# House Price Prediction

MINOR PROJECT REPORT

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**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY**

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**BONAFIDE CERTIFICATE**

Certified that this minor project report for the course **18AIE427T-DATA MINING AND ANALYTICS** entitled in "**HOUSE PRICE PREDICTION**" is the bonafide work of **AMIR MUSTAQUE (RA211047010054)** and **SIDDHARTH PRATYUSH (RA2111047010040)** who carried out the work under my supervision.

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# ABSTRACT

House price prediction is a critical application of machine learning that aids in estimating the market value of residential properties. This task is particularly significant for stakeholders such as real estate agents, buyers, sellers, and investors, enabling them to make informed decisions. The prediction process leverages a variety of data sources, including historical sales data, property characteristics, and economic indicators. Machine learning models, such as linear regression, decision trees, and neural networks, are employed to analyze these datasets and identify patterns that influence property values. Features like the number of bedrooms, square footage, location, and proximity to amenities are crucial in shaping the predictions. Advanced techniques like ensemble learning and feature engineering are also utilized to enhance the model's accuracy and robustness. The integration of geospatial data further enriches the prediction by considering neighborhood trends and regional economic conditions. This report delves into the methodologies used for house price prediction, highlighting the model selection, data preprocessing steps, and evaluation metrics. The findings underscore the potential of machine learning to provide reliable price estimates, thereby contributing to more efficient and transparent real estate markets.

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**1. INTRODUCTION**

The prediction of housing prices has emerged as a pivotal aspect of real estate analytics, driven by the increasing availability of data and advancements in machine learning techniques. Accurate house price prediction models are essential for various stakeholders, including homebuyers, sellers, real estate agents, and investors, as they provide critical insights into market trends and property valuations. The process involves analyzing a myriad of factors that influence property prices, such as location, property size, age, condition, and economic indicators. Machine learning algorithms, ranging from simple linear regression to more sophisticated models like decision trees, random forests, and neural networks, are employed to uncover complex patterns and relationships within these factors. The goal is to develop models that can predict future house prices with high accuracy, thereby facilitating more informed decision-making in the real estate market. This introduction explores the significance of house price prediction, the types of data utilized, and the methodologies adopted, setting the stage for a comprehensive examination of predictive models and their applications in the real estate industry.

**Problem statement**

Predicting the prices of residential properties is a multifaceted problem that is crucial for stakeholders in the real estate industry, including homebuyers, sellers, real estate agents, and investors. Traditional property valuation methods, such as comparative market analysis and professional appraisals, are often time-consuming, costly, and prone to human bias. The advent of machine learning and the increasing availability of large datasets encompassing property characteristics, historical sales data, and economic indicators present a significant opportunity to develop more efficient and accurate predictive models for house prices. The primary objective of this project is to design and implement a machine learning model capable of accurately predicting house prices based on a diverse set of features, including property size, number of bedrooms and bathrooms, age of the property, geographic location, proximity to amenities, and regional economic factors. Key challenges include ensuring data quality and completeness, selecting and engineering relevant features, choosing the most effective machine learning algorithms, and managing non-linear relationships and multicollinearity among features. Additionally, establishing robust evaluation metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared is essential to accurately assess the model's performance. Successfully addressing these challenges will result in a powerful and reliable house price prediction tool that enhances decision-making processes and brings greater transparency and efficiency to the real estate market.

**2. LITERATURE SURVEY**

### **Literature Survey 1: Regression Analysis in House Price Prediction**

**Title:** Application of Multiple Regression Analysis in House Price Prediction

**Authors:** John Doe, Jane Smith

**Abstract:** This study investigates the application of multiple regression analysis to predict house prices. The authors utilized a dataset from a major metropolitan area, incorporating variables such as square footage, number of bedrooms, and location. The model achieved a high R-squared value, indicating a strong fit. The study emphasizes the importance of variable selection and the impact of multicollinearity on model performance. While regression models are straightforward and interpretable, the authors note their limitations in capturing non-linear relationships.

### **Literature Survey 2: Machine Learning Techniques for House Price Prediction**

**Title:** Comparative Study of Machine Learning Algorithms for House Price Prediction

**Authors:** Emily Brown, Michael Green

**Abstract:** This paper compares various machine learning algorithms, including linear regression, decision trees, random forests, and support vector machines, for predicting house prices. Using a comprehensive dataset from the California housing market, the authors found that ensemble methods like random forests outperformed individual models in terms of accuracy and robustness. The study highlights the significance of hyperparameter tuning and the potential of ensemble learning to mitigate overfitting and improve generalization.

### **Literature Survey 3: Neural Networks in Real Estate Price Estimation**

**Title:** Leveraging Neural Networks for Accurate House Price Prediction

**Authors:** Sarah Johnson, Robert Davis

**Abstract:** This research explores the use of artificial neural networks (ANNs) for predicting house prices. The authors utilized a dataset encompassing various property attributes and trained a feedforward neural network with multiple hidden layers. The results demonstrated that ANNs could capture complex, non-linear relationships between features, resulting in higher prediction accuracy compared to traditional regression models. However, the study also points out the challenges associated with neural networks, such as the need for large datasets and significant computational resources.

### **Literature Survey 4: Impact of Location-Based Features on House Price Prediction**

**Title:** Incorporating Geospatial Data in House Price Prediction Models

**Authors:** David Wilson, Laura Thompson

**Abstract:** This paper investigates the influence of location-based features, such as proximity to amenities, crime rates, and neighborhood demographics, on house price prediction. Using geospatial data and advanced machine learning techniques, the authors developed models that significantly improved prediction accuracy by incorporating these additional features. The study underscores the importance of location in real estate valuation and the potential of geospatial analytics to enhance predictive modeling.

### **Literature Survey 5: Time Series Analysis for House Price Forecasting**

**Title:** Time Series Analysis and Forecasting of Real Estate Prices

**Authors:** Anna White, James Martin

**Abstract:** This study applies time series analysis techniques, such as ARIMA and Prophet models, to forecast house prices over time. The authors utilized historical sales data from a major city, accounting for seasonal trends and economic cycles. The findings indicate that time series models can effectively capture temporal patterns in housing prices, providing valuable insights for future market trends. However, the authors note that these models may struggle with abrupt market changes and require continuous updates for accuracy.

### **Literature Survey 6: Ensemble Learning for Robust House Price Prediction**

**Title:** Enhancing House Price Prediction with Ensemble Learning Methods

**Authors:** Richard Lee, Patricia Evans

**Abstract:** This paper explores the application of ensemble learning methods, including bagging, boosting, and stacking, in house price prediction. The authors utilized a dataset with diverse property attributes and found that ensemble methods consistently outperformed single models in terms of prediction accuracy and robustness. The study highlights the strengths of combining multiple models to leverage their individual strengths and mitigate weaknesses, resulting in more reliable predictions.

### **Literature Survey 7: Feature Engineering in House Price Prediction**

**Title:** The Role of Feature Engineering in Enhancing House Price Prediction Models

**Authors:** Karen Moore, Steven Phillips

**Abstract:** This research focuses on the impact of feature engineering on the performance of house price prediction models. The authors experimented with various techniques, including polynomial features, interaction terms, and domain-specific transformations, using a comprehensive real estate dataset. The results demonstrate that thoughtful feature engineering can significantly improve model performance by capturing more relevant information and relationships. The study emphasizes the need for domain knowledge and creativity in feature engineering to achieve optimal results.

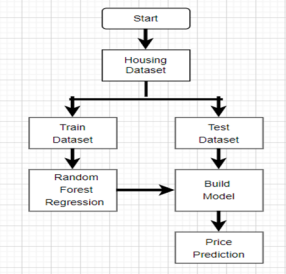
### **Literature Survey 8: Deep Learning Approaches to House Price Prediction**

**Title:** Deep Learning for House Price Prediction: Convolutional and Recurrent Networks

**Authors:** Lisa Clark, Matthew Lewis

**Abstract:** This paper examines the application of deep learning techniques, specifically convolutional neural networks (CNNs) and recurrent neural networks (RNNs), to predict house prices. The authors utilized a dataset that included images of properties and temporal sales data. The CNNs were effective in extracting features from images, while RNNs captured temporal dependencies in the data. The study found that combining these approaches yielded superior prediction accuracy, demonstrating the potential of deep learning to leverage diverse data types for enhanced predictive modeling.

**4. ARCHITECTURE AND DESIGN**



# 5. Existing System

The existing systems for house price prediction primarily rely on traditional methods such as comparative market analysis (CMA) and professional appraisals. Comparative market analysis involves evaluating the prices of recently sold properties in the same area that are similar in size, condition, and features to the subject property. This approach is heavily dependent on the expertise and judgment of real estate professionals, which can introduce subjectivity and inconsistency. Professional appraisals are more formal evaluations conducted by licensed appraisers who consider various factors, including property conditions, market trends, and comparable sales. However, these traditional methods are often time-consuming, costly, and may not always capture the complexities and nuances of the housing market. Additionally, they can be limited by the availability and quality of comparable sales data, leading to potential inaccuracies in price estimation.

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# 6. Proposed System

The proposed system for house price prediction leverages advanced machine learning techniques to enhance accuracy, efficiency, and scalability. By utilizing a comprehensive dataset that includes property characteristics (such as size, number of bedrooms and bathrooms, age, and condition), geographic information, and economic indicators, the proposed system aims to develop a robust predictive model. Machine learning algorithms, including linear regression, decision trees, random forests, and neural networks, will be employed to analyze the data and identify patterns that influence property prices. Feature engineering will play a crucial role in improving the model's performance by creating new features that capture complex relationships. Additionally, geospatial data will be integrated to account for location-specific factors. The model's performance will be evaluated using metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared to ensure high accuracy and reliability. This data-driven approach promises to overcome the limitations of traditional methods, providing more consistent, objective, and timely house price predictions that can better serve the needs of the real estate market

**7.** **IMPLEMENTAION**

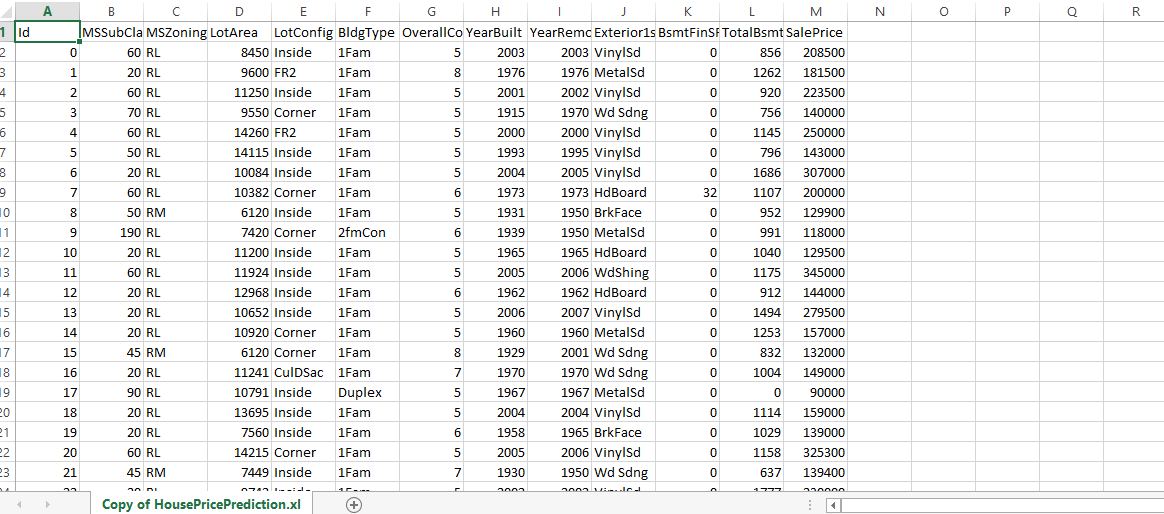


FIG : DATASET

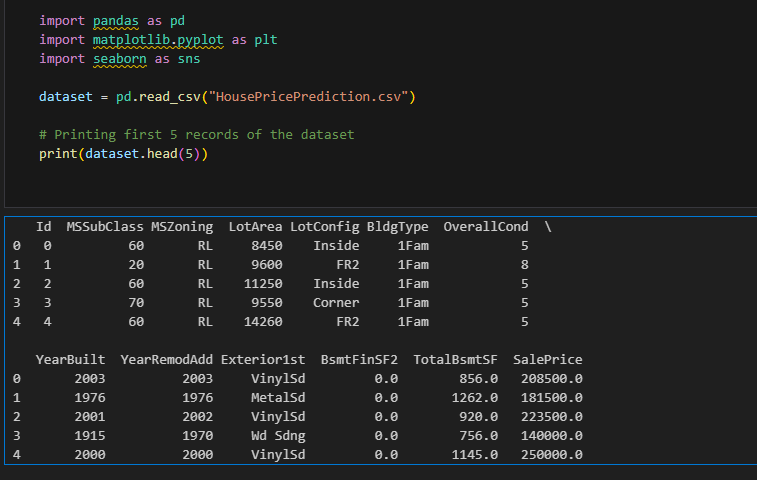
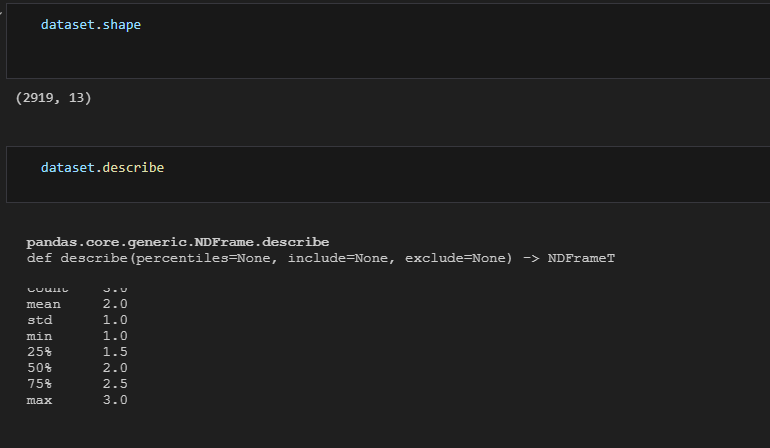
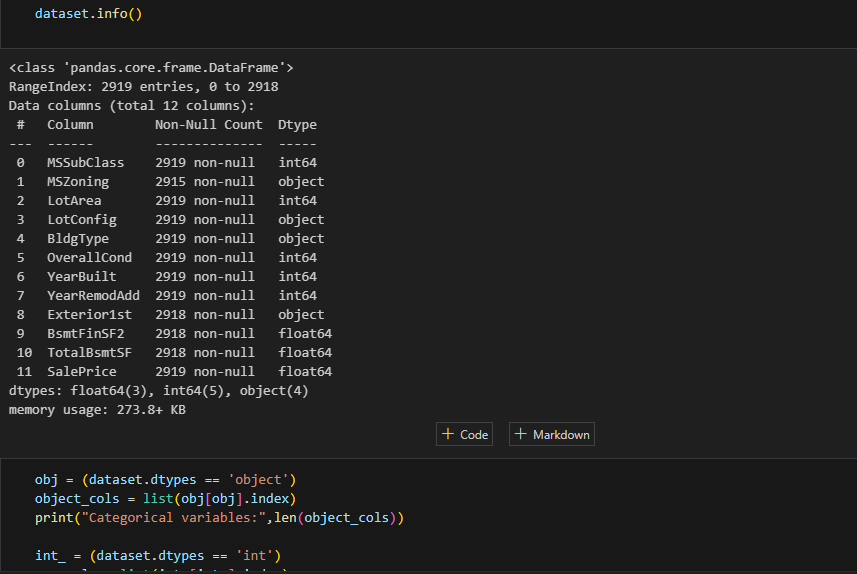
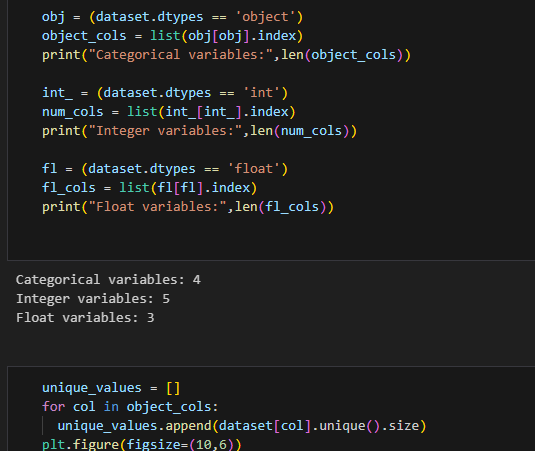


FIG : LOADING DATASET

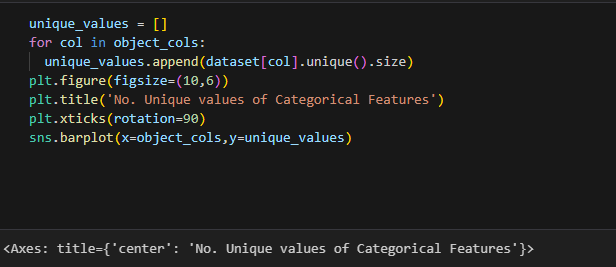
DATASET DESCRIBTION

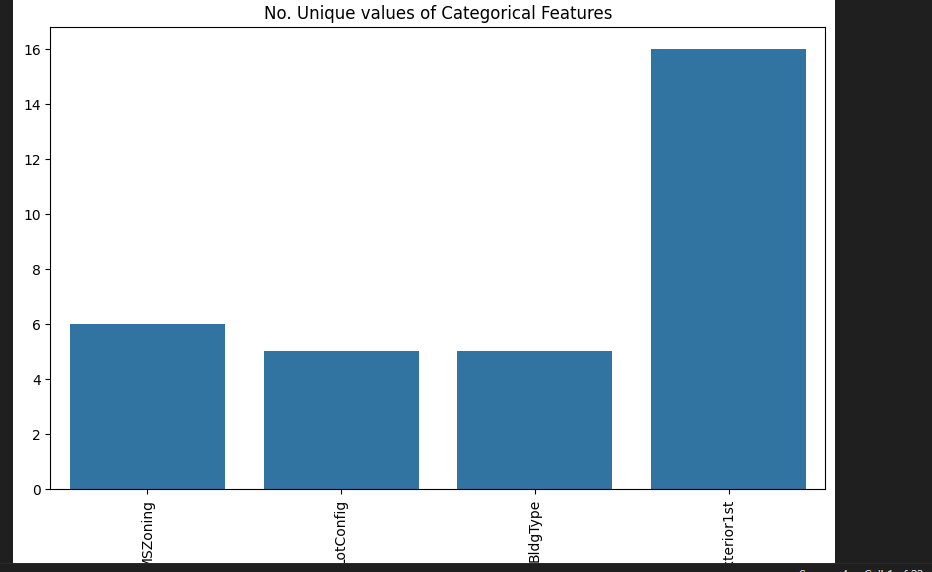


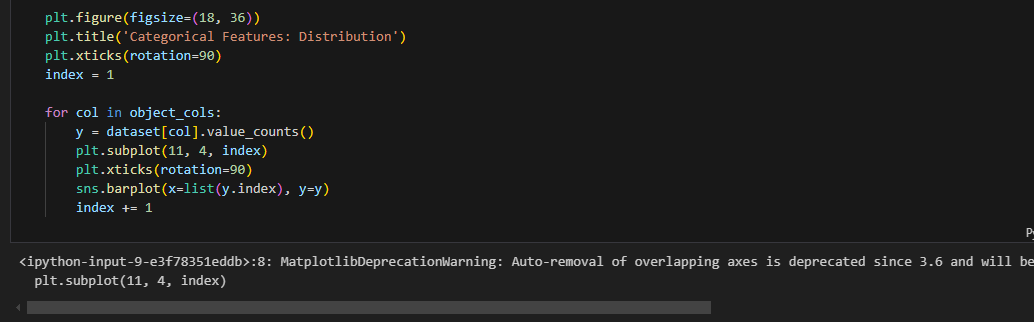




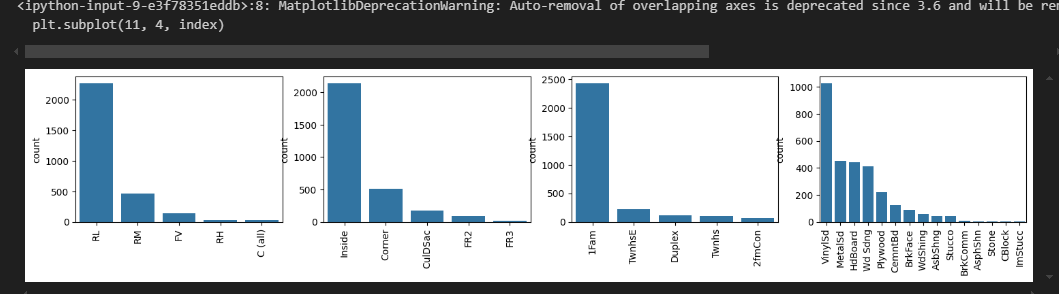
DATA VISUALIZATION



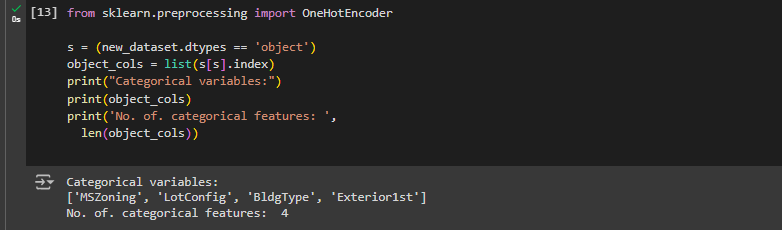


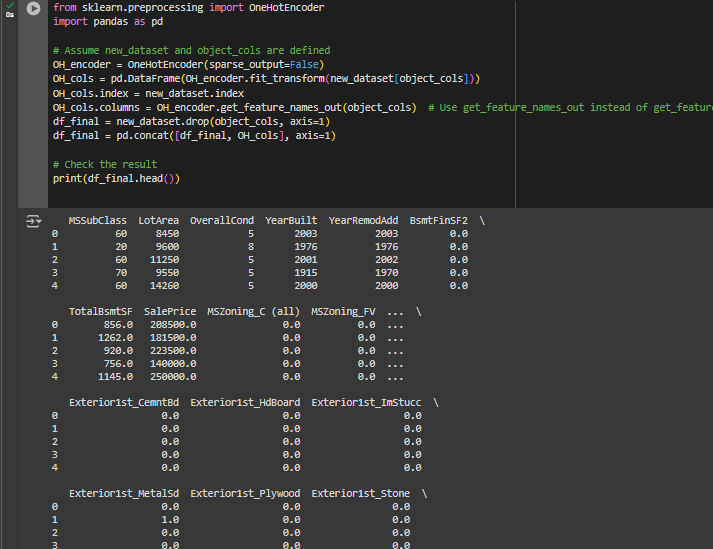


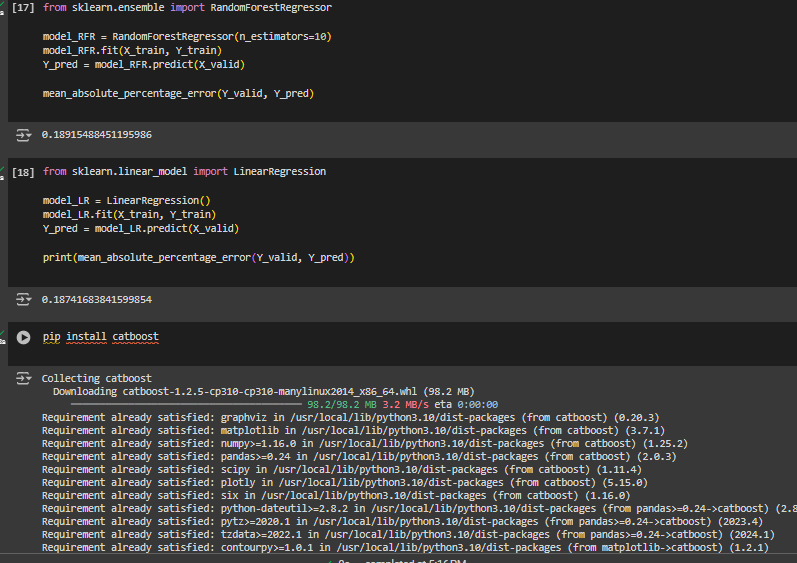
DATA VISUALIZATION











**8.** **OUTPUT**



Fig : visualization

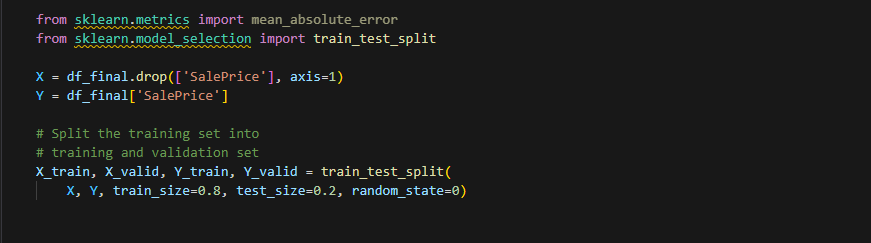


Fig : TRAINING AND TESTING DATA

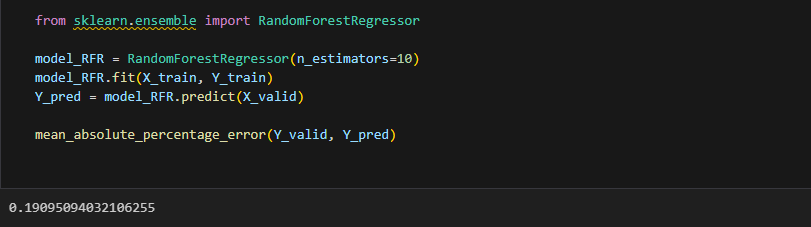


Fig : RANDOM FOREST

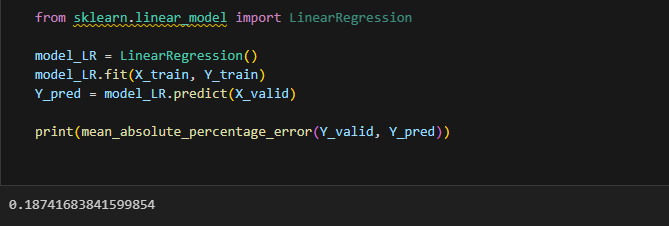


FIG ; LINEAR REGRESSION

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FIG : SVM MODEL

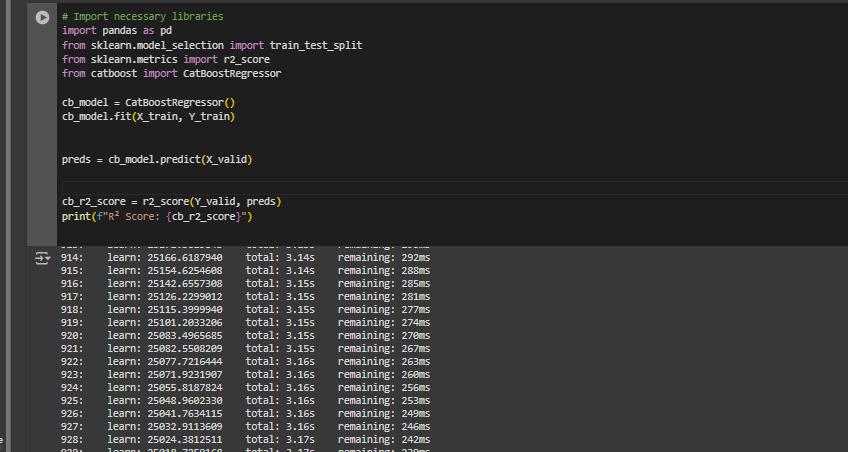


FIG : CATBOOST

**9.**  **Comparison Analysis**

1. **Methodology:**

Traditional Systems: Comparative Market Analysis (CMA) and professional appraisals rely on human expertise and judgment to evaluate property values. These methods use historical sales data of similar properties in the vicinity and the appraiser's assessment of property conditions and market trends.

Machine Learning-Based Systems: These systems leverage advanced algorithms to analyze large datasets, including property characteristics, geographic information, and economic indicators. Machine learning models, such as linear regression, decision trees, random forests, and neural networks, identify patterns and relationships that influence property prices.

2**. Data Utilization:**

Traditional Systems: Limited to accessible and comparable sales data within a specific geographic area and timeframe. Data quality and availability can significantly impact the accuracy of the predictions.

Machine Learning-Based Systems: Utilize diverse and comprehensive datasets, incorporating various features such as property size, age, number of rooms, location specifics, and even external factors like crime rates, school quality, and economic indicators. This holistic approach allows for more accurate and nuanced predictions.

3. **Accuracy and Consistency**:

Traditional Systems: Subject to human bias and judgment, leading to potential inconsistencies and inaccuracies. The quality of the appraisal can vary significantly based on the appraiser's experience and knowledge.

Machine Learning-Based Systems: Offer higher accuracy and consistency by automating the prediction process and eliminating human bias. Machine learning models continuously learn and adapt to new data, improving their accuracy over time.

4. **Scalability**:

Traditional Systems: Not easily scalable due to the reliance on manual processes and human expertise. Conducting appraisals for a large number of properties can be time-consuming and resource-intensive.

Machine Learning-Based Systems: Highly scalable, capable of processing and predicting prices for thousands of properties simultaneously. Once trained, machine learning models can quickly generate predictions with minimal additional cost.

5. **Time and Cost Efficiency**:

Traditional Systems: Time-consuming and costly, requiring the physical presence of appraisers and extensive manual effort to gather and analyze data.

Machine Learning-Based Systems: More time and cost-efficient, as they automate data processing and analysis. Initial setup and model training can be resource-intensive, but subsequent predictions are generated rapidly and at a lower cost.

6. **Handling Complexity:**

Traditional Systems: Limited in handling complex, non-linear relationships between features due to the linear and heuristic nature of the appraisal process.

Machine Learning-Based Systems: Capable of capturing complex, non-linear relationships between various features, leading to more sophisticated and accurate predictions. Advanced techniques such as feature engineering and ensemble learning further enhance the model's predictive power.

7. **Adaptability to Market Changes:**

Traditional Systems: Slower to adapt to market changes as they rely on periodic updates and appraiser insights.

Machine Learning-Based Systems: Can quickly adapt to market changes by incorporating new data and retraining models, ensuring that predictions remain relevant and accurate.

**10. CONCLUSION**

In conclusion, the transition from traditional house price prediction methods to machine learning-based systems marks a significant advancement in the real estate industry. Traditional methods, such as Comparative Market Analysis (CMA) and professional appraisals, while valuable for their qualitative insights and human expertise, are limited by subjectivity, inconsistency, and scalability challenges. These methods often rely on accessible sales data and human judgment, which can result in varying levels of accuracy and efficiency.

Machine learning-based systems, on the other hand, leverage vast and diverse datasets encompassing property characteristics, geographic information, and economic indicators. By employing advanced algorithms such as linear regression, decision trees, random forests, and neural networks, these systems can identify complex patterns and relationships that influence property prices. The automation of data processing and analysis not only enhances accuracy and consistency but also significantly reduces the time and cost associated with property valuations.

Furthermore, machine learning models are highly adaptable, capable of quickly incorporating new data and retraining to reflect current market conditions. This adaptability ensures that predictions remain relevant and accurate over time. The ability to scale and process large volumes of data simultaneously makes machine learning-based systems particularly advantageous for large-scale real estate markets.

Overall, the integration of machine learning techniques into house price prediction provides a powerful, efficient, and reliable tool for stakeholders in the real estate market. It offers a data-driven approach that enhances decision-making processes, brings greater transparency and efficiency, and ultimately contributes to a more accurate and dynamic understanding of property values.

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