# Derivative 2016

We can see that

$$f(x) = \left(\frac{\operatorname{tg}(x)}{x}\right)^{(\sin(x))}$$

It's obvious that

$$f'(x) = \left(\frac{\operatorname{tg}(x)}{x}\right)^{(\sin(x))} * \left(\cos(x) * 1 * \ln\left(\frac{\operatorname{tg}(x)}{x}\right) + \sin(x) * \frac{\frac{\frac{1}{(\cos(x))^2} * x - 1 * \operatorname{tg}(x)}{x^2}}{\frac{\operatorname{tg}(x)}{x}}\right)$$

Most functions that occur in practice have derivatives at all points or at almost every point. Early in the history of calculus, many mathematicians assumed that a continuous function was differentiable at most points. Under mild conditions, for example if the function is a monotone function or a Lipschitz function, this is true. However, in 1872 Weierstrass found the first example of a function that is continuous everywhere but differentiable nowhere.

$$f'(x) = \left(\frac{\operatorname{tg}(x)}{x}\right)^{(\sin(x))} * \left(\cos(x) * \ln\left(\frac{\operatorname{tg}(x)}{x}\right) + \sin(x) * \frac{\frac{\frac{1}{(\cos(x))^2} * x - \operatorname{tg}(x)}{x^2}}{\frac{\operatorname{tg}(x)}{x}}\right)$$