Differentiation is the process of finding derivatives of a function, which represents the rate of change of a function with respect to another quantity. The laws of differential calculus were established by Sir Isaac Newton, and the principles of limits and derivatives are widely used in various scientific disciplines. The differentiation of a function means calculating the rate of change of one quantity with respect to another. This speed is not the same as the average calculated and is equivalent to the slope of the tangent line at each point on the curve. The ratio of a small change in one quantity to a small change in another dependent quantity is called differentiation. Differentiation has numerous applications, including determining the maximum or minimum value of a function, calculating the velocity and acceleration of moving objects, and finding the tangent of a curve. If y = f(x) is differentiable, then its derivative is denoted as f'(x) or dy/dx. The geometrical meaning of the derivative of y = f(x) is the slope of the tangent line to the curve y = f(x) at point (x, f(x)). The first principle of differentiation involves computing the derivative using limits. For a function y = f(x), take two points P and Q with coordinates (x, f(x)) and (x+h, f(x+h)), respectively. The sum, difference, product, and composite of differentiable functions, wherever they are defined, are differentiable, and the quotient of two differentiable functions is differentiable, wherever it is defined. The differentiation rules are: - Sum Rule: If y = u(x) ± v(x), then dy/dx = du/dx ± dv/dx. - Product Rule: If y = u(x) × v(x), then dy/dx = u.dv/dx + v.du/dx. - Quotient Rule: If y = u(x) ÷ v(x), then dy/dx = (v.du/dx- u.dv/dx)/ v2 - Chain Rule: Let y = f(u) be a function of u and if u=g(x) so that y = f(g(x)), then d/dx(f(g(x)))= f'(g(x))g'(x) - Constant Rule: y = k f(x), k ≠ 0, then d/dx(k(f(x)) = k d/dx f(x). Differentiation of Special Functions if x= f(t), y = g(t), where t is parameter, then we apply differentiation of parametric functions. \(\dfrac{dy}{dx} = \dfrac{\dfrac{dy}{dt}}{\dfrac{dx}{dt}} = \dfrac{\dfrac{d .g(t)}{dt}}{\dfrac{d.f(t)}{dt}} = \dfrac{g'(t)}{f'(t)} If y = f(x) and z = g(x). then the differentiation of y with respect to x is given by y' = dy/dx. For example, let us find dy/dx if x2 +y2 =1. We differentiate both sides of the equation. d/dx . x2 + d/dx . y2 = d/dx . 1 2x + 2y.dy/dx = 0 dy/dx = -x/y Logarithmic Differentiation Functions If a function is the product and quotient of functions, as in y = \(\dfrac{f_1(x). f_2(x)..... }{g_1(x). g_2(x)....}\) we first take the logarithm and then differentiate it. If a function is in the form of an exponent of a function over another, as in [f(x)] g(x) then we take the logarithm of the function f(x) (to base e) and then differentiate it. For example, if y = xx , then log y = x log x 1/y. dy/dx = log x + 1 Higher-Order Differentiation We find higher-order derivatives on successive differentiation. The further differentiation of the first derivative is denoted by f'' or \(\dfrac{d^2y}{dx^2}\) and the third derivative is denoted by f''' or \(\dfrac{d^3y}{dx^3}\). The nth derivative of f(x) is f n(x) is used in the power series. For example, the rate of change of displacement is the velocity. The second derivative of displacement is the acceleration and the third derivative is called the jerk. Consider a function y = f(x) = x5 - 3x4 + x f1(x) = 5x4 - 12x3 + 1 f2(x) = 20x3 - 36 x2 f3(x) = 60x2 - 72 x f4(x) = 120x -72 The partial differential coefficient of f(x,y) with respect to x is the ordinary differential coefficient of f(x,y) when y is regarded as a constant. It is written as \( \dfrac{\delta f}{\delta x}\). For example, if z = f(x,y) = x4 + y4+3xy2 +x2y +x + 2y, then we consider y as constant to find \( \dfrac{\delta f}{\delta x}\) and consider x as constant to find \( \dfrac{\delta f}{\delta y}\). Thus we find the partial derivatives of the function. \( \dfrac{\delta f}{\delta x} = 4x^3 + 3y^2 + 2xy + 1\) and \( \dfrac{\delta f}{\delta y} = 4y^3 + 6xy + x^2 + 2\) ###ARTICLEThe quotient rule of differentiation states that d/dx(u/v) = (v*u'- u.v')/ v2. Given u = x and v' = sec^2x, with u' = 1, we can find the derivative of y as follows: \(\dfrac{d}{dx}(\dfrac{x}{1 + \tan x})\\=\dfrac{(1+tan x) -(x sec^2 x)}{(1+tan x)^2}\\=\dfrac{1+ tan x - x sec^2x}{(1+tan x)^2}\) Okay, the user wants me to paraphrase the given article text using one of the three methods: adding spelling errors, writing as a non-native speaker, or increasing burstiness. Let me first understand the original text. It's about calculus, specifically derivatives, with examples of rules like the power rule, quotient rule, chain rule, etc. The user provided a detailed example of the quotient rule and a few others. Now, I need to choose which method to use. The user mentioned that the assistant should pick one at random, so I'll go with adding spelling errors. Let me check the original text for places where I can introduce minor typos or misspellings without changing the meaning. For example, "Quotient Rule" could be "Quotient Ruel," or "f'(x)" might become "f'(x)". I should make sure the mathematical expressions remain correct, just the spelling of words is altered. Let me go through each section and apply this. Also, I need to maintain the structure and examples as they are but tweak the text for spelling errors. Let me make sure not to alter any mathematical formulas or the examples, only the surrounding text. Once done, I'll format the response with the specified headers and ensure the examples are correctly presented. Let me double-check that all the rules and examples are still clear and accurate despite the spelling changes. ### Derivative Rules and Examples The derivative of a function measures its rate of change. One of the fundamental rules is the **Power Rule**, which states that the derivative of $ x^n $ is $ nx^{n-1} $. For example, the derivative of $ x^3 $ is $ 3x^2 $. Another important rule is the **Quotient Rule**, which is used to differentiate the quotient of two functions. If $ f(x) = \frac{g(x)}{h(x)} $, then the derivative is given by: $$ f'(x) = \frac{g'(x)h(x) - g(x)h'(x)}{[h(x)]^2} $$ For instance, if $ f(x) = \frac{3x+9}{2-x} $, applying the quotient rule yields: $$ f'(x) = \frac{3(2-x) - (-1)(3x+9)}{(2-x)^2} = \frac{15}{(2-x)^2} $$ The **Chain Rule** is used for composite functions. If $ f(g(x)) $, then the derivative is: $$ f'(g(x)) \cdot g'(x) $$ For example, if $ f(x) = x^2 $ and $ g(x) = 2x+1 $, then: $$ f'(g(x)) = 2(2x+1) \cdot 2 = 8x+4 $$ Other rules include the **Product Rule**, which states: $$ \frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + f'(x)g(x) $$ For example, the derivative of $ \sin(x)e^x $ is: $$ \cos(x)e^x + \sin(x)e^x $$ **Common Derivative Formulas** include: - $ \frac{d}{dx}[e^x] = e^x $ - $ \frac{d}{dx}[\ln(x)] = \frac{1}{x} $ - $ \frac{d}{dx}[\sin(x)] = \cos(x) $ - $ \frac{d}{dx}[\cos(x)] = -\sin(x) $ - $ \frac{d}{dx}[\tan(x)] = \sec^2(x) $ For example, the derivative of $ \frac{1}{x} $ is: $$ - x^{-2} $$ When differentiating $ y = \ln(x^2+1) $, the chain rule gives: $$ \frac{2x}{x^2+1} $$ These rules and examples form the foundation of calculus, enabling the analysis of functions and their behaviors. Using the Quotient Rule for Derivatives: A Step-by-Step Guide When it comes to differentiating functions that involve division, the quotient rule is often the go-to approach. This mathematical concept helps us find the rate at which a function changes as its input varies. Given a function f(x) divided by another function g(x), the quotient rule states that the derivative of this expression is given by: $\frac{d}{dx}\left(\frac{f\left(x\right)}{g\left(x\right)}\right)=\frac{f'(x)\cdot g(x)-f(x)\cdot g'(x)}{(g(x))^{2}}$ Let's consider an example where $f\left(x\right)=x^2+1$ and $g\left(x\right)=x$. Here, $f'\left(x\right)=2x$ and $g'\left(x\right)=1$. Substituting these values into the quotient rule formula yields: $\frac{d}{dx}\left(\frac{f\left(x\right)}{g\left(x\right)}\right)=\frac{\left(2x\cdot x\right)-\left(x^2+1\right)}{x^2}$ = $\frac{2x^2-x^2-1}{x^2}$ Simplifying this expression gives us the derivative of the original function. Moving on to more complex functions, let's consider an example involving the product of two trigonometric functions. Suppose we want to differentiate $f\left(x\right)=\sin\left(x^2\right)\cdot \cos\left(x\right)$. To do this, we'll need to apply both the chain rule and the product rule. ###ARTICLEThe Winter Olympic Federations is fully committed to innovation, universality, and strengthening the special and clearly differentiated appeal of the Olympic Winter Games. ###ARTICLEThe Derivative Calculator employs a parser that converts mathematical functions into a tree-like structure, adhering to the order of operations and detecting missing multiplication signs. This parser is implemented in JavaScript using the Shunting-yard algorithm and can be executed directly within the browser for quick feedback in LaTeX code. When the "Go!" button is clicked, the calculator sends the mathematical function and settings to the server for re-analysis, transforming it into a form that can be understood by the computer algebra system Maxima. Maxima applies various rules to simplify the function and compute derivatives using known differentiation rules. The Derivative Calculator's output is transformed back into LaTeX, while displaying steps of calculation involves manual calculations using JavaScript code and a table of derivative functions for trigonometric, logarithmic, exponential, and square root functions. For the "Check answer" feature, Maxima computes the difference between two expressions, simplifying it as far as possible. If the difference simplifies to zero, the task is solved; otherwise, a probabilistic algorithm is applied. The interactive function graphs are computed in the browser using JavaScript and HTML5 canvas elements, detecting singularities during graphing. The calculator also features gesture control implemented using Hammer.js.