AI for Sustainable Development Goals– Week 2 Project

SDG 11: Sustainable Cities and Communities

Problem Statement:
Urban transportation systems in many cities suffer from inefficient routing and uneven service distribution, leading to longer commute times, higher emissions, and congestion. This project focuses on identifying optimal transit hub locations to improve route planning efficiency and accessibility.

Machine Learning Approach:
An unsupervised learning model – **K-Means Clustering** – was applied to analyze spatial data (bus stop coordinates) and demand data (daily passenger counts). The model groups stops with similar demand and proximity, suggesting optimal cluster centers (hubs). The best number of clusters (k = 4) was chosen using the silhouette score method.

Dataset and Tools:
A synthetic dataset of 300 bus stops was generated to simulate city-scale passenger demand. Each stop has X-Y coordinates and daily passenger counts. The workflow used **Python, Scikit-learn, Pandas, and Matplotlib** in Jupyter Notebook.

Results:
The clustering identified four major service zones and their hub locations. Weighted centroids (by passenger count) suggest where central stations should be established to minimize average distance and improve coverage. Visualization plots include the elbow curve, silhouette analysis, and clustered map.

Evaluation Metrics:
Silhouette score and inertia were used for performance evaluation. For real-world deployment, additional metrics such as route efficiency, accessibility improvement, and emission reduction should be considered.

Ethical Reflection:
Bias in data collection (e.g., under-representation of low-income neighborhoods) may cause unequal service allocation. Fairness can be improved by including socioeconomic and accessibility indicators. Privacy protection is essential when using GPS or ridership data.

Conclusion:
This project demonstrates how machine learning can enhance urban mobility planning by providing data-driven insights into route optimization, promoting sustainability, reducing congestion, and improving quality of life in cities.