In [1]:
```
import pandas as pd
import numpy as np


from google.colab import drive

drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

In [2]:
```
# load the dataset into a dataframe
df = pd.read_csv("./drive/My Drive/Datasets/housing.csv")
df.head()

# check info of the dataset
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 10 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   longitude           20640 non-null  float64
 1   latitude            20640 non-null  float64
 2   housing_median_age  20640 non-null  float64
 3   total_rooms         20640 non-null  float64
 4   total_bedrooms      20433 non-null  float64
 5   population          20640 non-null  float64
 6   households          20640 non-null  float64
 7   median_income       20640 non-null  float64
 8   median_house_value  20640 non-null  float64
 9   ocean_proximity     20640 non-null  object
dtypes: float64(9), object(1)
memory usage: 1.6+ MB
```

In [3]:
```
# Check for missing values
df.isnull().sum()
```

Out[3]:
```
longitude               0
latitude                0
housing_median_age      0
total_rooms             0
total_bedrooms        207
population              0
households              0
median_income           0
median_house_value      0
ocean_proximity         0
dtype: int64
```

In [4]:
```
# Replace missing values in 'total_bedrooms' with the mean value of that column
mean_total_bedrooms = df['total_bedrooms'].mean()
df['total_bedrooms'].fillna(mean_total_bedrooms, inplace=True)
```

In [5]:
```
# check if the missing values have been replaced
df.isnull().sum()
```

Out[5]:
```
longitude             0
latitude              0
housing_median_age    0
total_rooms           0
total_bedrooms        0
population            0
households            0
```

```
median_income         0
median_house_value    0
ocean_proximity       0
dtype: int64
```

In [6]:
```python
# let's check how many districts belong to each attribute
df["ocean_proximity"].value_counts()
```

Out[6]:
```
<1H OCEAN     9136
INLAND        6551
NEAR OCEAN    2658
NEAR BAY      2290
ISLAND           5
Name: ocean_proximity, dtype: int64
```

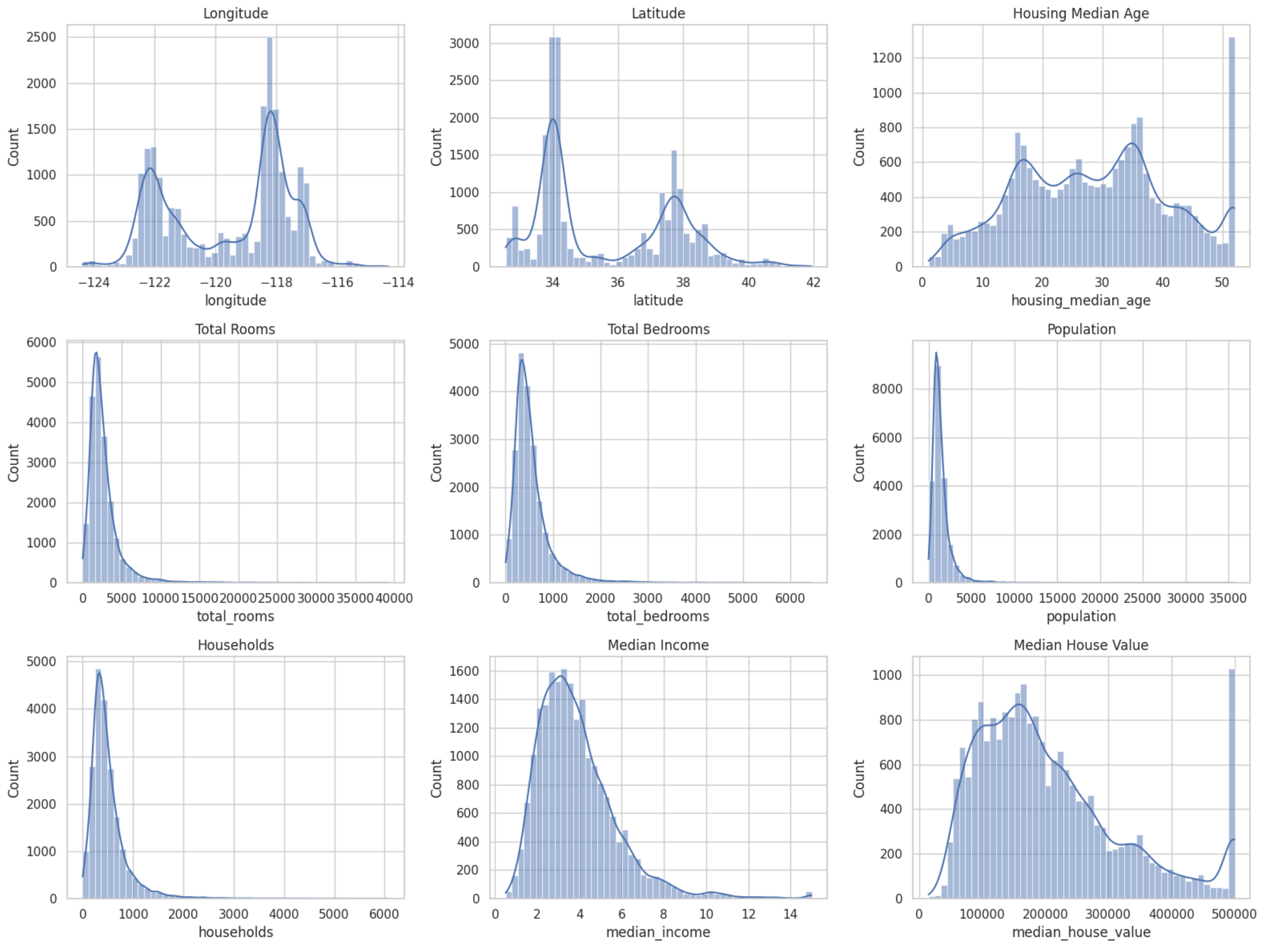
In [7]:
```python
# Let's check the summary statistics of the numerical attributes
df.describe().T
```

Out[7]:

	count	mean	std	min	25%	50%	75
longitude	20640.0	-119.569704	2.003532	-124.3500	-121.8000	-118.4900	-118.010
latitude	20640.0	35.631861	2.135952	32.5400	33.9300	34.2600	37.710
housing_median_age	20640.0	28.639486	12.585558	1.0000	18.0000	29.0000	37.000
total_rooms	20640.0	2635.763081	2181.615252	2.0000	1447.7500	2127.0000	3148.000
total_bedrooms	20640.0	537.870553	419.266592	1.0000	297.0000	438.0000	643.250
population	20640.0	1425.476744	1132.462122	3.0000	787.0000	1166.0000	1725.000
households	20640.0	499.539680	382.329753	1.0000	280.0000	409.0000	605.000
median_income	20640.0	3.870671	1.899822	0.4999	2.5634	3.5348	4.743
median_house_value	20640.0	206855.816909	115395.615874	14999.0000	119600.0000	179700.0000	264725.000

In [8]:
```python
import matplotlib.pyplot as plt
import seaborn as sns

# Set the style of the plots (optional)
sns.set(style="whitegrid")

# Create subplots for multiple histograms
fig, axes = plt.subplots(nrows=3, ncols=3, figsize=(16, 12))

# Plot histograms for numerical attributes
sns.histplot(df['longitude'], bins=50, ax=axes[0, 0], kde=True)
axes[0, 0].set_title('Longitude')

sns.histplot(df['latitude'], bins=50, ax=axes[0, 1], kde=True)
axes[0, 1].set_title('Latitude')

sns.histplot(df['housing_median_age'], bins=50, ax=axes[0, 2], kde=True)
axes[0, 2].set_title('Housing Median Age')

sns.histplot(df['total_rooms'], bins=50, ax=axes[1, 0], kde=True)
axes[1, 0].set_title('Total Rooms')

sns.histplot(df['total_bedrooms'].dropna(), bins=50, ax=axes[1, 1], kde=True)
axes[1, 1].set_title('Total Bedrooms')

sns.histplot(df['population'], bins=50, ax=axes[1, 2], kde=True)
axes[1, 2].set_title('Population')

sns.histplot(df['households'], bins=50, ax=axes[2, 0], kde=True)
axes[2, 0].set_title('Households')
```

```python
sns.histplot(df['median_income'], bins=50, ax=axes[2, 1], kde=True)
axes[2, 1].set_title('Median Income')

sns.histplot(df['median_house_value'], bins=50, ax=axes[2, 2], kde=True)
axes[2, 2].set_title('Median House Value')

# Adjust layout
plt.tight_layout()

# Show the histograms
plt.show()
```



In [9]:

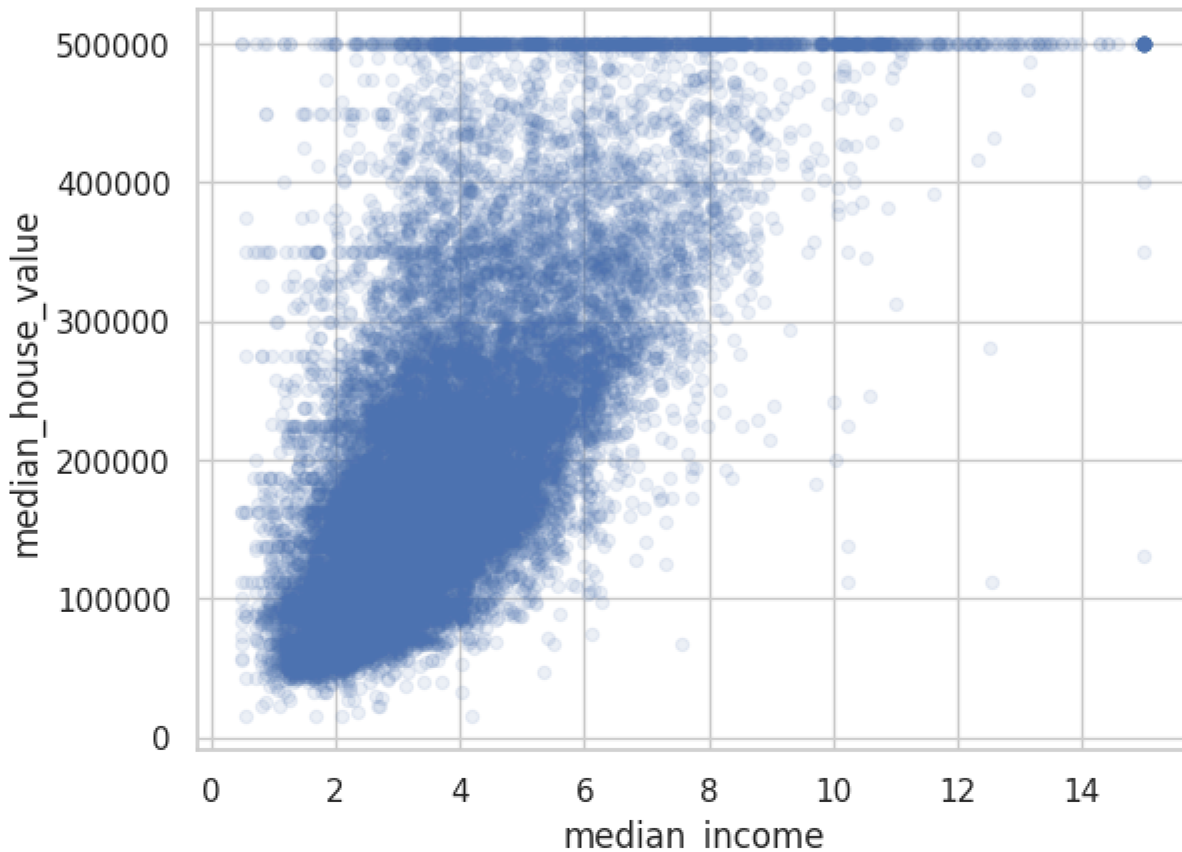
```python
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import OneHotEncoder, StandardScaler
from sklearn.compose import ColumnTransformer
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score


# Calculate correlations with respect to 'median_house_value' for numerical attributes
numerical_attributes = df.select_dtypes(include=['number'])
correlations = numerical_attributes.corr()
correlations_with_target = correlations["median_house_value"].sort_values(ascending=Fals

# Display the sorted correlations
print(correlations_with_target)
```

```
median_house_value    1.000000
median_income         0.688075
total_rooms           0.134153
```

```
housing_median_age    0.105623
households            0.065843
total_bedrooms        0.049454
population           -0.024650
longitude            -0.045967
latitude             -0.144160
Name: median_house_value, dtype: float64
```

In [10]:
```
df.plot(kind="scatter", x="median_income", y="median_house_value", alpha=0.1)
```

Out[10]:
```
<Axes: xlabel='median_income', ylabel='median_house_value'>
```



In [11]:
```
df["rooms_per_household"] = df["total_rooms"]/df["households"]
df["bedrooms_per_room"] = df["total_bedrooms"]/df["total_rooms"]
df["population_per_household"]=df["population"]/df["households"]
```

In [12]:
```
# Calculate correlations with respect to 'median_house_value' for numerical attributes
numerical_attributes = df.select_dtypes(include=['number'])
correlations = numerical_attributes.corr()
correlations_with_target = correlations["median_house_value"].sort_values(ascending=Fals

# Display the sorted correlations
print(correlations_with_target)
```

```
median_house_value          1.000000
median_income               0.688075
rooms_per_household         0.151948
total_rooms                 0.134153
housing_median_age          0.105623
households                  0.065843
total_bedrooms              0.049454
population_per_household   -0.023737
population                 -0.024650
longitude                  -0.045967
latitude                   -0.144160
bedrooms_per_room          -0.220049
Name: median_house_value, dtype: float64
```

In [13]:
```
# Copy the original dataset to create a clean dataset
df_clean = df.copy()

# Separate the predictors (features) and labels (target values)
housing_labels = df_clean["median_house_value"].copy()  # Labels
df_clean = df_clean.drop("median_house_value", axis=1)     # Predictors
```

In [14]:
```
# Replace missing values
imputer = SimpleImputer(strategy="median")
df_clean_numeric = df_clean.drop("ocean_proximity", axis=1)
imputer.fit(df_clean_numeric)
X = imputer.transform(df_clean_numeric)
df_clean_transformed = pd.DataFrame(X, columns=df_clean_numeric.columns)
```

In [15]:
```
# Encode categorical attributes
categorical_columns = ["ocean_proximity"]
column_transformer = ColumnTransformer(
    transformers=[("encoder", OneHotEncoder(), categorical_columns)],
    remainder="passthrough"
)
df_encoded = column_transformer.fit_transform(df_clean)
```

In [16]:
```
# Scale the features
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(df_encoded)

# Split the data into features (X) and the target variable (y)
X = X_train_scaled  # Use the scaled features
y = housing_labels  # Target variable

# Split the data into training (80%) and testing (20%) sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42
```

In [17]:
```
# Create a Linear Regression model
model = LinearRegression()

# Train the model on the training data
model.fit(X_train, y_train)
```

Out[17]:
```
LinearRegression

LinearRegression()
```

In [18]:
```
# Make predictions on the test set
y_pred = model.predict(X_test)

# Evaluate the model's performance
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f"Mean Squared Error: {mse:.2f}")
print(f"R-squared (R2) Score: {r2:.2f}")
```

```
Mean Squared Error: 5569121311.08
R-squared (R2) Score: 0.58
```

In [19]:
```
from sklearn.metrics import mean_absolute_error
from sklearn.metrics import explained_variance_score

mae = mean_absolute_error(y_test, y_pred)
rmse = np.sqrt(mse)
explained_variance = explained_variance_score(y_test, y_pred)
print(f"Mean Absolute Error: {mae:.2f}")
```

```
print(f"Root Mean Squared Error: {rmse:.2f}")
print(f"Explained Variance Score: {explained_variance:.2f}")
```

```
Mean Absolute Error: 51511.95
Root Mean Squared Error: 74626.55
Explained Variance Score: 0.58
```

In [20]:

```
from sklearn.model_selection import GridSearchCV
from sklearn.ensemble import RandomForestRegressor


# Define the parameter grid
param_grid = {
    'n_estimators': [50, 100, 200],  # Number of trees (for Random Forest)
    'max_depth': [10, 20, 30],      # Maximum depth of trees
    'min_samples_split': [2, 5, 10],  # Minimum samples required to split a node
    'min_samples_leaf': [1, 2, 4],    # Minimum samples required at a leaf node
}

# Create the GridSearchCV object
grid_search = GridSearchCV(estimator=RandomForestRegressor(random_state=42),
                           param_grid=param_grid,
                           scoring='neg_mean_squared_error',  # Use MSE as the scoring m
                           cv=5)  # 5-fold cross-validation

# Fit the grid search to your data
grid_search.fit(X_train, y_train)

# Get the best hyperparameters
best_params = grid_search.best_params_
print("Best Hyperparameters:", best_params)

# Get the best model
best_model = grid_search.best_estimator_

# Evaluate the best model on the test set
y_pred_best = best_model.predict(X_test)
mse_best = mean_squared_error(y_test, y_pred_best)
r2_best = r2_score(y_test, y_pred_best)
print(f"Best Model Mean Squared Error: {mse_best:.2f}")
print(f"Best Model R-squared (R2) Score: {r2_best:.2f}")
```

```
Best Hyperparameters: {'max_depth': 30, 'min_samples_leaf': 2, 'min_samples_split': 2,
'n_estimators': 200}
Best Model Mean Squared Error: 2457965223.27
Best Model R-squared (R2) Score: 0.81
```