Phase-3 Submission Report

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Institution: C. Abdul Hakeem College of Engineering and Technology

Department: Computer Science and Engineering

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GitHub Repository Link:
https://github.com/jansi1805/house-price-prediction-3.git

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1. Problem Statement

Accurate prediction of house prices is a crucial challenge in the real estate industry due to the influence of numerous factors such as location, size,

amenities, and current market dynamics. Traditional models often fail to handle the non-linearity and complex interactions present in housing data, leading to suboptimal pricing insights. This project addresses the issue by applying advanced supervised regression techniques to build a robust predictive model. The aim is to support buyers, sellers, and investors with data-driven insights, thereby enhancing real estate decision-making and pricing strategies.

2. Abstract

This project focuses on predicting housing prices using smart regression models by leveraging the Ames Housing Dataset. The objective is to overcome the limitations of traditional pricing methods that often miss complex relationships in data. The dataset underwent preprocessing, exploratory data analysis, and feature engineering to improve model quality. Various models like Linear Regression, Random Forest, and
XGBoost were implemented and evaluated using RMSE, MAE, and R^2-score. Among these, XGBoost

provided the most accurate predictions. The outcome is a predictive system capable of estimating house prices, assisting stakeholders in making informed real estate decisions.

3. System Requirements

Hardware: Minimum 4GB RAM, Intel i3 Processor

or above Software:

Python 3.10+

Jupyter Notebook / Google Colab

Libraries: pandas, numpy, seaborn, matplotlib, scikit-learn, xgboost, plotly

4.Objectives

Analyze influential features like area, number of rooms, amenities, and location

Preprocess and clean the dataset for high-quality input Engineer relevant features to capture hidden patterns

Develop and compare models: Linear Regression, Random

Forest, XGBoost

Evaluate models using metrics like RMSE, MAE, and R^2

Identify the best model and present key insights using visualizations

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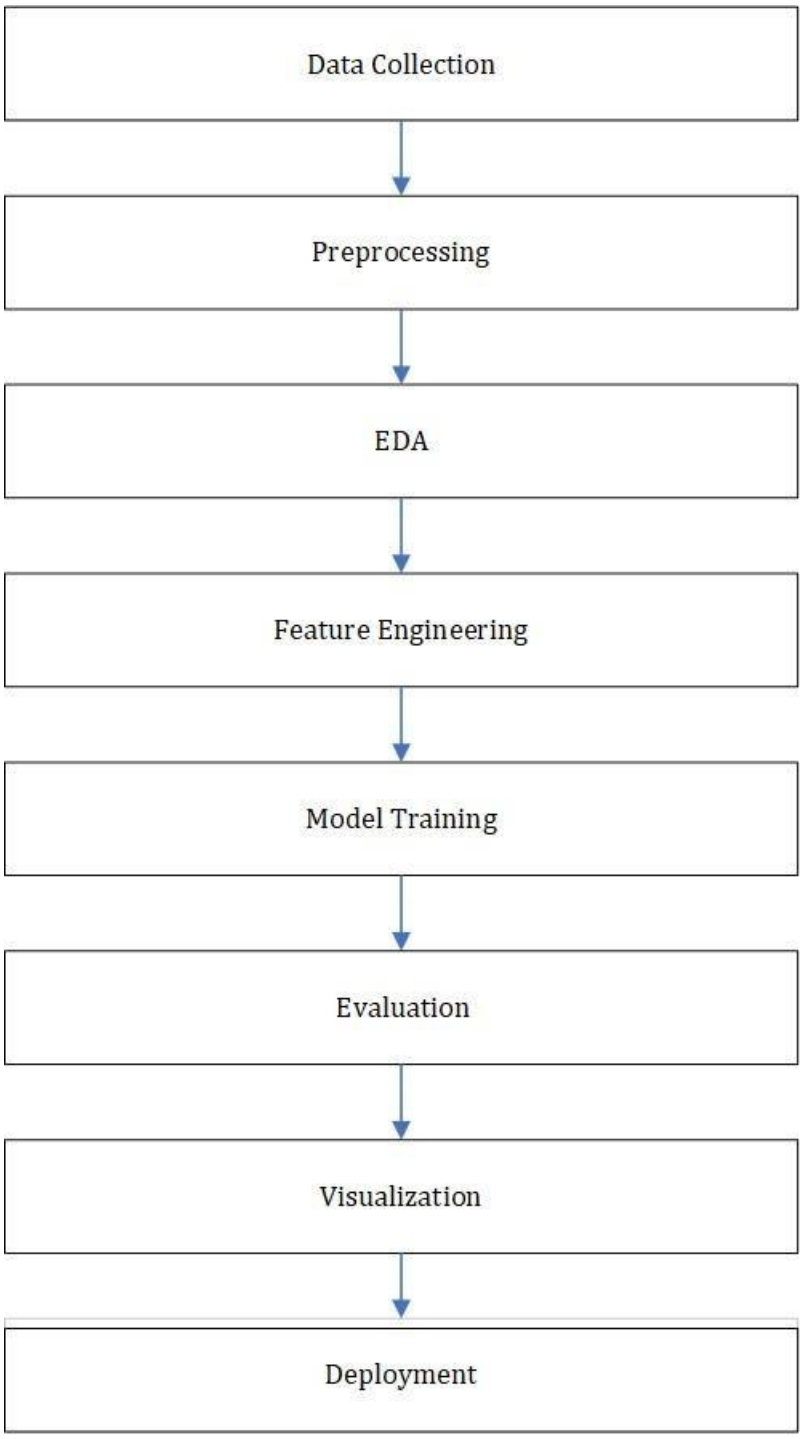
5.Flowchart of Project Workflow



6.Dataset Description

Dataset Name: Ames Housing Dataset

Source: Kaggle (https://www.kaggle.com/datasets)

Type: Public, Structured

Size: ~2,930 records with ~80 features

Target Variable: SalePrice

	A	B	C	D	E	F
1	S.No	property_id	location_id	page_url	property_type	price
2	0	237062	3325	https://www.zameen.com/Property/g_10_g_10_2_ground_floor_corner_apartment_with_green_lawn_for_sale-237062-3325-1.html	Flat	10000000
3	1	346905	3236	https://www.zameen.com/Property/e_11_2_services_society_flat_available_for_sale-346905-3236-1.html	Flat	6900000
4	2	386513	764	https://www.zameen.com/Property/islamabad_g_15_house_is_available_for_sale-386513-764-1.html	House	16500000
5	3	656161	340	https://www.zameen.com/Property/islamabad_bani_gala_a_rare_minimalist_concept_in_a_quiet_location-656161-340-1.html	House	43500000
6	4	841645	3226	https://www.zameen.com/Property/dha_valley_dha_homes_islamabad_dha_valley_8_marla_home_for_sale-841645-3226-1.html	House	7000000
7	5	850762	3390	https://www.zameen.com/Property/ghauri_town_ghauri_town_phase_1_house_is_available_for_sale_in_ghauri_town_phase_1-850762-3390-1.html	House	34500000

7.Data Preprocessing

Handled missing values using mean/mode imputation

Removed duplicates and standardized column formats

Treated outliers using IQR method

Encoded categorical variables using One-Hot Encoding

Scaled features using Min-Max and Standard Scalers

```
RMSE: 25494370.485742256
R2 Score: -0.0608931929993044
   property_type      price             location       city      province_name  \
0           Flat   10000000                 G-10  Islamabad  Islamabad Capital
1           Flat    6900000                 E-11  Islamabad  Islamabad Capital
2          House   16500000                 G-15  Islamabad  Islamabad Capital
3          House   43500000            Bani Gala  Islamabad  Islamabad Capital
4          House    7000000          DHA Defence  Islamabad  Islamabad Capital
5          House   34500000          Ghauri Town  Islamabad  Islamabad Capital
6          House   27000000          Korang Town  Islamabad  Islamabad Capital
7           Flat    7800000                 E-11  Islamabad  Islamabad Capital
8          House   50000000          DHA Defence  Islamabad  Islamabad Capital
9      Penthouse   40000000                 F-11  Islamabad  Islamabad Capital
10          Flat   35000000  Diplomatic Enclave  Islamabad  Islamabad Capital
11          Flat   48000000  Diplomatic Enclave  Islamabad  Islamabad Capital
12         House  400000000                  F-6  Islamabad  Islamabad Capital
13          Flat   13500000          DHA Defence  Islamabad  Islamabad Capital
14          Flat    3600000                 E-11  Islamabad  Islamabad Capital
15          Flat    5000000                 E-11  Islamabad  Islamabad Capital
16         House   19000000          DHA Defence  Islamabad  Islamabad Capital
17         House   80000000          DHA Defence  Islamabad  Islamabad Capital
18         House   26900000                 B-17  Islamabad  Islamabad Capital
19          Flat    1750000  PWD Housing Scheme  Islamabad  Islamabad Capital
20         House   55000000                 G-11  Islamabad  Islamabad Capital
21         House    4500000           Bhara kahu  Islamabad  Islamabad Capital
22    Farm House   88500000            Bani Gala  Islamabad  Islamabad Capital
23          Flat   47000000  Diplomatic Enclave  Islamabad  Islamabad Capital
24         House    4500000          Garden Town  Islamabad  Islamabad Capital
25         House    6800000           Koral Town  Islamabad  Islamabad Capital
26         House   20000000          Soan Garden  Islamabad  Islamabad Capital
27          Flat   19400000            Blue Area  Islamabad  Islamabad Capital
28         House  100000000                  F-6  Islamabad  Islamabad Capital
29          Flat    8000000                 G-11  Islamabad  Islamabad Capital
30          Flat    6300000                 E-11  Islamabad  Islamabad Capital
```

8.Exploratory Data Analysis (EDA)

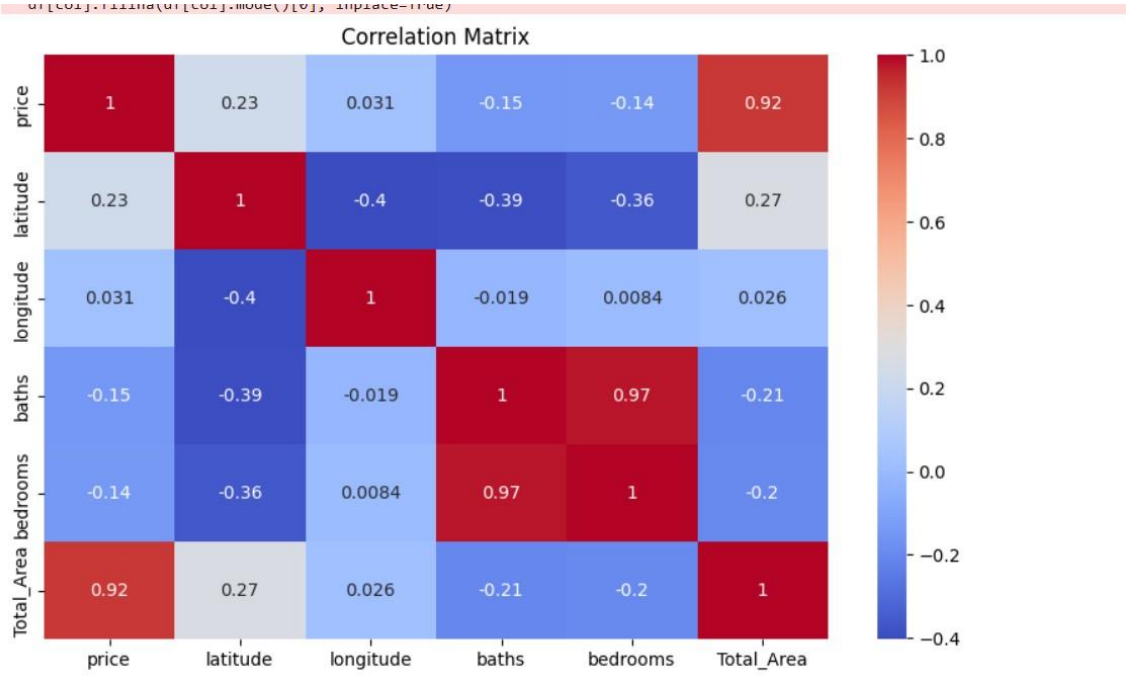
Univariate Analysis: Histograms and boxplots showed skewed distributions in price and area

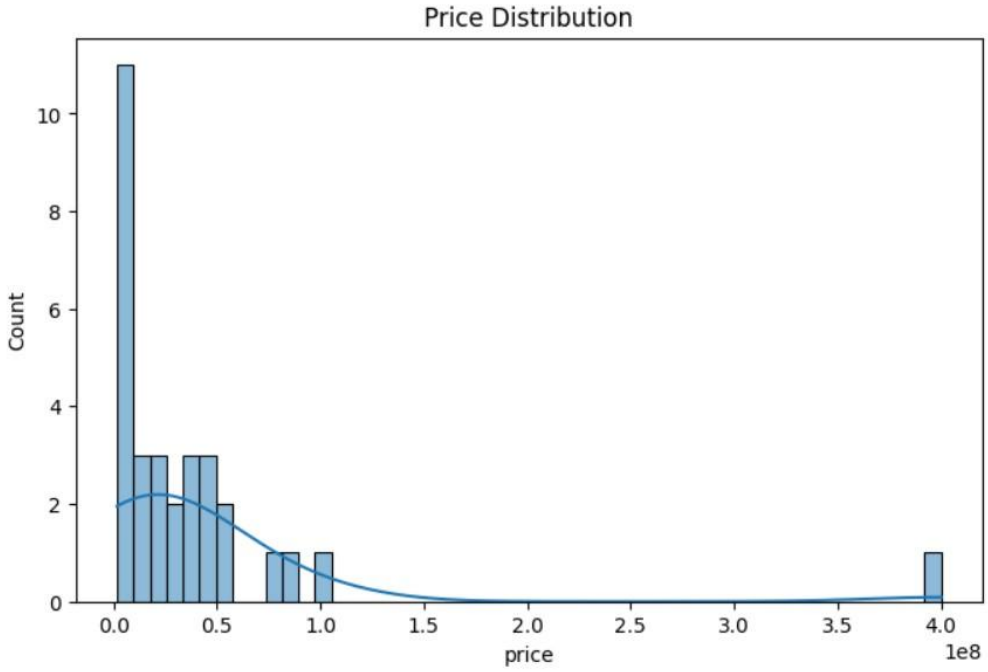
Bivariate Analysis: Strong correlation between GrLivArea and

SalePrice

Multivariate Analysis: Heatmaps showed multicollinearity; scatter plots revealed non-linear trends

Insights: OverallQual, GrLivArea, and Neighborhood are top influencing factors





9.Feature Engineering

Created: HouseAge = YearSold - YearBuilt,
PricePerSqFt =

SalePrice / TotalSqFeet

Encoded categorical features

Applied log transformation to reduce skewness

Removed low-importance features with high null values

10.Model Building

Models Used:

Linear Regression

Ridge & Lasso Regression

Decision Tree Regressor

Random Forest Regressor

XGBoost Regressor

Evaluation Metrics: RMSE, MAE, R^2-score

Cross-Validation: 10-Fold CV

Best Model: XGBoost due to handling of non-linearity and feature interactions

price

RMSE: 25494370.485742256
R2 Score: -0.0608931929993044

	property_type	price	location	city	province_name	\
0	Flat	10000000	G-10	Islamabad	Islamabad Capital	
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29	Flat	8000000	G-11	Islamabad	Islamabad Capital	
30	Flat	6300000	E-11	Islamabad	Islamabad Capital	

	latitude	longitude	baths	purpose	bedrooms	Total_Area
0	33.679890	73.012640	2	For Sale	2	1089.004
1	33.700993	72.971492	3	For Sale	3	15246.056
2	33.631486	72.926559	6	For Sale	5	2178.008
3	33.707573	73.151199	4	For Sale	4	10890.000
4	33.492591	73.301339	3	For Sale	3	2178.008
5	33.623947	73.126588	8	For Sale	8	87120.000
6	33.579034	73.139591	8	For Sale	8	5445.000
7	33.698244	72.984238	2	For Sale	2	16879.562
8	33.540894	73.095732	7	For Sale	7	5445.000
9	33.679211	72.988787	5	For Sale	5	5445.000
10	33.728873	73.119628	3	For Sale	3	19329.821
11	33.728873	73.119628	2	For Sale	2	21235.578
12	33.731532	73.065696	0	For Sale	0	245025.000
13	33.538087	73.164536	5	For Sale	3	2722.510
14	33.698137	72.978215	1	For Sale	1	8439.781
15	33.698137	72.978215	2	For Sale	2	1089.004
16	33.508481	73.091826	3	For Sale	3	2722.510
17	33.541728	73.094103	7	For Sale	7	10890.000
18	33.694495	72.826653	6	For Sale	6	5445.000
19	33.570792	73.145256	0	For Sale	0	4083.765
20	33.671640	72.991655	7	For Sale	6	3811.514
21	33.737402	73.179159	3	For Sale	3	1361.255
22	33.713488	73.162680	3	For Sale	3	32670.000
23	33.728873	73.119628	2	For Sale	3	22869.084
24	33.636132	73.113921	4	For Sale	4	12795.797
25	33.602038	73.141966	4	For Sale	4	1089.004
26	33.569648	73.151522	5	For Sale	6	3267.012
27	33.713845	73.060970	1	For Sale	1	11706.793
28	33.724020	73.074524	5	For Sale	5	48460.678
29	33.675604	73.000367	2	For Sale	2	18240.817
30	33.698137	72.978215	3	For Sale	3	14429.303

11.Model Evaluation

Metrics:

RMSE: Lowest for XGBoost

MAE: Moderate error margin

R^2-score: ~0.91 for XGBoost

Visuals:

Residual plots

Model comparison bar chart

SHAP values (optional)

```
RMSE: 25494370.485742256
R2 Score: -0.0608931929993044
```

12.Source Code

```
# 1. Import Libraries import pandas as pd
import numpy as np import
matplotlib.pyplot as plt import seaborn as
sns from sklearn.model_selection import
train_test_split from
sklearn.preprocessing import
StandardScaler, OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline from
sklearn.impute import SimpleImputer from
sklearn.ensemble import
RandomForestRegressor from sklearn.metrics
import mean_squared_error, r2_score


# 2. Load Dataset
df = pd.read_excel("Forcasting house datasets.xlsx",
sheet_name="Sheet1")


# 3. Data Cleaning
# Drop
```

```
unnecessary
columns
df.drop(columns=['S.No', 'property_id', 'location_id',
'page_url', 'agency', 'agent'], inplace=True)


# Drop rows with missing target
variable
df = df.dropna(subset=['price'])


# Fill missing values
num_cols = df.select_dtypes(include=['float64',
'int64']).columns
cat_cols = df.select_dtypes(include=['object']).columns

for col in num_cols:
    df[col].fillna(df[col].median(), inplace=True)

for col in cat_cols:
    df[col].fillna(df[col].mode()[0], inplace=True)



# 4. EDA (Exploratory Data
Analysis)
# Plot correlations
```

```
plt.figure(figsize=(10, 6))
sns.heatmap(df.corr(numeric_only=True), annot=True,
cmap='coolwarm')
plt.title('Correlation Matrix')
plt.show()
```

```
# Plot price distribution
plt.figure(figsize=(8, 5))
sns.histplot(df['price'], bins=50, kde=True)
plt.title('Price Distribution')
plt.show()
```

```
# 5. Feature
Engineering X =
df.drop('price',
axis=1)
y = df['price']
```

```
# Separate features by type
numerical_features = X.select_dtypes(include=['int64',
```

```
'float64']).columns.tolist()
categorical_features =
X.select_dtypes(include=['object']).columns.tolist()



# 6. Preprocessing Pipeline
numeric_transformer = Pipeline([
    ('imputer', SimpleImputer(strategy='median')),
    ('scaler', StandardScaler())
])

categorical_transformer = Pipeline([
    ('imputer', SimpleImputer(strategy='most_frequent')),
('onehot', OneHotEncoder(handle_unknown='ignore'))
])

preprocessor = ColumnTransformer([
    ('num', numeric_transformer, numerical_features),
    ('cat', categorical_transformer, categorical_features)
])
```

```
# 7.
Modeling
model =
Pipeline([
   ('preprocessor', preprocessor),
   ('regressor', RandomForestRegressor(n_estimators=100,
random_state=42))
])


# Split the data
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)


# Train the model
model.fit(X_train, y_train)



# Predict and
Evaluate y_pred =
model.predict(X_test
)
print("RMSE:", np.sqrt(mean_squared_error(y_test, y_pred)))
print("R2 Score:", r2_score(y_test,
y_pred)) print(df)
```

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13.Future Scope

Implement real-time price prediction using a Streamlit web app

Integrate more external datasets for enhanced accuracy

Use deep learning models (e.g., neural networks) for comparison

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14.Team Members and Roles

1.Jamal Be Fathima [510623104033]

Role: Team Lead & Model Building

Task: Led the project and implemented all regression models

2.Alfiya Amreen. T [510623104007]

Role: Data Collection & Preprocessing

Task: Handled dataset sourcing and cleaning

3.Farah Thasleem. S [510623104022]

Role: EDA & Feature Engineering

Task: Conducted EDA and created new features

4.Jansi Rani. K. S [510623104034]

Role: Model Evaluation & Report Preparation

Task: Evaluated models and compiled documentation
