The past week we did study deeply explored **basic probability** and its **powerful applications in Artificial Intelligence (AI)**. We delved into fundamental concepts such as **experiment**, **outcome**, **sample space**, and various types of **events**, including **intersection**, **union**, and **complement**. Methods for calculating probability, specifically **Classical Probability**, **Geometric Probability**, and **Empirical Probability**, along with the **Law of Large Numbers**, were introduced to solidify understanding of randomness.

Crucial principles and theorems were thoroughly examined, including **Bayes' Rule (Bayes' Theorem)** – a core foundation for AI – the **Total Probability Theorem**, **Conditional Probability**, and **Independent Events**. We also became familiar with key **probability distributions** like the **Uniform distribution** and, notably, the **Gaussian distribution**, which are essential for data modeling.

This knowledge was then applied to practical AI problems:

• We developed a **spam message classification program** utilizing both the traditional **Naive Bayes Classifier** and a more modern approach with **Vector Databases** and **Sentence Embeddings**, incorporating **FAISS** for high-speed similarity search. The process involved data preparation, including preprocessing and feature extraction.

• The ability to control randomness was illustrated through a **Monte Carlo simulation** to estimate **Pi (π)**, demonstrating the integration of theory and practical application.

• In Natural Language Processing, **Levenshtein distance** was employed for spell-checking, including an enhanced version that incorporated a **QWERTY Keyboard Cost Model** to better reflect human typing habits.

• **Background Subtraction** techniques in Computer Vision were implemented using **NumPy matrix operations** and the **OpenCV** library to isolate objects from their backgrounds.

This intensive week provided a robust theoretical toolkit and clearly demonstrated the indispensable role of probability in constructing intelligent and powerful AI systems.