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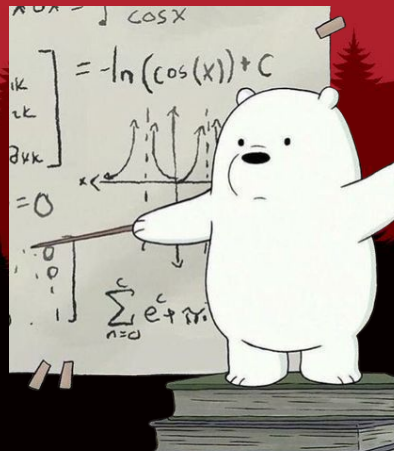
Mathematics for AI ✨

By : Bachiri Inas



Workshop Plan

01

Linear Algebra

02

Calculus

03

Statistics

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Linear Algebra

01

Vectors & their operations

02

Matrices & their operations

03

How to use them for AI?

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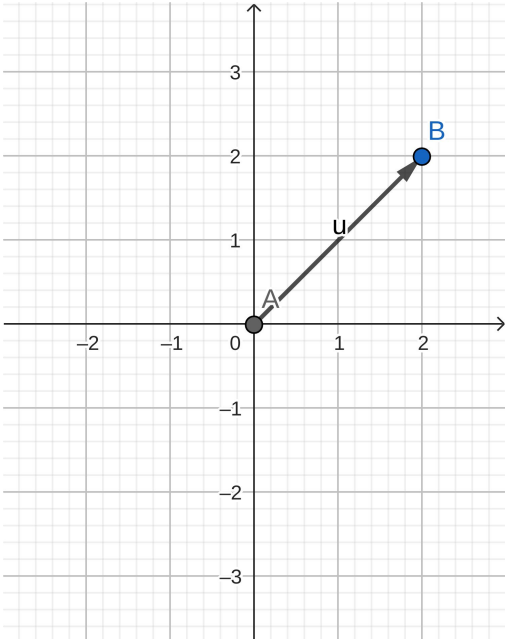
Vectors

A vector is a mathematical object, having a direction and a magnitude. It determines the position of one point in the space relative to another.

$$u = \begin{bmatrix} x_B - x_A \\ y_B - y_A \end{bmatrix} = \begin{bmatrix} 2 - 0 \\ 2 - 0 \end{bmatrix} = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$$



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Vectors

This is all you should know, let’s jump to **code** !

Matrices

A matrix is a mathematical object stacking **mulitple vectors**. Basically a set of numbers arranged in **rows** and **columns** so as to form a rectangular array

$$A = \begin{bmatrix} a_{11} & a_{12} & .. & a_{1n} \\ a_{21} & a_{22} & .. & a_{2n} \\ .. & .. & .. & .. \\ a_{m1} & a_{m2} & .. & a_{mn} \end{bmatrix}$$

Matrices

Let’s play with some **matrices** !

Calculus

01

Gradient

02

Optimization

03

Gradient Descent

Gradient

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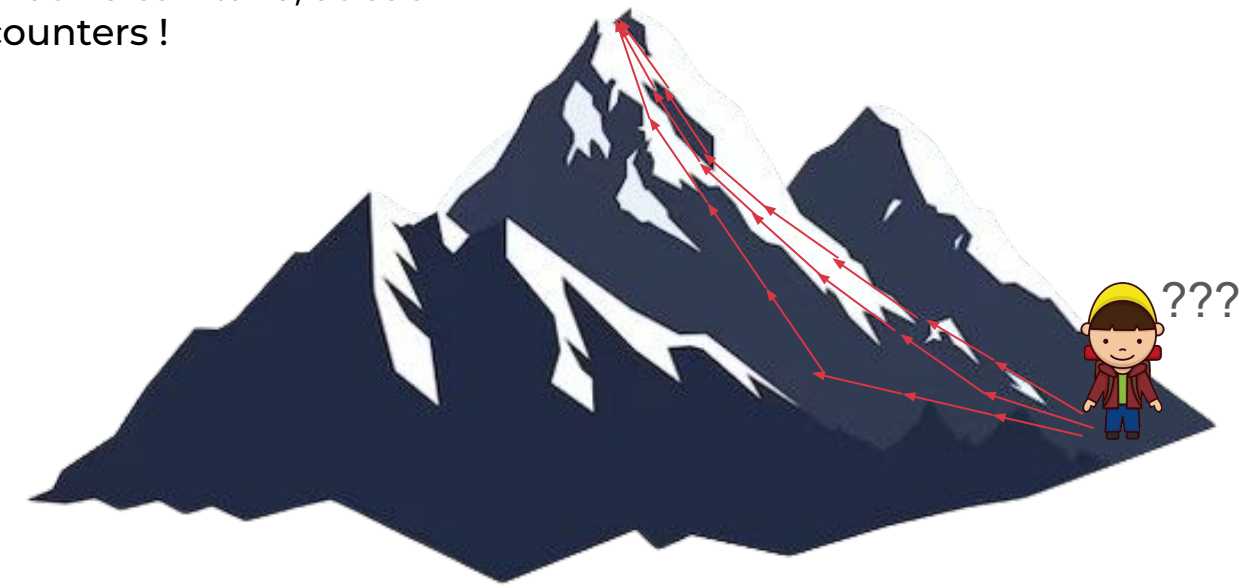
Gradient

Gradient

Gradient

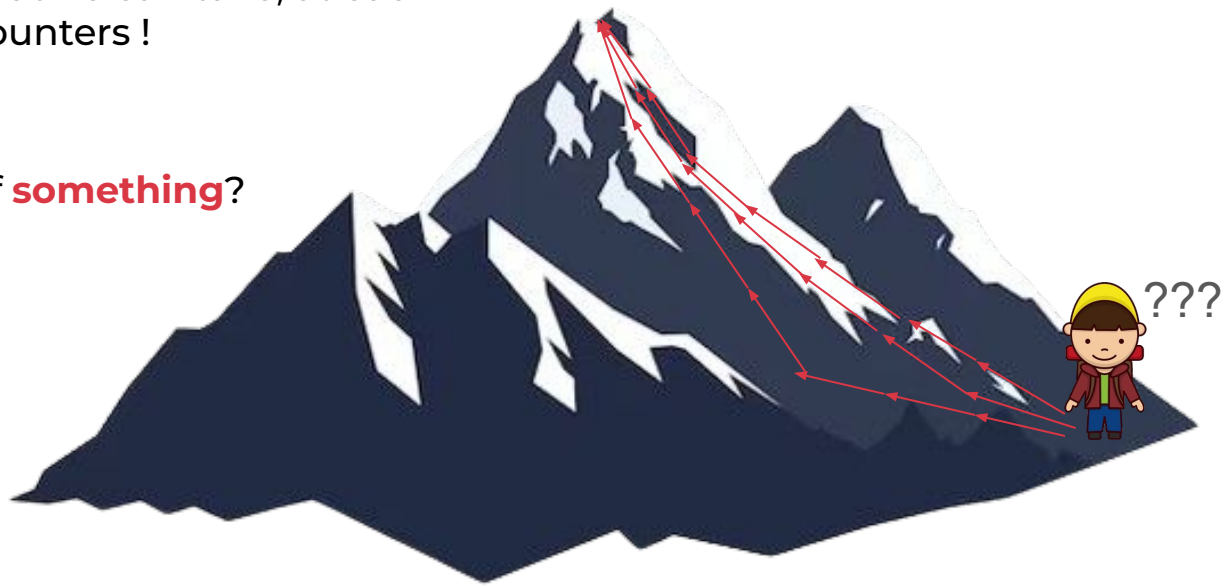
Our AI Camper needs to know what is **the steepest step** that he can take, at each position he encounters !



Gradient

Our AI Camper needs to know what is **the steepest step** that he can take, at each position he encounters !

Reminds you of **something**?



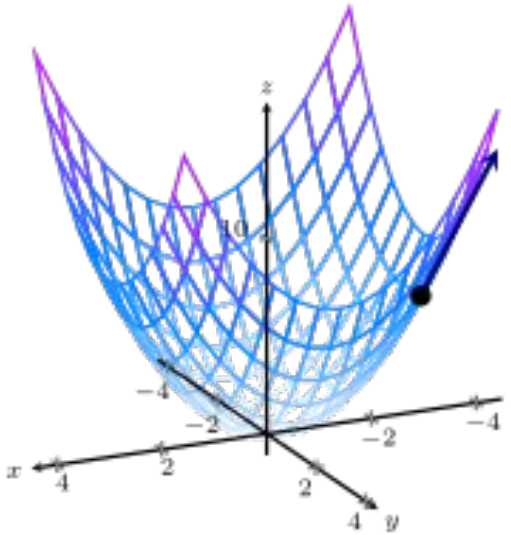
Gradient

Vectors !

Gradient

The gradient of a function is a vector whose value at a point (x,y) gives the **direction** and the **magnitude** of the fastest increase.

$$\nabla f(x,y) = \begin{bmatrix} \frac{\partial f}{\partial x}(x,y) \\ \\ \frac{\partial f}{\partial y}(x,y) \end{bmatrix}$$

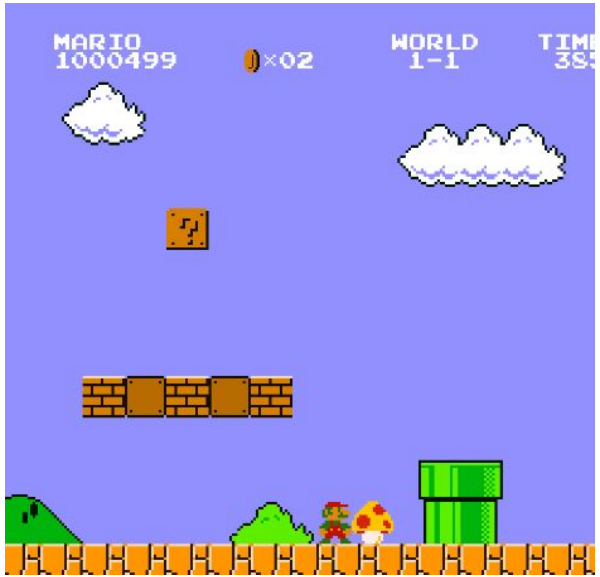


Mathematical Optimization

Optimizing a function means : **minimzing** or **maximizing** it.

Mathematical Optimization

- **Optimization problem:** maximization.
- **Function to optimize:** number of points.



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Mathematical Optimization

- **Optimization problem:** minimization.
- **Function to optimize:** distance.

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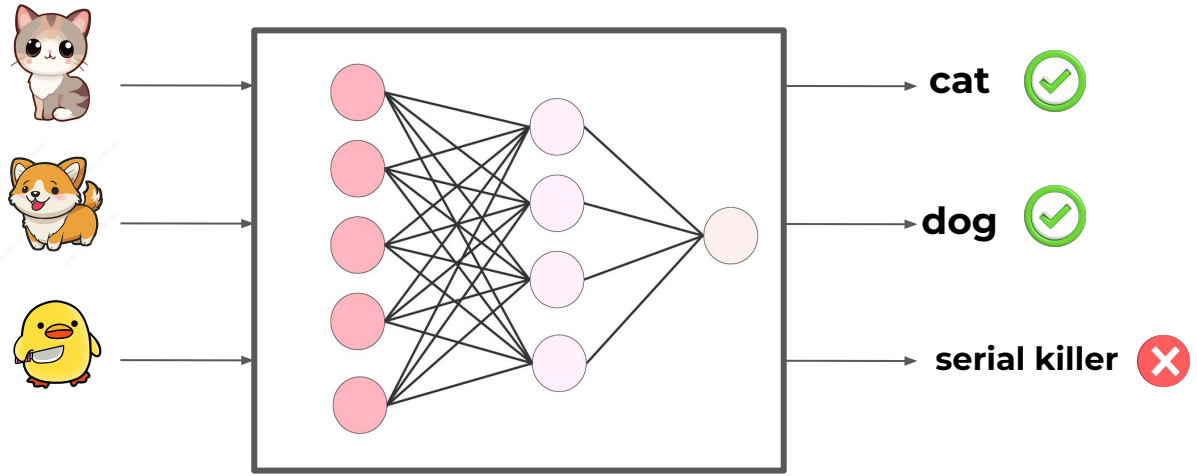
Mathematical Optimization

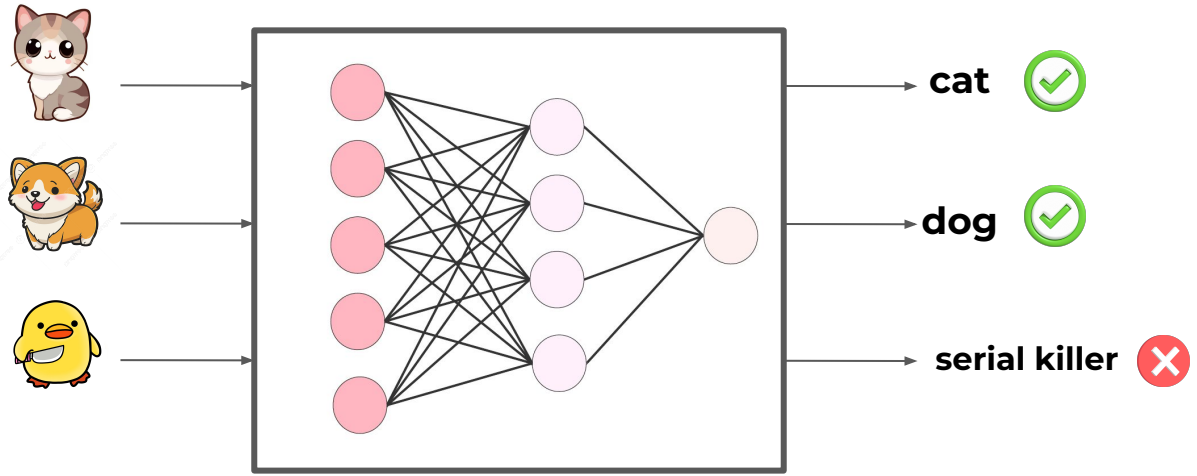
In the context of AI



AI model ✨

Mathematical Optimization

In the context of AI



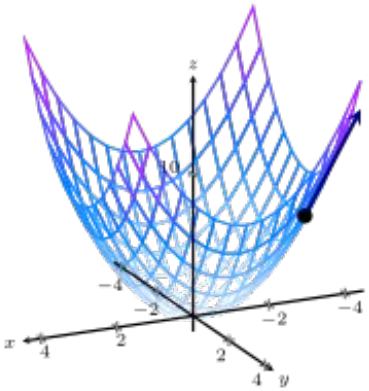
AI model ✨

we want to **minimize** the number of times our AI model makes a mistake !

Mathematical Optimization

In the context of AI

- The number of times our AI model makes a mistake is called a **loss function.**
- It measures the distance between the predicted values and the real values.
- It is usually **convex.**



Mathematical Optimization

In the context of AI

- The number of times our AI model makes a mistake is called a **loss function.**
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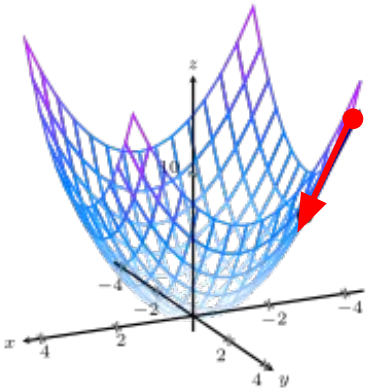


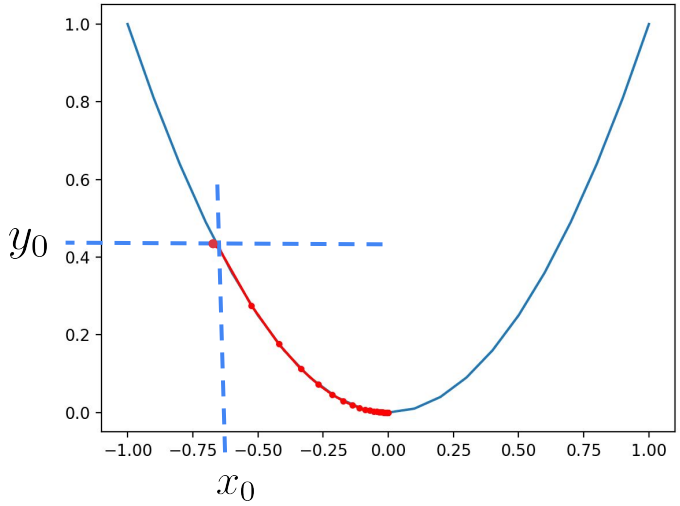
Gradient Descent

Start from : (x_0, y_0)

Repeat until (termination condition is satisfied) :

$$x_n = x_{n-1} - \alpha \frac{\partial f}{\partial x}(x_{n-1})$$

$$y_n = y_{n-1} - \alpha \frac{\partial f}{\partial y}(y_{n-1})$$



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Gradient Descent

Enough talking, let’s **code** !

Descriptive Statistics

01

Measures of center

02

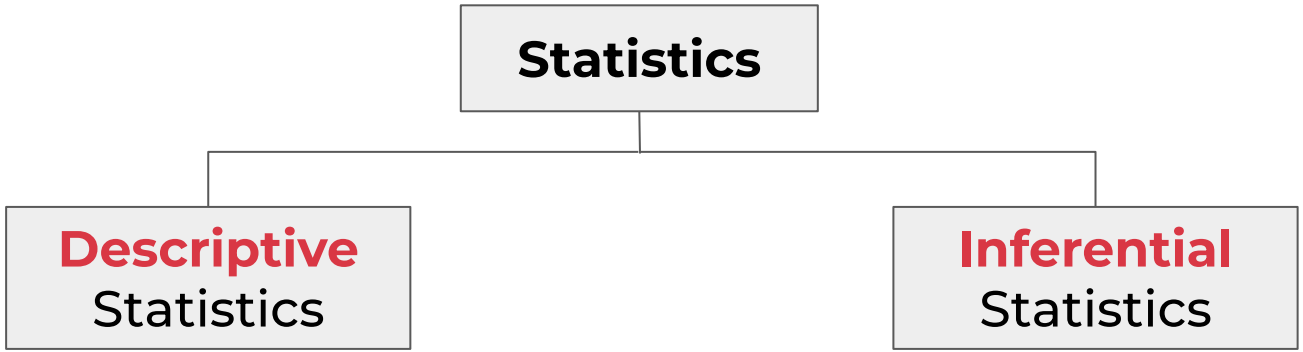
Measures of spread

03

Outliers

Statistics

Statistics is the study of how to **collect**, **analyze**, and **draw conclusions** from data.



Descriptive Statistics

Measures of center

- **Mean :** sum of all the data points divided by the total number of data points

- **Median :** the middle value of the dataset where 50% of the data is less than the median, and 50% of the data is greater than the median

Descriptive Statistics

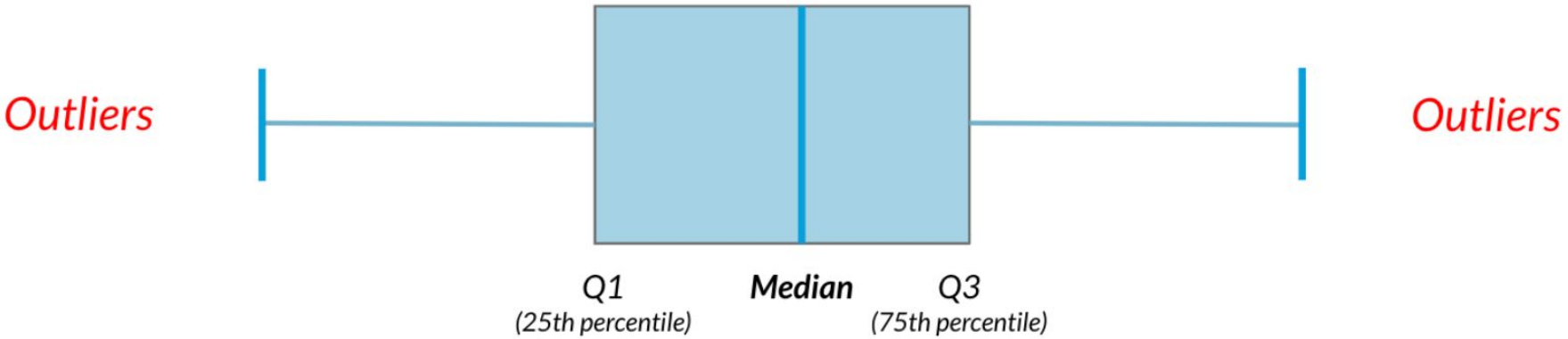
Measures of spread (1/2)

- **Standard Deviation :** measures data spread around the mean; higher values indicate more variability.
- **Quartiles :** three points (Q1, Q2, Q3) dividing data into four parts, representing the 25th, 50th and 75th percentiles.
- **Quintiles :** values dividing a dataset into five equal parts; similar to quartiles but with four points (Q1 to Q4) representing the 20th, 40th, 60th, and 80th percentiles.

Descriptive Statistics

Outliers

Data points significantly **differing** from the dataset.



📌 Descriptive Statistics

Back to our notebook !

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Thank you for attending

any questions ?