## Project Summary

Our project develops a real estate recommendation and price prediction system tailored to the Egyptian market. We use a content-based filtering approach with the k-Nearest Neighbors (KNN) algorithm to suggest properties that match user preferences, such as location, property type, number of bedrooms, furnishing status, and price range. Additionally, we implement a price prediction module using ensemble regression techniques, including BaggingRegressor and Histogram-Based Gradient Boosting, to estimate fair market values.

In our project, we begin by collecting and preprocessing a comprehensive dataset of Egyptian real estate listings. We address missing values, encode categorical variables, and normalize numerical features to ensure data quality. To enhance search flexibility, we use fuzzy matching via RapidFuzz, which corrects user input misspellings during filtering. Our recommendation engine leverages KNN with cosine similarity on normalized feature vectors to deliver the top five most relevant properties for each user query.

For price prediction, we train and compare multiple regression models, such as Random Forest, Gradient Boosting, and Linear Regression, using metrics like R² and Mean Absolute Error. Through ensemble methods, we reduce overfitting and improve prediction reliability, providing users with dependable price estimates to support their decision-making.

We validate our models through cross-validation and real-world scenarios, ensuring that our system operates with low latency and high accuracy. The modular design, implemented entirely in Python using scikit-learn, pandas, and NumPy, allows seamless integration into future web or mobile interfaces using frameworks like Streamlit or FastAPI.

In conclusion, our project offers an end-to-end solution for property seekers and sellers by delivering personalized recommendations, dynamic filtering, and trustworthy price insights. We acknowledge limitations, such as data staleness and cold-start challenges, and outline future work, including real-time data integration, interactive frontend development, and user feedback loops. Through our project, we aim to empower users with data-driven tools that simplify and optimize real estate decisions in Egypt’s dynamic property market.