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The Basics of Differentiation (Derivatives)

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1. What is a Derivative?

A derivative represents the rate at which one quantity changes with respect to another. In simpler terms, it tells us the slope of a function at any given point.

2. How to Compute a Derivative

The derivative of a function $f(x)$ with respect to x is written as $f'(x)$ or $\frac{df(x)}{dx}$. It represents the instantaneous rate of change of the function at any point on its curve.

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Example:

For a simple function $f(x) = x^2$ **, the derivative is:** $f'(x) = 2x$

This means that at any point x, the rate of change (slope) is $2x$ **. So, at** $x = 1$ **, the slope is 2; at** $x = 2$ **, the slope is 4, and so on.**

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Geometric Interpretation of a Derivative

- If you imagine the graph of a function, the derivative at a specific point is the slope of the line that touches the curve at that point (called the tangent line). If the function is increasing, the slope is positive; if it’s decreasing, the slope is negative.

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- **Neural Networks: In neural networks, weights and biases are represented as binary floating-point numbers, and understanding how these numbers are manipulated at a binary level can lead to optimizations in AI algorithms.**

- **Error Detection & Correction: AI systems must handle errors during data transmission and processing. Binary systems allow the use of parity bits and other techniques to detect and correct errors, which is fundamental to reliable AI systems.**