# AI-powered Sustainable Transport Optimizer for Smart Cities

## Category:

Cloud Application Development

## Skills Required:

Python, IBM Cloud

## Project Overview:

The AI-powered Sustainable Transport Optimizer is an intelligent assistant designed to help city planners and citizens make urban transport more sustainable. The system analyzes traffic patterns, public transport usage, and citizen feedback to recommend eco-friendly improvements. Leveraging IBM Watsonx Granite LLM, it offers data summarization, actionable recommendations, and forecasting, all integrated via a modular FastAPI backend and an interactive Streamlit dashboard.

## Key Technologies:

- IBM Watsonx Granite LLM for summarization, report generation, and chat  
- Pinecone vector database for semantic search of policy documents  
- Streamlit for the dashboard interface  
- FastAPI for backend APIs  
- Pydantic & dotenv for configuration management  
- Machine Learning (Linear Regression) for KPI forecasting  
- Data integration with JSON, CSV, and text files

## Core Modules & Features:

1. Traffic Data Summarizer: Upload traffic CSV reports and summarize data into actionable insights using Granite LLM.  
2. Eco Route Recommendation: Suggest greener public transport routes based on data analysis.  
3. Citizen Feedback Analyzer: Collect and categorize feedback from citizens (e.g., overcrowded buses).  
4. EV Charging Placement Optimizer: Analyze demand to recommend new EV charging station locations.  
5. KPI Forecasting: Forecast ridership, traffic density, and CO₂ savings.  
6. Anomaly Detection: Identify sudden spikes or drops in traffic or transport KPIs.  
7. Chat Assistant: Citizens ask questions like "How can my commute be greener?" and get AI-driven suggestions.

## Additional Mentor-Attracting Features:

1. Real-Time Data Integration: Connect live traffic APIs to provide dynamic insights.  
2. AI-Powered Chatbot with Natural Language Querying: Users can ask complex questions and get instant answers.  
3. Automated Report Generation: Create PDF/HTML reports for quick presentations.  
4. Visualization Dashboard: Interactive maps and graphs (using Plotly) to illustrate data.  
5. Integration with Sustainability Goals: Track KPIs aligned with SDGs like CO₂ reduction.  
6. User Feedback Loop: Citizens rate AI suggestions, helping improve accuracy.

## Use Case Scenarios:

- Data Summarization: Upload yearly traffic reports and get summarized insights.  
- Eco Route Suggestion: Recommend optimized, lower-emission routes.  
- Feedback Analysis: Categorize and visualize citizen complaints.  
- EV Planning: Forecast demand for charging stations.  
- Forecasting: Predict next year’s ridership and emissions savings.  
- Anomaly Detection: Highlight unexpected traffic surges.  
- Chat Assistant: Answer citizen questions about sustainable travel.

## Project Deliverables:

- Code uploaded to GitHub repository.  
- Updated documentation and project report.  
- Screenshots and sample outputs.  
- Demo links or live dashboard URLs.  
- (Optional) Project demo video.

## Completion Workflow:

- Move completed modules to review in the Kanban board.  
- Mentor review at ~90% completion.  
- Final approval and project completion certificate.

## References:

- IBM Watsonx Granite LLM documentation  
- Pinecone vector database  
- Streamlit and FastAPI official docs  
- scikit-learn ML libraries  
- Sustainable city planning resources