frac{dy}{dt})$ .

Why is this so?

We want to differentiate $s^2$ w.r.t. $t$ , but we can only differentiate $s^2$ w.r.t $s$ because that is the only available term.

Thus, $\frac{d}{ds}(s^2)=2s$ .

Since what we want is $\frac{d}{dt}(s^2)$ , we can get it using the chain rule, which states that $\frac{d}{dt}(s^2)=\frac{d}{ds}(s^2)\times\frac{ds}{dt}=2s(\frac{ds}{dt})$ .

Therefore, applying the same rule to $x^2$ and $y^2$ , we get the equation $2s(\frac{ds}{dt})=2x(\frac{dx}{dt})+2y(\frac{dy}{dt})$ .

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