

Import Libraries

```
In [1]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import calendar
from pandas.api.types import CategoricalDtype
from sklearn.preprocessing import StandardScaler
```

Data Loading

```
In [3]: train_data_path=r"C:\Users\pc_planet\Desktop\AI\House-Price-Prediction-master\House-Price-Prediction-master\ML_I
test_data_path=r"C:\Users\pc_planet\Desktop\AI\House-Price-Prediction-master\House-Price-Prediction-master\ML_Mi

df_train=pd.read_csv(train_data_path)
df_test=pd.read_csv(test_data_path)

print(df_train.shape)
print(df_test.shape)

(1460, 81)
(1459, 80)
```

Data Analysis

```
In [5]: pd.set_option('display.max_columns',None) #to display all columns
pd.set_option('display.max_rows',None) #to display all rows
```

```
In [7]: df_train.head()
```

```
Out[7]:
```

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	LotConfig	LandSlope	Neigh
0	1	60	RL	65.0	8450	Pave	NaN	Reg	Lvl	AllPub	Inside	Gtl	
1	2	20	RL	80.0	9600	Pave	NaN	Reg	Lvl	AllPub	FR2	Gtl	
2	3	60	RL	68.0	11250	Pave	NaN	IR1	Lvl	AllPub	Inside	Gtl	
3	4	70	RL	60.0	9550	Pave	NaN	IR1	Lvl	AllPub	Corner	Gtl	
4	5	60	RL	84.0	14260	Pave	NaN	IR1	Lvl	AllPub	FR2	Gtl	

```
In [9]: df_test.head()
```

```
Out[9]:
```

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	LotConfig	LandSlope	Ne
0	1461	20	RH	80.0	11622	Pave	NaN	Reg	Lvl	AllPub	Inside	Gtl	
1	1462	20	RL	81.0	14267	Pave	NaN	IR1	Lvl	AllPub	Corner	Gtl	
2	1463	60	RL	74.0	13830	Pave	NaN	IR1	Lvl	AllPub	Inside	Gtl	
3	1464	60	RL	78.0	9978	Pave	NaN	IR1	Lvl	AllPub	Inside	Gtl	
4	1465	120	RL	43.0	5005	Pave	NaN	IR1	HLS	AllPub	Inside	Gtl	

data integration

```
In [11]: df=pd.concat((df_train,df_test))
temp_df=df
print(df.shape)

(2919, 81)
```

```
In [13]: df.head()
```

Out[13]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	LotConfig	LandSlope	Neig
0	1	60	RL	65.0	8450	Pave	NaN	Reg		Lvl	AllPub	Inside	Gtl
1	2	20	RL	80.0	9600	Pave	NaN	Reg		Lvl	AllPub	FR2	Gtl
2	3	60	RL	68.0	11250	Pave	NaN	IR1		Lvl	AllPub	Inside	Gtl
3	4	70	RL	60.0	9550	Pave	NaN	IR1		Lvl	AllPub	Corner	Gtl
4	5	60	RL	84.0	14260	Pave	NaN	IR1		Lvl	AllPub	FR2	Gtl

In [15]:

df.tail()

Out[15]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	LotConfig	LandSlope	
	1454	2915	160	RM	21.0	1936	Pave	NaN	Reg	Lvl	AllPub	Inside	Gtl
	1455	2916	160	RM	21.0	1894	Pave	NaN	Reg	Lvl	AllPub	Inside	Gtl
	1456	2917	20	RL	160.0	20000	Pave	NaN	Reg	Lvl	AllPub	Inside	Gtl
	1457	2918	85	RL	62.0	10441	Pave	NaN	Reg	Lvl	AllPub	Inside	Gtl
	1458	2919	60	RL	74.0	9627	Pave	NaN	Reg	Lvl	AllPub	Inside	Mod

Exploratory data analysis

In [17]:

df.info()

```
<class 'pandas.core.frame.DataFrame'>
Index: 2919 entries, 0 to 1458
Data columns (total 81 columns):
#   Column              Non-Null Count  Dtype
---  -
0   Id                   2919 non-null  int64
1   MSSubClass           2919 non-null  int64
2   MSZoning              2915 non-null  object
3   LotFrontage          2433 non-null  float64
4   LotArea              2919 non-null  int64
5   Street               2919 non-null  object
6   Alley                198 non-null   object
7   LotShape             2919 non-null  object
8   LandContour          2919 non-null  object
9   Utilities            2917 non-null  object
10  LotConfig            2919 non-null  object
11  LandSlope            2919 non-null  object
12  Neighborhood         2919 non-null  object
13  Condition1           2919 non-null  object
14  Condition2           2919 non-null  object
15  BldgType             2919 non-null  object
16  HouseStyle           2919 non-null  object
17  OverallQual          2919 non-null  int64
18  OverallCond          2919 non-null  int64
19  YearBuilt            2919 non-null  int64
20  YearRemodAdd         2919 non-null  int64
21  RoofStyle            2919 non-null  object
22  RoofMatl             2919 non-null  object
23  Exterior1st          2918 non-null  object
24  Exterior2nd          2918 non-null  object
25  MasVnrType           1153 non-null  object
26  MasVnrArea           2896 non-null  float64
27  ExterQual            2919 non-null  object
28  ExterCond            2919 non-null  object
29  Foundation           2919 non-null  object
30  BsmtQual             2838 non-null  object
31  BsmtCond             2837 non-null  object
32  BsmtExposure         2837 non-null  object
33  BsmtFinType1         2840 non-null  object
34  BsmtFinSF1           2918 non-null  float64
35  BsmtFinType2         2839 non-null  object
36  BsmtFinSF2           2918 non-null  float64
37  BsmtUnfSF            2918 non-null  float64
38  TotalBsmtSF          2918 non-null  float64
39  Heating              2919 non-null  object
40  HeatingQC            2919 non-null  object
41  CentralAir           2919 non-null  object
42  Electrical            2918 non-null  object
43  1stFlrSF             2919 non-null  int64
44  2ndFlrSF             2919 non-null  int64
45  LowQualFinSF         2919 non-null  int64
46  GrLivArea            2919 non-null  int64
```

```

47 BsmFullBath      2917 non-null float64
48 BsmHalfBath     2917 non-null float64
49 FullBath        2919 non-null int64
50 HalfBath        2919 non-null int64
51 BedroomAbvGr    2919 non-null int64
52 KitchenAbvGr    2919 non-null int64
53 KitchenQual     2918 non-null object
54 TotRmsAbvGrd    2919 non-null int64
55 Functional       2917 non-null object
56 Fireplaces      2919 non-null int64
57 FireplaceQu     1499 non-null object
58 GarageType      2762 non-null object
59 GarageYrBlt     2760 non-null float64
60 GarageFinish    2760 non-null object
61 GarageCars      2918 non-null float64
62 GarageArea      2918 non-null float64
63 GarageQual      2760 non-null object
64 GarageCond      2760 non-null object
65 PavedDrive      2919 non-null object
66 WoodDeckSF      2919 non-null int64
67 OpenPorchSF     2919 non-null int64
68 EnclosedPorch   2919 non-null int64
69 3SsnPorch       2919 non-null int64
70 ScreenPorch     2919 non-null int64
71 PoolArea        2919 non-null int64
72 PoolQC          10 non-null object
73 Fence           571 non-null object
74 MiscFeature     105 non-null object
75 MiscVal         2919 non-null int64
76 MoSold          2919 non-null int64
77 YrSold          2919 non-null int64
78 SaleType        2918 non-null object
79 SaleCondition   2919 non-null object
80 SalePrice       1460 non-null float64

```

```

dtypes: float64(12), int64(26), object(43)
memory usage: 1.8+ MB

```

```
In [19]: df.describe()
```

```
Out[19]:
```

	Id	MSSubClass	LotFrontage	LotArea	OverallQual	OverallCond	YearBuilt	YearRemodAdd	MasVnrArea
count	2919.000000	2919.000000	2433.000000	2919.000000	2919.000000	2919.000000	2919.000000	2919.000000	2896.000000
mean	1460.000000	57.137718	69.305795	10168.114080	6.089072	5.564577	1971.312778	1984.264474	102.201311
std	842.787043	42.517628	23.344905	7886.996359	1.409947	1.113131	30.291442	20.894344	179.334251
min	1.000000	20.000000	21.000000	1300.000000	1.000000	1.000000	1872.000000	1950.000000	0.000000
25%	730.500000	20.000000	59.000000	7478.000000	5.000000	5.000000	1953.500000	1965.000000	0.000000
50%	1460.000000	50.000000	68.000000	9453.000000	6.000000	5.000000	1973.000000	1993.000000	0.000000
75%	2189.500000	70.000000	80.000000	11570.000000	7.000000	6.000000	2001.000000	2004.000000	164.000000
max	2919.000000	190.000000	313.000000	215245.000000	10.000000	9.000000	2010.000000	2010.000000	1600.000000

```
In [21]: int_feature=df.select_dtypes(include=['int64']).columns
```

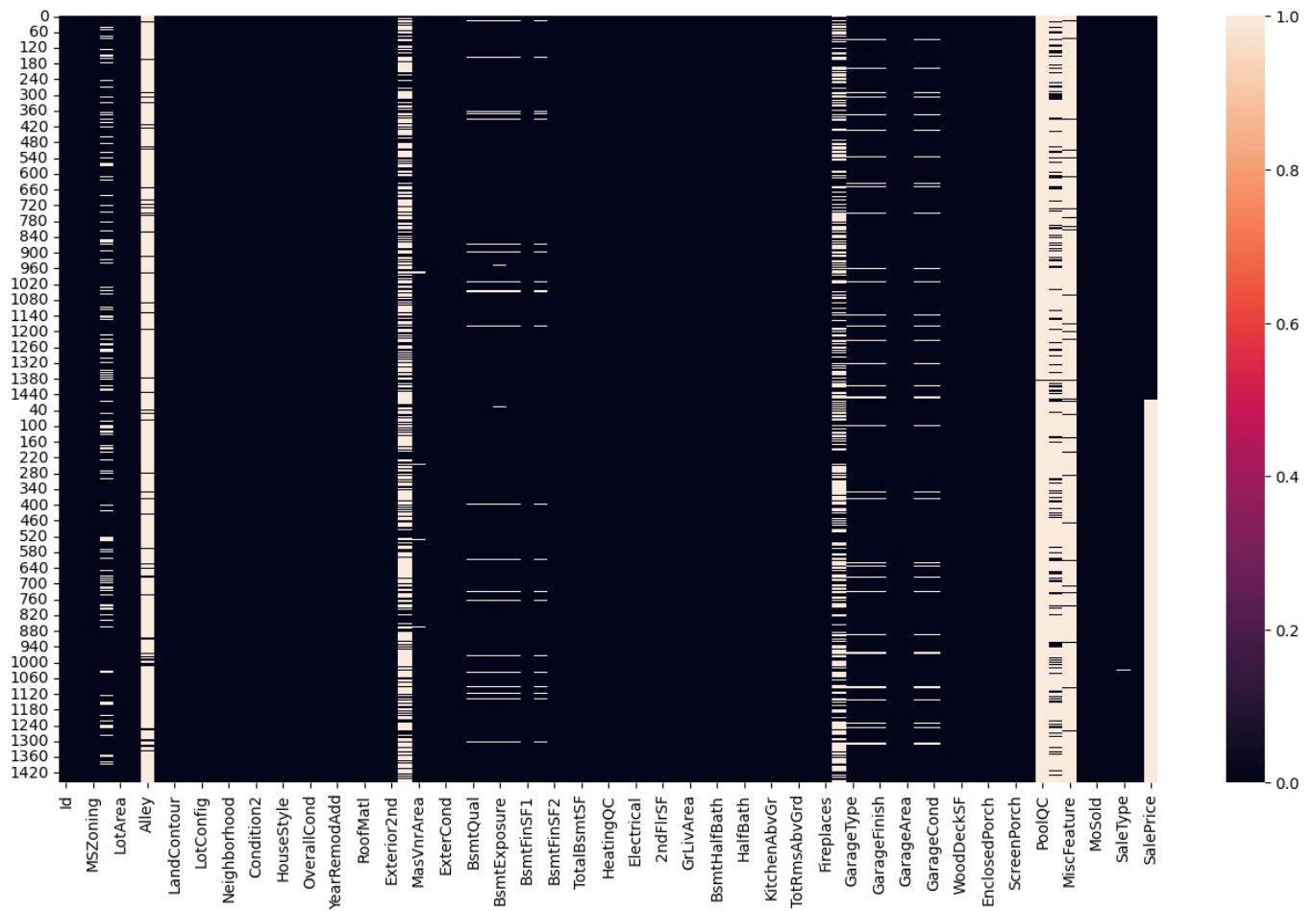
```
In [23]: float_feature=df.select_dtypes(include=['float64']).columns
```

```
In [25]: cat_feature=df.select_dtypes(include=['object']).columns
```

visualing missing value

```
In [27]: plt.figure(figsize=(16,9))
sns.heatmap(df.isnull())
```

```
Out[27]: <Axes: >
```



```
In [29]: # set index as is column
df=df.set_index("Id")
```

get the null value percentage for every feature

```
In [31]: null_count=df.isnull().sum()
null_count
```

```

Out[31]: MSSubClass      0
         MSZoning        4
         LotFrontage    486
         LotArea        0
         Street         0
         Alley         2721
         LotShape       0
         LandContour    0
         Utilities      2
         LotConfig      0
         LandSlope      0
         Neighborhood   0
         Condition1     0
         Condition2     0
         BldgType       0
         HouseStyle     0
         OverallQual    0
         OverallCond    0
         YearBuilt      0
         YearRemodAdd   0
         RoofStyle      0
         RoofMatl       0
         Exterior1st    1
         Exterior2nd    1
         MasVnrType     1766
         MasVnrArea     23
         ExterQual      0
         ExterCond      0
         Foundation     0
         BsmtQual       81
         BsmtCond       82
         BsmtExposure   82
         BsmtFinType1   79
         BsmtFinSF1     1
         BsmtFinType2   80
         BsmtFinSF2     1
         BsmtUnfSF      1
         TotalBsmtSF    1
         Heating        0
         HeatingQC      0
         CentralAir     0
         Electrical     1
         1stFlrSF       0
         2ndFlrSF       0
         LowQualFinSF   0
         GrLivArea      0
         BsmtFullBath    2
         BsmtHalfBath    2
         FullBath       0
         HalfBath       0
         BedroomAbvGr   0
         KitchenAbvGr   0
         KitchenQual     1
         TotRmsAbvGrd   0
         Functional     2
         Fireplaces     0
         FireplaceQu    1420
         GarageType     157
         GarageYrBlt    159
         GarageFinish   159
         GarageCars     1
         GarageArea     1
         GarageQual     159
         GarageCond     159
         PavedDrive     0
         WoodDeckSF     0
         OpenPorchSF    0
         EnclosedPorch   0
         3SsnPorch      0
         ScreenPorch    0
         PoolArea       0
         PoolQC         2909
         Fence          2348
         MiscFeature     2814
         MiscVal        0
         MoSold         0
         YrSold         0
         SaleType       1
         SaleCondition   0
         SalePrice      1459
         dtype: int64

```

```

In [33]: null_percent=df.isnull().sum()/df.shape[0]*100

```

null_percent

```
Out[33]: MSSubClass      0.000000
          MSZoning       0.137033
          LotFrontage    16.649538
          LotArea        0.000000
          Street         0.000000
          Alley          93.216855
          LotShape       0.000000
          LandContour    0.000000
          Utilities      0.068517
          LotConfig      0.000000
          LandSlope      0.000000
          Neighborhood   0.000000
          Condition1     0.000000
          Condition2     0.000000
          BldgType       0.000000
          HouseStyle     0.000000
          OverallQual    0.000000
          OverallCond    0.000000
          YearBuilt      0.000000
          YearRemodAdd   0.000000
          RoofStyle      0.000000
          RoofMatl       0.000000
          Exterior1st    0.034258
          Exterior2nd    0.034258
          MasVnrType     60.500171
          MasVnrArea     0.787941
          ExterQual      0.000000
          ExterCond      0.000000
          Foundation     0.000000
          BsmtQual       2.774923
          BsmtCond       2.809181
          BsmtExposure   2.809181
          BsmtFinType1   2.706406
          BsmtFinSF1     0.034258
          BsmtFinType2   2.740665
          BsmtFinSF2     0.034258
          BsmtUnfSF      0.034258
          TotalBsmtSF    0.034258
          Heating        0.000000
          HeatingQC      0.000000
          CentralAir     0.000000
          Electrical     0.034258
          1stFlrSF       0.000000
          2ndFlrSF       0.000000
          LowQualFinSF   0.000000
          GrLivArea      0.000000
          BsmtFullBath   0.068517
          BsmtHalfBath   0.068517
          FullBath       0.000000
          HalfBath       0.000000
          BedroomAbvGr   0.000000
          KitchenAbvGr   0.000000
          KitchenQual    0.034258
          TotRmsAbvGrd   0.000000
          Functional     0.068517
          Fireplaces     0.000000
          FireplaceQu    48.646797
          GarageType     5.378554
          GarageYrBltd   5.447071
          GarageFinish    5.447071
          GarageCars     0.034258
          GarageArea     0.034258
          GarageQual     5.447071
          GarageCond     5.447071
          PavedDrive     0.000000
          WoodDeckSF     0.000000
          OpenPorchSF    0.000000
          EnclosedPorch   0.000000
          3SsnPorch      0.000000
          ScreenPorch    0.000000
          PoolArea       0.000000
          PoolQC         99.657417
          Fence          80.438506
          MiscFeature     96.402878
          MiscVal        0.000000
          MoSold         0.000000
          YrSold         0.000000
          SaleType       0.034258
          SaleCondition   0.000000
          SalePrice      49.982871
          dtype: float64
```

drop column/features

```
In [35]: """ as per domain knowldge we will not drop this feature rather we add some constant value 'NA' """
miss_value_50_perc=null_percent>null_percent>50]
miss_value_50_perc
```

```
Out[35]: Alley          93.216855
MasVnrType      60.500171
PoolQC          99.657417
Fence           80.438506
MiscFeature     96.402878
dtype: float64
```

```
In [37]: """ as per domain knowldge we will not drop this feature rather we add some constant value 'NA' """
miss_value_20_50_perc=null_percent[(null_percent>20)& (null_percent<51)]
miss_value_20_50_perc
```

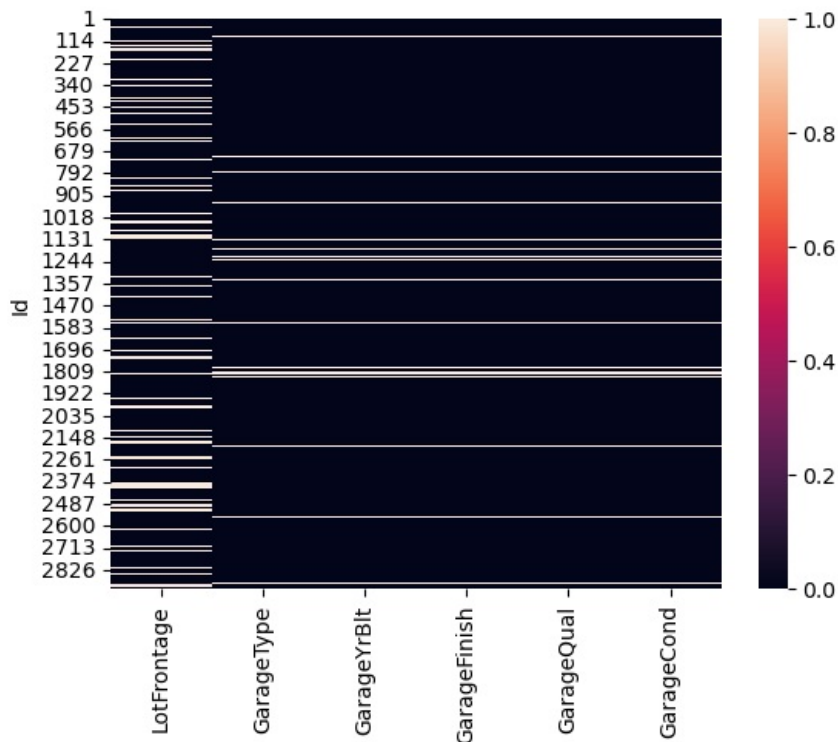
```
Out[37]: FireplaceQu    48.646797
SalePrice              49.982871
dtype: float64
```

```
In [39]: miss_value_5_20_perc=null_percent[(null_percent>5)& (null_percent<21)]
miss_value_5_20_perc
```

```
Out[39]: LotFrontage    16.649538
GarageType             5.378554
GarageYrBlt           5.447071
GarageFinish           5.447071
GarageQual             5.447071
GarageCond             5.447071
dtype: float64
```

```
In [41]: sns.heatmap(df[miss_value_5_20_perc.keys()].isnull())
```

```
Out[41]: <Axes: ylabel='Id'>
```



```
In [22]: ## as per observation we will not drop any feature from data set
```

missing value imputation

```
In [43]: missing_value_feat=null_percent>null_percent>0]
print("Total missing value feature=",len(missing_value_feat))
missing_value_feat
```

Total missing value feature= 35

```
Out[43]: MSZoning      0.137033
         LotFrontage  16.649538
         Alley       93.216855
         Utilities   0.068517
         Exterior1st  0.034258
         Exterior2nd  0.034258

         MasVnrType   60.500171
         MasVnrArea   0.787941
         BsmtQual     2.774923
         BsmtCond     2.809181
         BsmtExposure 2.809181
         BsmtFinType1 2.706406
         BsmtFinSF1   0.034258
         BsmtFinType2 2.740665
         BsmtFinSF2   0.034258
         BsmtUnfSF    0.034258
         TotalBsmtSF  0.034258
         Electrical   0.034258
         BsmtFullBath  0.068517
         BsmtHalfBath 0.068517
         KitchenQual  0.034258
         Functional   0.068517
         FireplaceQu  48.646797
         GarageType    5.378554
         GarageYrBlt   5.447071
         GarageFinish  5.447071
         GarageCars    0.034258
         GarageArea    0.034258
         GarageQual    5.447071
         GarageCond    5.447071
         PoolQC       99.657417
         Fence        80.438506
         MiscFeature   96.402878
         SaleType      0.034258
         SalePrice    49.982871
         dtype: float64
```

```
In [45]: cat_na_feat=missing_value_feat[missing_value_feat.keys().isin(cat_feature)]
         print("total number of categorical missing feature",len(cat_na_feat))
         cat_na_feat
```

total number of categorical missing feature 23

```
Out[45]: MSZoning      0.137033
         Alley       93.216855
         Utilities   0.068517
         Exterior1st  0.034258
         Exterior2nd  0.034258
         MasVnrType   60.500171
         BsmtQual     2.774923
         BsmtCond     2.809181
         BsmtExposure 2.809181
         BsmtFinType1 2.706406
         BsmtFinType2 2.740665
         Electrical   0.034258
         KitchenQual  0.034258
         Functional   0.068517
         FireplaceQu  48.646797
         GarageType    5.378554
         GarageFinish  5.447071
         GarageQual    5.447071
         GarageCond    5.447071
         PoolQC       99.657417
         Fence        80.438506
         MiscFeature   96.402878
         SaleType      0.034258
         dtype: float64
```

```
In [47]: int_na_feat=missing_value_feat[missing_value_feat.keys().isin(int_feature)]
         print("total number of int missing feature",len(int_na_feat))
         int_na_feat
```

total number of int missing feature 0

```
Out[47]: Series([], dtype: float64)
```

```
In [49]: float_na_feat=missing_value_feat[missing_value_feat.keys().isin(float_feature)]
         print("total number of float missing feature",len(float_na_feat))
         float_na_feat
```

total number of float missing feature 12


```
Out[49]: LotFrontage    16.649538
MasVnrArea      0.787941
BsmtFinSF1      0.034258

BsmtFinSF2      0.034258
BsmtUnfSF       0.034258
TotalBsmtSF     0.034258
BsmtFullBath    0.068517
BsmtHalfBath    0.068517
GarageYrBlt     5.447071
GarageCars      0.034258
GarageArea      0.034258
SalePrice      49.982871
dtype: float64
```

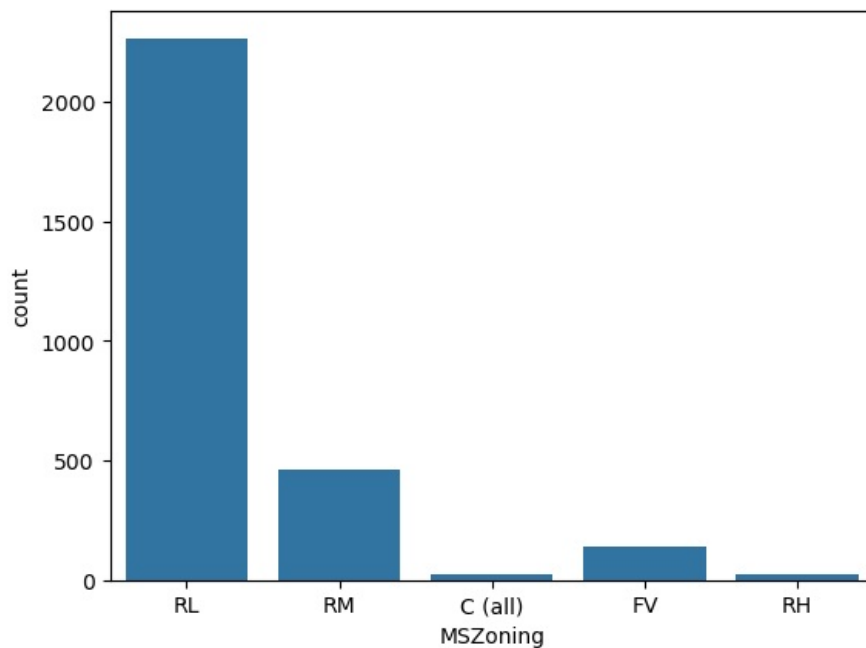
```
In [51]: ## funtion to visualize data feature before and after imputation of missing value
def plot_data(df, df_new, feature):
    plt.subplot(121)
    sns.countplot(x=feature, data=df)
    plt.title("Before Imputation")
    plt.subplot(122)
    sns.countplot(x=feature, data=df_new)
    plt.title("After Imputation")
    plt.show()
```

```
In [53]: ### handling MSZoning=0.137033

df["MSZoning"].value_counts()

# count plot in graph form
sns.countplot(x=df["MSZoning"])
```

```
Out[53]: <Axes: xlabel='MSZoning', ylabel='count'>
```

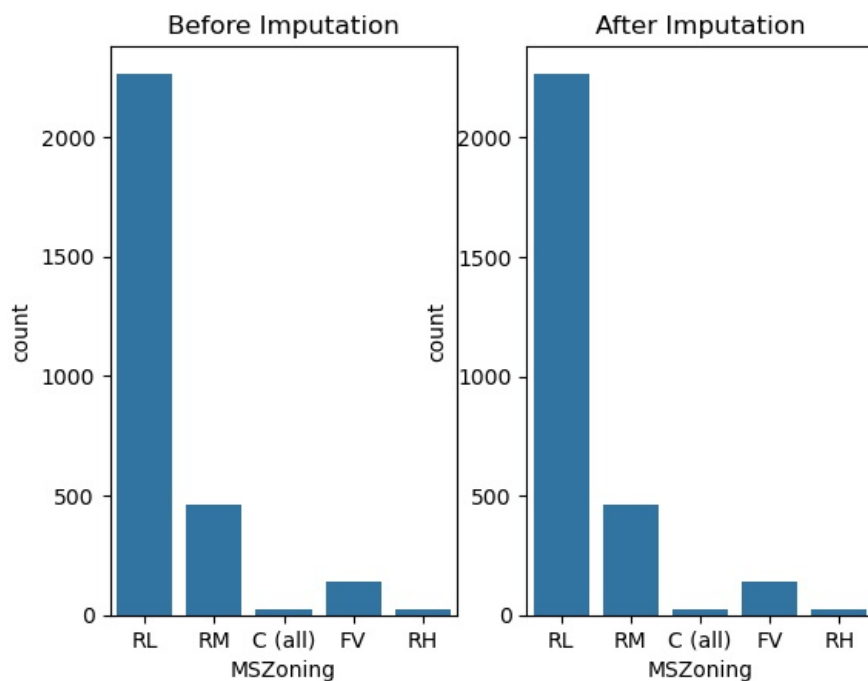


```
In [55]: ## backing up original data frame
df_mvi=df.copy()
```

```
In [59]: # as we can see here RL is the mode for this feature
mszoning_mode=df["MSZoning"].mode()[0]
mszoning_mode
df_mvi["MSZoning"] = df_mvi["MSZoning"].replace(np.nan, mszoning_mode)
# now chcek do we have any missinf vLUE
df_mvi["MSZoning"].isnull().sum()
```

```
Out[59]: 0
```

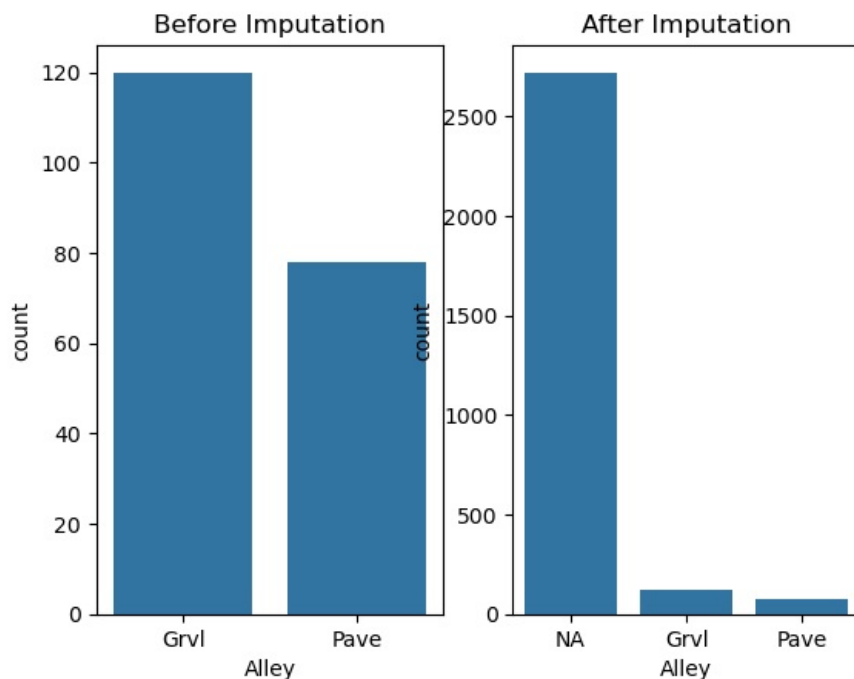
```
In [61]: #compare before and after imputation
feature="MSZoning"
plot_data(df,df_mvi,feature)
```



```
In [65]: ## handling alley = 93.216855

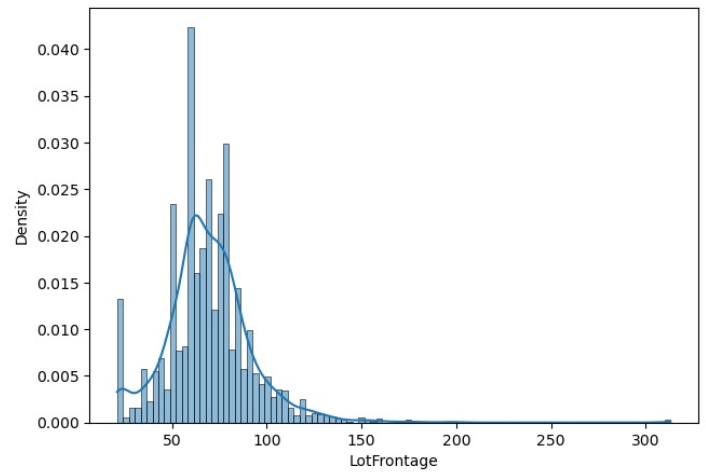
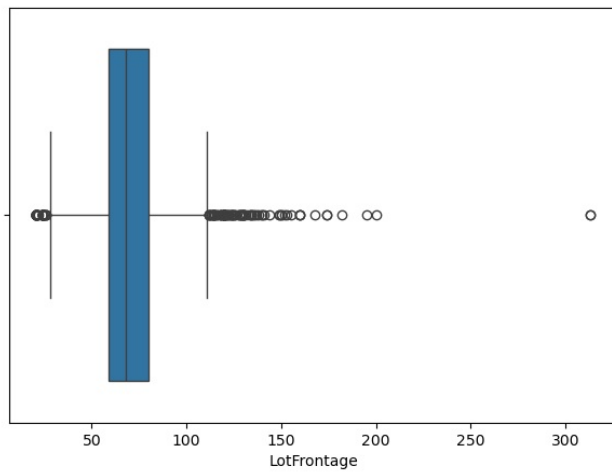
df_mvi["Alley"].value_counts()
alley_cont="NA"
df_mvi["Alley"] = df_mvi["Alley"].replace(np.nan, alley_cont) # Replace missing value with 'NA'
# replace missing value with 'NA'
df_mvi["Alley"].isnull().sum()

# compare before and after imputation
plot_data(df,df_mvi,"Alley")
```



```
In [67]: #LotFrontage=16.649538
def boxHistPlot(df,feature, figsize=(16,5)):
    plt.figure(figsize=figsize)
    plt.subplot(121)
    sns.boxplot(x=feature, data=df)
    plt.subplot(122)
    sns.histplot(x=feature,data=df,stat="density", kde=True)
    plt.show()
```

```
In [69]: boxHistPlot(df,"LotFrontage")
```

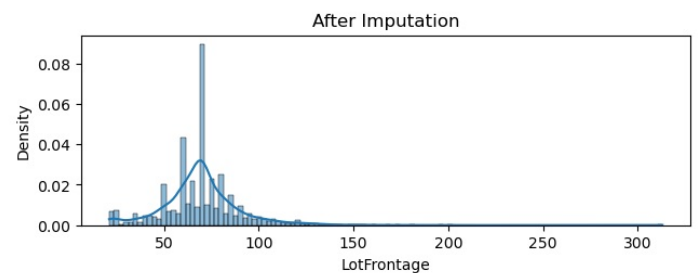
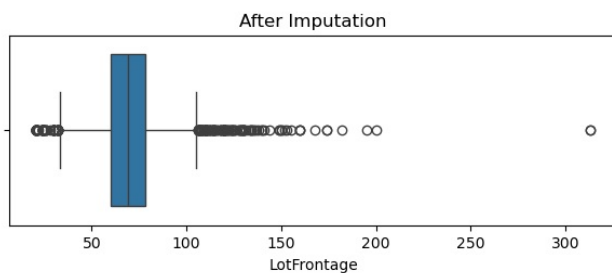
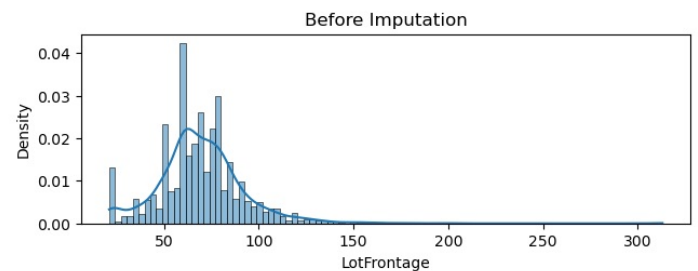
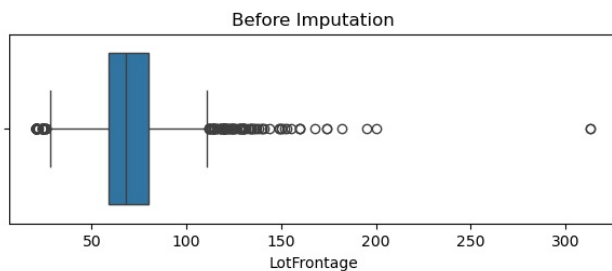


```
In [73]: lotfrontage_mean=df["LotFrontage"].mean()
# lotfrontage_mean
df_mvi["LotFrontage"] = df_mvi["LotFrontage"].replace(np.nan, lotfrontage_mean)
df_mvi["LotFrontage"].isnull().sum()
```

Out[73]: 0

```
In [75]: # compare old and new box hist plot after imputation
def oldNewBoxHistPlot(df,df_new,feature, figsize=(16,5)):
    plt.figure(figsize=figsize)
    plt.subplot(221)
    sns.boxplot(x=feature, data=df)
    plt.title("Before Imputation")
    plt.subplot(222)
    sns.histplot(x=feature,data=df,stat="density", kde=True)
    plt.title("Before Imputation")
    plt.figure(figsize=figsize)
    plt.subplot(223)
    sns.boxplot(x=feature, data=df_new)
    plt.title("After Imputation")
    plt.subplot(224)
    sns.histplot(x=feature,data=df_new,stat="density", kde=True)
    plt.title("After Imputation")
    plt.show()

oldNewBoxHistPlot(df,df_mvi,"LotFrontage")
```



```
In [79]: ## handling utility
df["Utilities"].value_counts()
utility_const=df["Utilities"].mode()[0]
df_mvi["Utilities"] = df_mvi["Utilities"].replace(np.nan, utility_const)
df_mvi["Utilities"].isnull().sum()
```

Out[79]: 0

```
In [81]: # Exterior1st      0.034258
# Exterior2nd      0.034258
# both are object type

print(df["Exterior1st"].value_counts())
print("-----")
```

```
print(df["Exterior2nd"].value_counts())
```

```
Exterior1st
VinylSd      1025
MetalSd       450
HdBoard       442
Wd Sdng       411
Plywood       221
CemntBd       126
BrkFace        87
WdShng        56
AsbShng       44
Stucco         43
BrkComm         6
AsphShn        2
Stone          2
CBlock         2
ImStucc        1
Name: count, dtype: int64
```

```
-----
Exterior2nd
VinylSd      1014
MetalSd       447
HdBoard       406
Wd Sdng       391
Plywood       270
CmentBd       126
Wd Shng        81
BrkFace        47
Stucco         47
AsbShng       38
Brk Cmn        22
ImStucc        15
Stone          6
AsphShn        4
CBlock         3
Other          1
Name: count, dtype: int64
```

```
In [85]: exterior_1_const=df["Exterior1st"].mode()[0]
df_mvi["Exterior1st"] = df_mvi["Exterior1st"].replace(np.nan, exterior_1_const)
df_mvi["Exterior1st"].isnull().sum()
```

```
Out[85]: 0
```

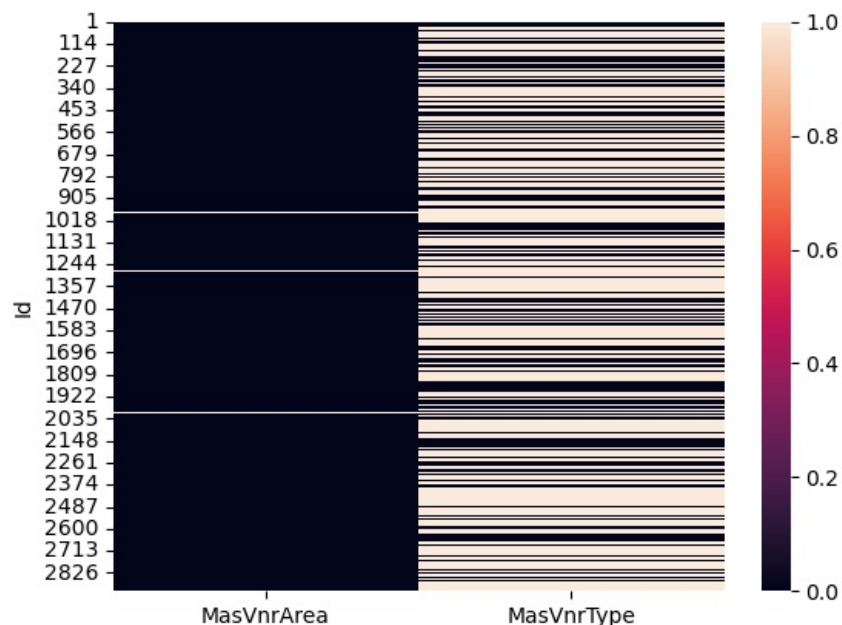
```
In [87]: exterior_2_const=df["Exterior2nd"].mode()[0]
df_mvi["Exterior2nd"] = df_mvi["Exterior2nd"].replace(np.nan, exterior_2_const)
df_mvi["Exterior2nd"].isnull().sum()
```

```
Out[87]: 0
```

```
In [89]: # MasVnrType      0.822199
# MasVnrArea      0.787941

sns.heatmap(df[["MasVnrArea", "MasVnrType"]].isnull())
```

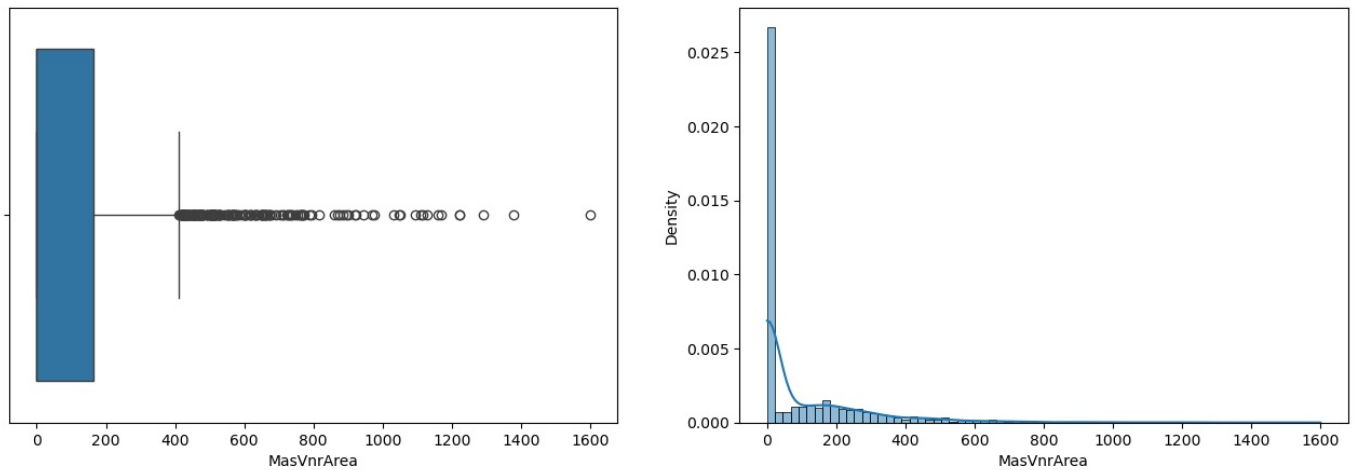
```
Out[89]: <Axes: ylabel='Id'>
```



```
In [91]: mas_vnr_type_const=df["MasVnrType"].mode()[0]
df_mvi["MasVnrType"] = df_mvi["MasVnrType"].replace(np.nan, mas_vnr_type_const)
df_mvi["MasVnrType"].isnull().sum()
```

Out[91]: 0

```
In [93]: boxHistPlot(df,"MasVnrArea")
```



```
In [95]: mas_vnr_area_const=0# as we can see the mode is 0 in above plots
df_mvi["MasVnrArea"] = df_mvi["MasVnrArea"].replace(np.nan, mas_vnr_area_const)
df_mvi["MasVnrArea"].isnull().sum()
```

Out[95]: 0

```
In [97]: ### handling basement
## categorical
# BsmtQual      2.774923
# BsmtCond      2.809181
# BsmtExposure  2.809181
# BsmtFinType1  2.706406
# BsmtFinType2  2.740665

## numerical
# BsmtFinSF1    0.034258
# BsmtFinSF2    0.034258
# BsmtUnfSF     0.034258
# TotalBsmtSF   0.034258
# BsmtFullBath  0.068517
# BsmtHalfBath  0.068517

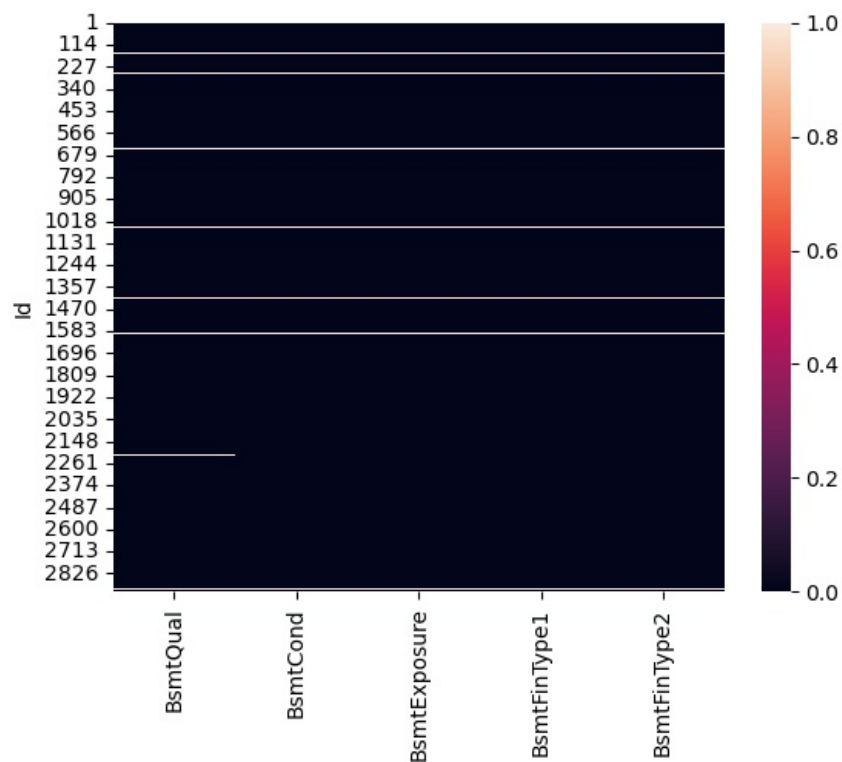
cat_bsmt_feat=["BsmtQual","BsmtCond","BsmtExposure","BsmtFinType1","BsmtFinType2"]
num_bsmt_feat=["BsmtFinSF1","BsmtFinSF2","BsmtUnfSF","TotalBsmtSF","BsmtFullBath","BsmtHalfBath"]

sns.heatmap(df[cat_bsmt_feat].isnull()) # check missing values in categorical features
for feat in cat_bsmt_feat:
    print(df[feat].value_counts())
    print("-----")
```

```

BsmtQual
TA    1283
Gd    1209
Ex     258
Fa     88
Name: count, dtype: int64
----
BsmtCond
TA    2606
Gd    122
Fa    104
Po     5
Name: count, dtype: int64
----
BsmtExposure
No    1904
Av     418
Gd     276
Mn     239
Name: count, dtype: int64
----
BsmtFinType1
Unf    851
GLQ    849
ALQ    429
Rec    288
BLQ    269
LwQ    154
Name: count, dtype: int64
----
BsmtFinType2
Unf    2493
Rec    105
LwQ     87
BLQ     68
ALQ     52
GLQ     34
Name: count, dtype: int64
----

```



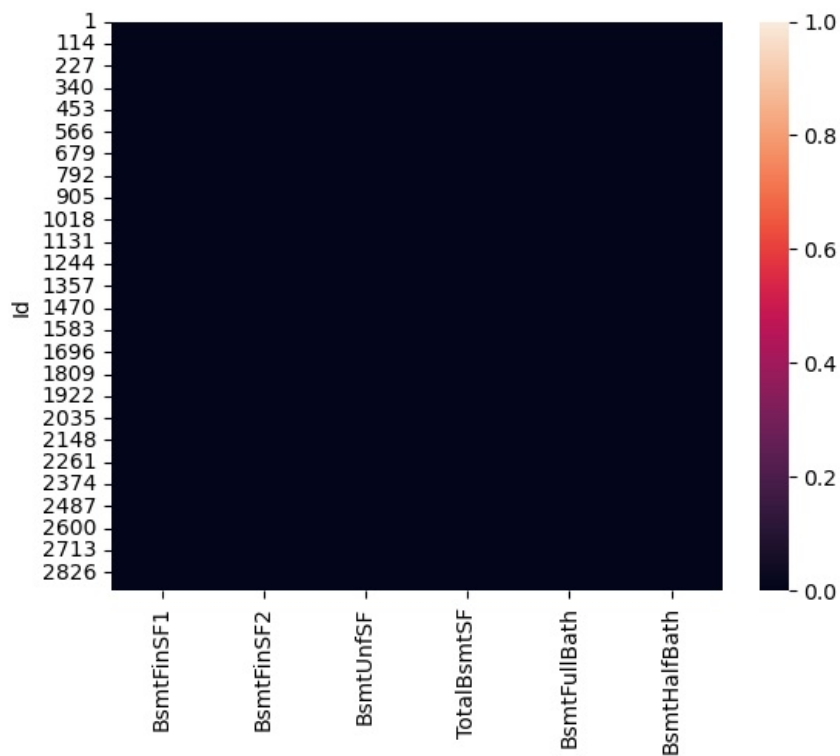
```

In [101.. bsmt_cont="NA"
for feat in cat_bsmt_feat:
    df_mvi[feat] = df_mvi[feat].replace(np.nan, bsmt_cont)

In [103.. sns.heatmap(df[num_bsmt_feat].isnull()) # check missing values in numerical features

Out[103.. <Axes: ylabel='Id'>

```



```
In [105... # analysing basement feature
df_bsmt=df[cat_bsmt_feat+num_bsmt_feat]
df_bsmt[df_bsmt.isnull().any(axis=1)]
```

Id	BsmtQual	BsmtCond	BsmtExposure	BsmtFinType1	BsmtFinType2	BsmtFinSF1	BsmtFinSF2	BsmtUnfSF	TotalBsmtSF	B
18	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
40	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
91	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
103	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
157	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
183	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
260	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
333	Gd	TA	No	GLQ	NaN	1124.0	479.0	1603.0	3206.0	
343	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
363	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
372	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
393	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
521	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
533	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
534	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
554	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
647	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
706	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
737	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
750	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
779	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
869	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
895	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	
898	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0	

949	Gd	TA	NaN	Unf	Unf	0.0	0.0	936.0	936.0
985	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1001	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1012	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1036	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1046	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1049	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1050	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1091	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1180	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1217	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1219	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1233	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1322	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1413	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1488	Gd	TA	NaN	Unf	Unf	0.0	0.0	1595.0	1595.0
1586	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1594	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1730	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1779	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1815	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1848	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1849	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1857	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1858	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1859	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1861	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
1916	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2041	Gd	NaN	Mn	GLQ	Rec	1044.0	382.0	0.0	1426.0
2051	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2067	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2069	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2121	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2123	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2186	TA	NaN	No	BLQ	Unf	1033.0	0.0	94.0	1127.0
2189	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2190	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2191	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2194	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2217	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2218	NaN	Fa	No	Unf	Unf	0.0	0.0	173.0	173.0
2219	NaN	TA	No	Unf	Unf	0.0	0.0	356.0	356.0
2225	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2349	Gd	TA	NaN	Unf	Unf	0.0	0.0	725.0	725.0
2388	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2436	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2453	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2454	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2491	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2499	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2525	TA	NaN	Av	ALQ	Unf	755.0	0.0	240.0	995.0

2548	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2553	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2565	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2579	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2600	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2703	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2764	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2767	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2804	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2805	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2825	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2892	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0
2905	NaN	NaN	NaN	NaN	NaN	0.0	0.0	0.0	0.0

```
In [107... bsmt_num=0
for feat in num_bsm_t_feat:
    df_mvi[feat] = df_mvi[feat].replace(np.nan, bsmt_num)
```

```
In [109... # Electrical      0.034258 -- KitchenQual      0.034258
df["Electrical"].value_counts()
```

```
Out[109... Electrical
SBrkr      2671
FuseA       188
FuseF        50
FuseP         8
Mix          1
Name: count, dtype: int64
```

```
In [111... df["KitchenQual"].value_counts()
```

```
Out[111... KitchenQual
TA      1492
Gd      1151
Ex       205
Fa        70
Name: count, dtype: int64
```

```
In [113... df_ekk=df[["Electrical", "KitchenQual", "KitchenAbvGr"]]
df_ekk[df_ekk.isnull().any(axis=1)]
```

```
Out[113...      Electrical  KitchenQual  KitchenAbvGr
Id
1380         NaN           Gd             1
1556      SBrkr          NaN             1
```

```
In [115... electrical_mode=df["Electrical"].mode()[0]
df_mvi["Electrical"] = df_mvi["Electrical"].replace(np.nan, electrical_mode)
df_mvi["Electrical"].isnull().sum()
```

```
Out[115... 0
```

```
In [117... kitchenqual_mode=df["KitchenQual"].mode()[0]
df_mvi["KitchenQual"] = df_mvi["KitchenQual"].replace(np.nan, kitchenqual_mode)
df_mvi["KitchenQual"].isnull().sum()
```

```
Out[117... 0
```

```
In [109... # Functional      0.068517 - mode
# FireplaceQu     48.646797 - NA
# PoolQC         99.657417 - NA
# Fence          80.438506 - NA
# MiscFeature     96.402878 - NA
# SaleType        0.034258 - mode
```

```
In [119... print(df["Functional"].value_counts())
print("----")
print(df["FireplaceQu"].value_counts())
print("----")
print(df["PoolQC"].value_counts())
```

```

print("-----")
print(df["Fence"].value_counts())
print("-----")
print(df["MiscFeature"].value_counts())
print("-----")
print(df["SaleType"].value_counts())
print("-----")

```

```

Functional
Typ      2717
Min2      70
Min1      65
Mod       35
Maj1      19
Maj2       9
Sev        2
Name: count, dtype: int64
-----
FireplaceQu
Gd       744
TA       592
Fa        74
Po        46
Ex        43
Name: count, dtype: int64
-----
PoolQC
Ex         4
Gd         4
Fa         2
Name: count, dtype: int64
-----
Fence
MnPrv     329
GdPrv     118
GdWo      112
MnWw       12
Name: count, dtype: int64
-----
MiscFeature
Shed      95
Gar2       5
Othr       4
TenC       1
Name: count, dtype: int64
-----
SaleType
WD        2525
New        239
COD         87
ConLD       26
CWD         12
ConLI        9
ConLw        8
Oth          7
Con          5
Name: count, dtype: int64
-----

```

```

In [127.. functional_mode=df["Functional"].mode()[0]
df_mvi["Functional"] = df_mvi["Functional"].replace(np.nan, functional_mode)
df_mvi["Functional"].isnull().sum()

```

Out[127.. 0

```

In [129.. saletype_mode=df["SaleType"].mode()[0]
df_mvi["SaleType"] = df_mvi["SaleType"].replace(np.nan, functional_mode)
df_mvi["SaleType"].isnull().sum()

```

Out[129.. 0

```

In [133.. other_cat_feat=["FireplaceQu", "PoolQC", "Fence", "MiscFeature"]

other_cat_const="NA"
for feat in other_cat_feat:
    df_mvi[feat] = df_mvi[feat].replace(np.nan, other_cat_const)
for feat in other_cat_feat:
    print(df_mvi[feat].isnull().sum())
    print("-----")

```

```
0
----
0
----
0
----
0
----
```

```
In [60]: # cat
# GarageType      5.378554 - NA
# GarageFinish    5.447071 - NA
# GarageQual      5.447071 - NA
# GarageCond      5.447071 - NA

# num
# GarageYrBlt     5.447071
# GarageCars      0.034258
# GarageArea      0.034258
```

```
In [135]: cat_garage_feat=["GarageType","GarageFinish","GarageQual","GarageCond"]
num_garage_feat=["GarageYrBlt","GarageCars","GarageArea"]

for feat in cat_garage_feat:
    print(df[feat].value_counts())
    print("----")

for feat in num_garage_feat:
    print(df[feat].value_counts())
    print("----")
```

```
GarageType
Attchd      1723
Detchd      779
BuiltIn     186
Basement    36
2Types      23
CarPort     15
Name: count, dtype: int64
----
```

```
GarageFinish
Unf      1230
RFn       811
Fin       719
Name: count, dtype: int64
----
```

```
GarageQual
TA      2604
Fa       124
Gd        24
Po         5
Ex         3
Name: count, dtype: int64
----
```

```
GarageCond
TA      2654
Fa       74
Gd       15
Po       14
Ex        3
Name: count, dtype: int64
----
```

```
GarageYrBlt
2005.0    142
2006.0    115
2007.0    115
2004.0     99
2003.0     92
1977.0     66
2008.0     61
1998.0     58
2000.0     55
1999.0     54
2002.0     53
1950.0     51
1976.0     50
1993.0     49
1968.0     48
1997.0     44
1958.0     42
1978.0     41
1956.0     41
2001.0     41
1996.0     40
```

1994.0	39
1966.0	39
1960.0	37
1954.0	37
1967.0	36
1959.0	36
1964.0	35
1974.0	35
1979.0	35
1995.0	35
1962.0	35
1963.0	34
1957.0	34
1965.0	34
1920.0	33
1969.0	32
1970.0	32
1980.0	32
1961.0	31
2009.0	29
1973.0	29
1975.0	28
1992.0	27
1972.0	27
1930.0	27
1990.0	26
1940.0	25
1955.0	24
1971.0	24
1953.0	23
1939.0	21
1988.0	20
1984.0	19
1948.0	19
1989.0	19
1987.0	18
1985.0	18
1991.0	17
1951.0	17
1952.0	16
1926.0	15
1925.0	15
1981.0	15
1949.0	14
1941.0	14
1986.0	12
1938.0	11
1983.0	11
1910.0	10
1945.0	10
1946.0	9
1982.0	9
1924.0	8
1935.0	8
1922.0	8
1936.0	7
1928.0	7
1915.0	7
1916.0	6
1937.0	6
1900.0	6
1923.0	6
1942.0	6
1921.0	5
1947.0	5
2010.0	5
1927.0	5
1932.0	4
1934.0	4
1931.0	4
1918.0	3
1914.0	2
1929.0	2
1917.0	2
1895.0	1
1943.0	1
2207.0	1
1908.0	1
1896.0	1
1933.0	1
1906.0	1
1919.0	1

Name: count, dtype: int64

```
----
GarageCars
2.0      1594
1.0       776
3.0       374
0.0       157
4.0        16
5.0         1
Name: count, dtype: int64
```

```
----
GarageArea
```

```
0.0      157
576.0     97
440.0     96
240.0     69
484.0     68
528.0     65
400.0     58
480.0     54
264.0     51
288.0     50
308.0     48
280.0     30
420.0     29
336.0     29
672.0     23
462.0     23
216.0     23
384.0     21
504.0     21
506.0     21
286.0     20
312.0     19
624.0     17
525.0     17
352.0     17
495.0     17
550.0     17
360.0     16
180.0     16
564.0     16
300.0     16
572.0     15
460.0     14
588.0     14
660.0     14
390.0     14
540.0     14
478.0     14
520.0     13
539.0     12
297.0     12
720.0     11
252.0     11
432.0     11
472.0     11
200.0     11
470.0     11
502.0     10
294.0     10
450.0     10
461.0     10
530.0      9
482.0      9
434.0      9
578.0      9
473.0      9
542.0      9
492.0      9
529.0      9
441.0      9
490.0      9
396.0      9
474.0      9
270.0      9
552.0      8
648.0      8
527.0      8
430.0      8
431.0      8
299.0      8
451.0      8
546.0      8
```

676.0	8
560.0	7
512.0	7
380.0	7
616.0	7
393.0	7
392.0	7
880.0	7
610.0	7
315.0	7
410.0	7
870.0	6
840.0	6
625.0	6
388.0	6
516.0	6
786.0	6
784.0	6
500.0	6
256.0	6
642.0	6
670.0	6
486.0	6
544.0	6
575.0	6
452.0	6
320.0	6
338.0	6
600.0	6
632.0	6
250.0	6
864.0	6
541.0	5
626.0	5
498.0	5
615.0	5
438.0	5
260.0	5
437.0	5
570.0	5
463.0	5
531.0	5
820.0	5
398.0	5
429.0	5
621.0	5
319.0	5
758.0	5
275.0	5
225.0	5
650.0	5
515.0	5
612.0	5
483.0	5
517.0	5
551.0	5
521.0	5
534.0	5
433.0	5
577.0	5
608.0	5
678.0	5
467.0	5
532.0	5
656.0	5
850.0	5
511.0	5
583.0	5
596.0	5
442.0	5
834.0	5
402.0	5
522.0	5
379.0	4
836.0	4
496.0	4
370.0	4
477.0	4
350.0	4
418.0	4
342.0	4
730.0	4
776.0	4

281.0	4
436.0	4
746.0	4
220.0	4
888.0	4
364.0	4
580.0	4
795.0	4
792.0	4
487.0	4
598.0	4
471.0	4
499.0	4
628.0	4
586.0	4
368.0	4
416.0	4
556.0	4
305.0	4
330.0	4
253.0	4
666.0	4
276.0	4
644.0	4
210.0	4
246.0	4
627.0	4
736.0	4
810.0	4
774.0	4
397.0	4
205.0	4
816.0	4
630.0	4
900.0	3
228.0	3
508.0	3
874.0	3
878.0	3
668.0	3
768.0	3
686.0	3
619.0	3
574.0	3
409.0	3
444.0	3
756.0	3
788.0	3
796.0	3
614.0	3
510.0	3
554.0	3
160.0	3
403.0	3
704.0	3
326.0	3
567.0	3
779.0	3
928.0	3
466.0	3
230.0	3
234.0	3
324.0	3
871.0	3
322.0	3
844.0	3
591.0	3
215.0	3
318.0	3
868.0	3
884.0	3
649.0	3
538.0	3
658.0	3
692.0	3
524.0	3
457.0	3
195.0	3
454.0	3
856.0	3
497.0	3
750.0	3
732.0	3

453.0	3
435.0	3
273.0	3
476.0	3
366.0	3
684.0	3
852.0	3
565.0	3
826.0	3
691.0	3
468.0	3
636.0	3
932.0	3
456.0	3
505.0	3
513.0	3
569.0	3
304.0	3
846.0	3
501.0	3
514.0	3
592.0	3
754.0	3
301.0	3
566.0	3
231.0	3
751.0	2
555.0	2
925.0	2
690.0	2
533.0	2
631.0	2
365.0	2
728.0	2
310.0	2
488.0	2
724.0	2
814.0	2
725.0	2
355.0	2
663.0	2
640.0	2
738.0	2
543.0	2
371.0	2
647.0	2
523.0	2
331.0	2
224.0	2
638.0	2
597.0	2
479.0	2
579.0	2
287.0	2
343.0	2
896.0	2
812.0	2
936.0	2
828.0	2
714.0	2
712.0	2
701.0	2
372.0	2
620.0	2
561.0	2
162.0	2
357.0	2
394.0	2
622.0	2
313.0	2
762.0	2
782.0	2
518.0	2
662.0	2
351.0	2
582.0	2
722.0	2
885.0	2
920.0	2
489.0	2
944.0	2
938.0	2
545.0	2

780.0	2
404.0	2
905.0	2
912.0	2
399.0	2
1052.0	2
464.0	2
311.0	2
748.0	2
548.0	2
968.0	2
894.0	2
386.0	2
590.0	2
866.0	2
683.0	2
447.0	2
271.0	2
839.0	2
680.0	2
711.0	2
772.0	2
282.0	2
685.0	2
702.0	2
898.0	2
606.0	2
843.0	2
594.0	2
573.0	2
641.0	2
509.0	2
493.0	2
296.0	2
617.0	2
422.0	2
427.0	2
908.0	2
706.0	2
721.0	2
164.0	2
603.0	2
292.0	2
765.0	2
558.0	2
645.0	2
408.0	2
283.0	2
349.0	2
789.0	2
605.0	2
618.0	2
865.0	2
675.0	2
682.0	2
412.0	2
895.0	2
423.0	2
818.0	2
481.0	2
389.0	2
924.0	2
303.0	2
726.0	2
831.0	2
494.0	2
800.0	2
439.0	2
249.0	1
266.0	1
904.0	1
207.0	1
811.0	1
1138.0	1
316.0	1
340.0	1
226.0	1
405.0	1
1184.0	1
1348.0	1
740.0	1
325.0	1
869.0	1

1314.0	1
1231.0	1
687.0	1
1150.0	1
557.0	1
698.0	1
715.0	1
428.0	1
1166.0	1
295.0	1
307.0	1
401.0	1
783.0	1
851.0	1
766.0	1
469.0	1
787.0	1
267.0	1
1488.0	1
1003.0	1
613.0	1
369.0	1
599.0	1
1154.0	1
100.0	1
571.0	1
1041.0	1
963.0	1
443.0	1
773.0	1
485.0	1
1085.0	1
899.0	1
959.0	1
803.0	1
760.0	1
584.0	1
449.0	1
688.0	1
568.0	1
353.0	1
791.0	1
1008.0	1
378.0	1
258.0	1
848.0	1
317.0	1
646.0	1
265.0	1
609.0	1
853.0	1
890.0	1
242.0	1
806.0	1
344.0	1
356.0	1
185.0	1
892.0	1
257.0	1
729.0	1
1110.0	1
585.0	1
1040.0	1
1174.0	1
916.0	1
876.0	1
933.0	1
747.0	1
1092.0	1
859.0	1
744.0	1
1105.0	1
293.0	1
1200.0	1
184.0	1
374.0	1
217.0	1
323.0	1
332.0	1
674.0	1
667.0	1
700.0	1
907.0	1

406.0	1
832.0	1
1134.0	1
1248.0	1
1043.0	1
254.0	1
719.0	1
862.0	1
562.0	1
749.0	1
261.0	1
842.0	1
1390.0	1
306.0	1
889.0	1
830.0	1
807.0	1
358.0	1
186.0	1
693.0	1
426.0	1
813.0	1
995.0	1
757.0	1
1356.0	1
459.0	1
367.0	1
716.0	1
739.0	1
290.0	1
665.0	1
611.0	1
425.0	1
1220.0	1
595.0	1
857.0	1
902.0	1
1020.0	1
455.0	1
414.0	1
354.0	1
602.0	1
327.0	1
284.0	1
833.0	1
601.0	1
841.0	1
689.0	1
808.0	1
752.0	1
255.0	1
424.0	1
824.0	1
328.0	1
983.0	1
475.0	1
858.0	1
954.0	1
549.0	1
927.0	1
535.0	1
263.0	1
375.0	1
363.0	1
209.0	1
1017.0	1
671.0	1
741.0	1
581.0	1
345.0	1
1053.0	1
413.0	1
458.0	1
694.0	1
886.0	1
949.0	1
673.0	1
309.0	1
815.0	1
623.0	1
972.0	1
984.0	1
604.0	1

```

845.0    1
559.0    1
465.0    1
713.0    1
962.0    1
958.0    1
708.0    1
526.0    1
1014.0   1
753.0    1
1418.0   1
213.0    1
198.0    1
860.0    1
248.0    1
696.0    1
825.0    1
947.0    1
373.0    1
770.0    1
639.0    1
377.0    1
804.0    1
244.0    1
208.0    1
445.0    1
189.0    1
1069.0   1
872.0    1
923.0    1
192.0    1
1025.0   1
272.0    1
Name: count, dtype: int64
----
```

```

In [139]: cat_garage_cont="NA"
for feat in cat_garage_feat:
    df_mvi[feat] = df_mvi[feat].replace(np.nan, cat_garage_cont)
num_garage_val=0
for feat in num_garage_feat:
    df_mvi[feat] = df_mvi[feat].replace(np.nan, num_garage_val)
```

```

In [63]: # df_mvi[cat_garage_feat].isnull().sum()
# df_mvi[num_garage_feat].isnull().sum()
```

Feature Transformation

Numerical to Categorical

```

In [141]: ## MSSubClass, YearBuilt, YearRemodAdd, GarageYrBlt, MoSold, YrSold
for num_con = ["MSSubClass", "YearBuilt", "YearRemodAdd", "GarageYrBlt", "MoSold", "YrSold"]
for feat in for_num_con:
    print(f"{feat}: data type = {df_mvi[feat].dtype}")
```

```

MSSubClass: data type = int64
YearBuilt: data type = int64
YearRemodAdd: data type = int64
GarageYrBlt: data type = float64
MoSold: data type = int64
YrSold: data type = int64
```

```

In [143]: df_mvi["MoSold"]=df_mvi["MoSold"].apply(lambda x: calendar.month_abbr[x])
```

```

In [145]: for feat in for_num_con:
    df_mvi[feat]=df_mvi[feat].astype(str)
```

```

In [147]: for feat in for_num_con:
    print(f"{feat}: data type = {df_mvi[feat].dtype}")
```

```

MSSubClass: data type = object
YearBuilt: data type = object
YearRemodAdd: data type = object
GarageYrBlt: data type = object
MoSold: data type = object
YrSold: data type = object
```

Categorical into Numerical(ordinal objects)

```

In [149]: ordinal_end_var=[
```

```

"ExterQual",
"ExterCond",
"BsmtQual",
"BsmtCond",
"BsmtExposure",
"BsmtFinType1",
"BsmtFinType2",
"HeatingQC",
"KitchenQual",
"FireplaceQu",
"GarageQual",
"GarageCond",
"PoolQC",
"Functional",
"GarageFinish",
"PavedDrive",
"Utilities",
]
print(len(ordinal_end_var))

```

17

```

In [151]: df_mvi["ExterQual"]=df_mvi["ExterQual"].astype(CategoricalDtype(categories=["Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["ExterCond"]=df_mvi["ExterCond"].astype(CategoricalDtype(categories=["Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["BsmtQual"]=df_mvi["BsmtQual"].astype(CategoricalDtype(categories=["NA","Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["BsmtCond"]=df_mvi["BsmtCond"].astype(CategoricalDtype(categories=["NA","Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["BsmtExposure"]=df_mvi["BsmtExposure"].astype(CategoricalDtype(categories=["NA","No","Mn","Av","Gd"],ordered=True))
df_mvi["BsmtFinType1"]=df_mvi["BsmtFinType1"].astype(CategoricalDtype(categories=["NA","Unf","LwQ","Rec","BLQ"],ordered=True))
df_mvi["BsmtFinType2"]=df_mvi["BsmtFinType2"].astype(CategoricalDtype(categories=["NA","Unf","LwQ","Rec","BLQ"],ordered=True))
df_mvi["HeatingQC"]=df_mvi["HeatingQC"].astype(CategoricalDtype(categories=["Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["KitchenQual"]=df_mvi["KitchenQual"].astype(CategoricalDtype(categories=["Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["FireplaceQu"]=df_mvi["FireplaceQu"].astype(CategoricalDtype(categories=["NA","Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["GarageQual"]=df_mvi["GarageQual"].astype(CategoricalDtype(categories=["NA","Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["GarageCond"]=df_mvi["GarageCond"].astype(CategoricalDtype(categories=["NA","Po","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["PoolQC"]=df_mvi["PoolQC"].astype(CategoricalDtype(categories=["NA","Fa","TA","Gd","Ex"],ordered=True))
df_mvi["Functional"]=df_mvi["Functional"].astype(CategoricalDtype(categories=["Sal","Sev","Maj2","Maj1","Mod","I"],ordered=True))
df_mvi["GarageFinish"]=df_mvi["GarageFinish"].astype(CategoricalDtype(categories=["NA","Unf","RFn","Fin"],ordered=True))
df_mvi["PavedDrive"]=df_mvi["PavedDrive"].astype(CategoricalDtype(categories=["N","P","Y"],ordered=True)).cat.set_order(["N","P","Y"])
df_mvi["Utilities"]=df_mvi["Utilities"].astype(CategoricalDtype(categories=["ELO","NoSeWa","NoSewr","AllPub"],ordered=True))

```

In [153]: df_mvi.info()

```

<class 'pandas.core.frame.DataFrame'>
Index: 2919 entries, 1 to 2919
Data columns (total 80 columns):
 #   Column          Non-Null Count  Dtype  
---  -
 0   MSSubClass      2919 non-null  object  
 1   MSZoning        2919 non-null  object  
 2   LotFrontage     2919 non-null  float64 
 3   LotArea         2919 non-null  int64   
 4   Street          2919 non-null  object  
 5   Alley           2919 non-null  object  
 6   LotShape        2919 non-null  object  
 7   LandContour     2919 non-null  object  
 8   Utilities       2919 non-null  int8     
 9   LotConfig       2919 non-null  object  
10   LandSlope       2919 non-null  object  
11   Neighborhood    2919 non-null  object  
12   Condition1      2919 non-null  object  
13   Condition2      2919 non-null  object  
14   BldgType        2919 non-null  object  
15   HouseStyle      2919 non-null  object  
16   OverallQual     2919 non-null  int64   
17   OverallCond     2919 non-null  int64   
18   YearBuilt       2919 non-null  object  
19   YearRemodAdd    2919 non-null  object  
20   RoofStyle       2919 non-null  object  
21   RoofMatl        2919 non-null  object  
22   Exterior1st     2919 non-null  object  
23   Exterior2nd     2919 non-null  object  
24   MasVnrType      2919 non-null  object  
25   MasVnrArea      2919 non-null  float64 
26   ExterQual       2919 non-null  int8     
27   ExterCond       2919 non-null  int8     
28   Foundation      2919 non-null  object  
29   BsmtQual        2919 non-null  int8     
30   BsmtCond        2919 non-null  int8     
31   BsmtExposure    2919 non-null  int8     
32   BsmtFinType1    2919 non-null  int8     
33   BsmtFinSF1      2919 non-null  float64 
34   BsmtFinType2    2919 non-null  int8     
35   BsmtFinSF2      2919 non-null  float64 
36   BsmtUnfSF       2919 non-null  float64 

```

```

37 TotalBsmstSF      2919 non-null float64
38 Heating          2919 non-null object
39 HeatingQC        2919 non-null int8
40 CentralAir       2919 non-null object
41 Electrical       2919 non-null object
42 1stFlrSF         2919 non-null int64
43 2ndFlrSF         2919 non-null int64
44 LowQualFinSF     2919 non-null int64
45 GrLivArea        2919 non-null int64
46 BsmstFullBath    2919 non-null float64
47 BsmstHalfBath    2919 non-null float64
48 FullBath         2919 non-null int64
49 HalfBath         2919 non-null int64
50 BedroomAbvGr    2919 non-null int64
51 KitchenAbvGr     2919 non-null int64
52 KitchenQual      2919 non-null int8
53 TotRmsAbvGrd    2919 non-null int64
54 Functional       2919 non-null int8
55 Fireplaces       2919 non-null int64
56 FireplaceQu      2919 non-null int8
57 GarageType       2919 non-null object
58 GarageYrBlt      2919 non-null object
59 GarageFinish     2919 non-null int8
60 GarageCars       2919 non-null float64
61 GarageArea       2919 non-null float64
62 GarageQual       2919 non-null int8
63 GarageCond       2919 non-null int8
64 PavedDrive       2919 non-null int8
65 WoodDeckSF       2919 non-null int64
66 OpenPorchSF     2919 non-null int64
67 EnclosedPorch    2919 non-null int64
68 3SsnPorch        2919 non-null int64
69 ScreenPorch      2919 non-null int64
70 PoolArea         2919 non-null int64
71 PoolQC          2919 non-null int8
72 Fence           2919 non-null object
73 MiscFeature      2919 non-null object
74 MiscVal          2919 non-null int64
75 MoSold           2919 non-null object
76 YrSold           2919 non-null object
77 SaleType         2919 non-null object
78 SaleCondition    2919 non-null object
79 SalePrice        1460 non-null float64
dtypes: float64(11), int64(20), int8(17), object(32)
memory usage: 1.5+ MB

```

```
In [71]: # df_mvi["ExterQual"]
```

Categorical into Numerical(nominal objects)

```
In [155.. df_encod=df_mvi.copy()

object_features=df_encod.select_dtypes(include="object").columns.to_list()
print(object_features)

['MSSubClass', 'MSZoning', 'Street', 'Alley', 'LotShape', 'LandContour', 'LotConfig', 'LandSlope', 'Neighborhood', 'Condition1', 'Condition2', 'BldgType', 'HouseStyle', 'YearBuilt', 'YearRemodAdd', 'RoofStyle', 'RoofMatl', 'Exterior1st', 'Exterior2nd', 'MasVnrType', 'Foundation', 'Heating', 'CentralAir', 'Electrical', 'GarageType', 'GarageYrBlt', 'Fence', 'MiscFeature', 'MoSold', 'YrSold', 'SaleType', 'SaleCondition']
```

```
In [157.. df_encod[object_features].head(2)
```

Out[157..

	MSSubClass	MSZoning	Street	Alley	LotShape	LandContour	LotConfig	LandSlope	Neighborhood	Condition1	Condition2
Id											
1	60	RL	Pave	NA	Reg	Lvl	Inside	Gtl	CollgCr	Norm	Norm
2	20	RL	Pave	NA	Reg	Lvl	FR2	Gtl	Veenker	Feedr	Norm

```
In [159.. print("before",df_encod.shape)
df_encod=pd.get_dummies(df_encod,
                        columns=object_features,
                        prefix=object_features,
                        drop_first=True)
print("after",df_encod.shape)

before (2919, 80)
after (2919, 513)
```

```
In [161.. df_encod.head(2)
```

Out[161]

	LotFrontage	LotArea	Utilities	OverallQual	OverallCond	MasVnrArea	ExterQual	ExterCond	BsmtQual	BsmtCond	BsmtExpo
--	-------------	---------	-----------	-------------	-------------	------------	-----------	-----------	----------	----------	----------

Id

1	65.0	8450	3	7	5	196.0	3	2	4	3
2	80.0	9600	3	6	8	0.0	2	2	4	3

Split data

In [163]

```
len_train=df_train.shape[0]
len_train
```

Out[163]

1460

In [165]

```
X_train=df_encod[:len_train].drop("SalePrice",axis=1)
y_train=df_encod[:len_train]["SalePrice"]
X_test=df_encod[len_train:].drop("SalePrice",axis=1)

print("Shape of X_train",X_train.shape)
print("Shape of y_train",y_train.shape)
print("Shape of X_test",X_test.shape)
```

Shape of X_train (1460, 512)

Shape of y_train (1460,)

Shape of X_test (1459, 512)

In [167]

```
sc = StandardScaler()

sc.fit(X_train) # it will learn about mean and std variance
X_train=sc.transform(X_train)
X_test=sc.transform(X_test)
```

Cross Validation and Model Selection

In [173]

!pip install xgboost

Defaulting to user installation because normal site-packages is not writeable

Collecting xgboost

Using cached xgboost-2.1.3-py3-none-win_amd64.whl.metadata (2.1 kB)

Requirement already satisfied: numpy in c:\programdata\anaconda3\lib\site-packages (from xgboost) (1.26.4)

Requirement already satisfied: scipy in c:\programdata\anaconda3\lib\site-packages (from xgboost) (1.13.1)

Downloading xgboost-2.1.3-py3-none-win_amd64.whl (124.9 MB)

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13.2/124.9	MB	162.9	kB/s	eta	0:11:26
13.2/124.9	MB	163.2	kB/s	eta	0:11:25
13.3/124.9	MB	163.7	kB/s	eta	0:11:23
13.3/124.9	MB	163.8	kB/s	eta	0:11:22
13.3/124.9	MB	164.9	kB/s	eta	0:11:18
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13.3/124.9	MB	165.7	kB/s	eta	0:11:14
13.3/124.9	MB	165.7	kB/s	eta	0:11:14
13.4/124.9	MB	166.2	kB/s	eta	0:11:12
13.4/124.9	MB	166.3	kB/s	eta	0:11:11
13.4/124.9	MB	166.3	kB/s	eta	0:11:11
13.4/124.9	MB	167.3	kB/s	eta	0:11:07
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13.4/124.9	MB	167.7	kB/s	eta	0:11:05
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29.8/124.9	MB	243.8	kB/s	eta	0:06:30
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-----	54.7/124.9	MB	112.9	kB/s	eta	0:10:23
-----	54.7/124.9	MB	112.9	kB/s	eta	0:10:23
-----	54.7/124.9	MB	112.9	kB/s	eta	0:10:23
-----	54.7/124.9	MB	112.9	kB/s	eta	0:10:23
-----	54.7/124.9	MB	112.9	kB/s	eta	0:10:23
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-----	69.3/124.9	MB	70.3	kB/s	eta	0:13:12
-----	69.3/124.9	MB	70.3	kB/s	eta	0:13:12
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-----	69.3/124.9	MB	71.9	kB/s	eta	0:12:54
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-----	69.4/124.9	MB	73.0	kB/s	eta	0:12:40
-----	69.4/124.9	MB	73.2	kB/s	eta	0:12:38
-----	69.4/124.9	MB	73.8	kB/s	eta	0:12:32
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-----	69.4/124.9	MB	73.9	kB/s	eta	0:12:32
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-----	69.5/124.9	MB	73.9	kB/s	eta	0:12:31
-----	69.5/124.9	MB	74.3	kB/s	eta	0:12:27
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-----	69.6/124.9	MB	84.9	kB/s	eta	0:10:52
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-----	69.6/124.9	MB	86.3	kB/s	eta	0:10:41
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-----	69.7/124.9	MB	87.4	kB/s	eta	0:10:33
-----	69.7/124.9	MB	87.4	kB/s	eta	0:10:33
-----	69.7/124.9	MB	87.7	kB/s	eta	0:10:30
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-----	69.7/124.9	MB	88.1	kB/s	eta	0:10:27
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-----	69.7/124.9	MB	88.7	kB/s	eta	0:10:22
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-----	69.8/124.9	MB	90.0	kB/s	eta	0:10:13
-----	69.8/124.9	MB	89.9	kB/s	eta	0:10:14
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-----	69.8/124.9	MB	90.5	kB/s	eta	0:10:09
-----	69.8/124.9	MB	90.5	kB/s	eta	0:10:09
-----	69.9/124.9	MB	91.7	kB/s	eta	0:10:01
-----	69.9/124.9	MB	91.7	kB/s	eta	0:10:01
-----	69.9/124.9	MB	91.7	kB/s	eta	0:10:01

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```

ERROR: Exception:
Traceback (most recent call last):
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_vendor\urllib3\response.py", line 438, in _error_catcher
    yield
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_vendor\urllib3\response.py", line 561, in read
    data = self._fp_read(amt) if not fp_closed else b""
    ^^^^^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_vendor\urllib3\response.py", line 527, in _fp_read
    return self._fp.read(amt) if amt is not None else self._fp.read()
    ^^^^^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_vendor\cachecontrol\filewrapper.py", line 98, in read
    data: bytes = self.__fp.read(amt)
    ^^^^^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\http\client.py", line 479, in read
    s = self.fp.read(amt)
    ^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\socket.py", line 708, in readinto
    return self._sock.recv_into(b)
    ^^^^^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\ssl.py", line 1252, in recv_into
    return self.read(nbytes, buffer)
    ^^^^^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\ssl.py", line 1104, in read
    return self._sslobj.read(len, buffer)
    ^^^^^^^^^^^^^^^^^^^^^
TimeoutError: The read operation timed out

```

During handling of the above exception, another exception occurred:

```

Traceback (most recent call last):
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\cli\base_command.py", line 180, in exc_logging_wrapper
    status = run_func(*args)
    ^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\cli\req_command.py", line 245, in wrapper
    return func(self, options, args)
    ^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\commands\install.py", line 377, in run
    requirement_set = resolver.resolve(
    ^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\resolution\resolvelib\resolver.py", line 179, in resolve
    self.factory.preparer.prepare_linked_requirements_more(reqs)
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\operations\prepare.py", line 552, in prepare_linked_requirements_more
    self._complete_partial_requirements(
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\operations\prepare.py", line 467, in _complete_partial_requirements
    for link, (filepath, _) in batch_download:
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\network\download.py", line 183, in __call__
    for chunk in chunks:
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\cli\progressBars.py", line 53, in _rich_progress_bar
    for chunk in iterable:
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_internal\network\utils.py", line 63, in response_chunks
    for chunk in response.raw.stream(
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_vendor\urllib3\response.py", line 622, in stream
    data = self.read(amt=amt, decode_content=decode_content)
    ^^^^^^^^^^^^^^^^^
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_vendor\urllib3\response.py", line 560, in read
    with self._error_catcher():
  File "C:\ProgramData\anaconda3\Lib\contextlib.py", line 158, in __exit__
    self.gen.throw(value)
  File "C:\ProgramData\anaconda3\Lib\site-packages\pip\_vendor\urllib3\response.py", line 443, in _error_catcher
    raise ReadTimeoutError(self._pool, None, "Read timed out.")
pip._vendor.urllib3.exceptions.ReadTimeoutError: HTTPSConnectionPool(host='files.pythonhosted.org', port=443): Read timed out.

```

```

In [181]: from sklearn.svm import SVR
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import SGDRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.gaussian_process import GaussianProcessRegressor
from sklearn.tree import DecisionTreeRegressor

from sklearn.ensemble import RandomForestRegressor
from sklearn.ensemble import GradientBoostingRegressor

from sklearn.neural_network import MLPRegressor

from xgboost import XGBRegressor

```

```
In [183.. svr = SVR()
lr = LinearRegression()
sgdr = SGDRegressor()
knn = KNeighborsRegressor()
gpr = GaussianProcessRegressor()
dtr = DecisionTreeRegressor()
rfr = RandomForestRegressor()
gbr = GradientBoostingRegressor()
xgbr = XGBRegressor()

mlpr = MLPRegressor()
```

```
In [81]: models = {"a":["LinearRegression",lr],
                  "b":["SVR",svr],
                  "c":["SGDRegressor",sgdr],
                  "d":["KNeighborsRegressor",knn],
                  "e":["GaussianProcessRegressor",gpr],
                  "f":["DecisionTreeRegressor",dtr],
                  "g":["GradientBoostingRegressor",gbr],
                  "h":["RandomForestRegressor",rfr],
                  "i":["XGBRegressor",xgbr],
                  "j":["MLPRegressor",mlpr],
                  } # Create a dictionary to store the results
```

```
In [185.. from sklearn.model_selection import cross_val_score, KFold
from sklearn.metrics import make_scorer,r2_score

def test_model(model, X_train=X_train,y_train=y_train):
    cv = KFold(n_splits=7, random_state=45, shuffle=True)
    r2 = make_scorer(r2_score)
    r2_val_score = cross_val_score(model, X_train, y_train, cv=cv, scoring=r2)
    score = [r2_val_score.mean()]
    return score
```

```
In [189.. # Define your models
models = {
    'Linear Regression': ['LinearRegression', LinearRegression()],
    'Random Forest': ['RandomForest', RandomForestRegressor()],
    'XGBoost': ['XGB', XGBRegressor()]
}

models_score = []
for model in models:
    print("Model Name: ", models[model][0])
    score = test_model(models[model][1], X_train, y_train)
    print("Score of Model:", score)
    print("-----")
    models_score.append([models[model][0], score])
```

```
Model Name: LinearRegression
Score of Model: [-4.5703194545623e+22]
-----
Model Name: RandomForest
Score of Model: [0.8393287534772974]
-----
Model Name: XGB
Score of Model: [0.8647006248183509]
-----
```

```
In [190.. models_score
```

```
Out[190.. [['LinearRegression', [-4.5703194545623e+22]],
          ['RandomForest', [0.8393287534772974]],
          ['XGB', [0.8647006248183509]]]
```

Model Training

```
In [193.. gbr.fit(X_train,y_train)
```

```
Out[193.. ▾ GradientBoostingRegressor ⓘ ?
GradientBoostingRegressor()
```

```
In [195.. y_pred=gbr.predict(X_test)
```

```
In [197.. # y_pred # is a numpy array hence we gonna convert it into dataframe
y_pred=pd.concat([df_test['Id'],pd.DataFrame(y_pred,columns=['SalePrice'])],axis=1)
y_pred
```

```
Out[197..      Id      SalePrice
```

0	1461	122103.500909
1	1462	155398.306856
2	1463	175032.391922
3	1464	180116.442684
4	1465	204131.608740
5	1466	170930.824326
6	1467	157931.059686
7	1468	159943.505730
8	1469	190038.522001
9	1470	129854.392427
10	1471	200965.020774
11	1472	96775.928621
12	1473	95677.490047
13	1474	154819.496462
14	1475	137990.081928
15	1476	407464.266211
16	1477	277826.803080
17	1478	311162.185967
18	1479	286536.780138
19	1480	484967.859526
20	1481	319955.713640
21	1482	213799.485481
22	1483	165842.688843
23	1484	174316.540813
24	1485	175527.486372
25	1486	193866.191964
26	1487	350948.923099
27	1488	239107.506370
28	1489	200610.223162
29	1490	222909.030296
30	1491	190933.714005
31	1492	89257.865711
32	1493	188818.811478
33	1494	292143.047463
34	1495	301955.268491
35	1496	235919.708953
36	1497	182223.884972
37	1498	165683.328424
38	1499	167733.284069
39	1500	146715.310659
40	1501	165761.689504
41	1502	159338.955452
42	1503	290292.318318
43	1504	228485.048420
44	1505	213225.858751
45	1506	191678.968133
46	1507	228042.622860
47	1508	195479.689872
48	1509	166041.677980
49	1510	145016.837279
50	1511	148873.274558

51	1512	178365.706433
52	1513	140476.074876
53	1514	168341.029077
54	1515	178321.250756
55	1516	163465.260063
56	1517	157512.957823
57	1518	145284.852879
58	1519	223650.222259
59	1520	132093.532511
60	1521	135562.659195
61	1522	166989.911132
62	1523	107692.268599
63	1524	120870.035256
64	1525	123556.409320
65	1526	124794.305518
66	1527	105503.673378
67	1528	133699.619091
68	1529	146055.499112
69	1530	181220.595430
70	1531	119190.434746
71	1532	106179.703188
72	1533	153585.916616
73	1534	114665.845976
74	1535	149604.690622
75	1536	113075.486553
76	1537	75780.606336
77	1538	184302.282671
78	1539	218631.243995
79	1540	108956.721840
80	1541	138725.393727
81	1542	130337.588753
82	1543	218312.566188
83	1544	84190.964390
84	1545	109251.432216
85	1546	126799.918659
86	1547	139660.828687
87	1548	137303.367651
88	1549	111319.608179
89	1550	133980.685975
90	1551	123568.127279
91	1552	131290.587942
92	1553	156106.771849
93	1554	109458.356379
94	1555	166263.894242
95	1556	81448.169260
96	1557	114725.742915
97	1558	101580.818266
98	1559	95914.527711
99	1560	136645.530469
100	1561	135531.311306
101	1562	125308.470082

102	1563	123784.639426
103	1564	166086.224743
104	1565	150653.398405
105	1566	223801.202415
106	1567	77733.601754
107	1568	227519.959920
108	1569	129156.753294
109	1570	140244.037675
110	1571	123945.225373
111	1572	145447.337056
112	1573	255673.681049
113	1574	116215.902988
114	1575	242491.774111
115	1576	224554.989355
116	1577	189216.565833
117	1578	143801.558212
118	1579	139046.099765
119	1580	189748.493283
120	1581	148871.409221
121	1582	129567.053906
122	1583	341271.818674
123	1584	239930.644859
124	1585	143925.872353
125	1586	77986.234090
126	1587	104936.301678
127	1588	153852.487005
128	1589	104145.393977
129	1590	137534.074984
130	1591	99056.328371
131	1592	111662.253093
132	1593	131678.000094
133	1594	124369.012517
134	1595	118804.196066
135	1596	239929.785561
136	1597	188095.762192
137	1598	208431.230373
138	1599	207259.400292
139	1600	200544.709478
140	1601	78228.651537
141	1602	111334.949757
142	1603	105921.150194
143	1604	287596.154935
144	1605	249070.309673
145	1606	160645.497180
146	1607	178069.321487
147	1608	209344.306732
148	1609	186625.055296
149	1610	143026.142954
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1360	2821	100769.428695
1361	2822	190735.250371
1362	2823	268786.100124
1363	2824	169166.139866
1364	2825	157607.025989
1365	2826	131424.569711
1366	2827	136489.686972
1367	2828	220880.511007
1368	2829	202130.441377
1369	2830	235795.554918
1370	2831	183598.935732
1371	2832	246968.870803
1372	2833	304737.984603

1373	2834	210989.171318
1374	2835	207695.396828
1375	2836	187495.111599
1376	2837	164006.884718
1377	2838	143821.792286
1378	2839	178160.136132
1379	2840	193334.037724
1380	2841	203646.684602
1381	2842	219963.198816
1382	2843	145502.080201
1383	2844	139243.229353
1384	2845	119891.369739
1385	2846	205282.401587
1386	2847	191817.605914
1387	2848	219330.003836
1388	2849	201628.564364
1389	2850	287453.756854
1390	2851	236153.003061
1391	2852	223822.038215
1392	2853	230806.007405
1393	2854	142859.687416
1394	2855	201349.810671
1395	2856	202114.156817
1396	2857	187495.111599
1397	2858	210576.541508
1398	2859	125912.299923
1399	2860	128566.466755
1400	2861	130563.062325
1401	2862	195874.344536
1402	2863	132624.343778
1403	2864	250350.190115
1404	2865	140279.367259
1405	2866	149483.694981
1406	2867	100005.348742
1407	2868	104469.426224
1408	2869	105381.748515
1409	2870	138689.208714
1410	2871	91474.882384
1411	2872	51279.113382
1412	2873	108749.867332
1413	2874	128949.150407
1414	2875	110661.371033
1415	2876	170860.457861
1416	2877	140183.545417
1417	2878	184586.320687
1418	2879	139457.453874
1419	2880	98317.244197
1420	2881	166197.191030
1421	2882	167619.188677
1422	2883	194880.087035
1423	2884	207392.854468

1424	2885	188415.936454
1425	2886	223820.252844
1426	2887	99800.643271
1427	2888	137083.060890
1428	2889	62676.467761
1429	2890	86359.654738
1430	2891	138192.797032
1431	2892	69975.788043
1432	2893	98985.136419
1433	2894	73002.725122
1434	2895	306479.716978
1435	2896	289467.797250
1436	2897	196104.573949
1437	2898	154903.073955
1438	2899	229527.501384
1439	2900	152508.873443
1440	2901	221113.034781
1441	2902	180440.037247
1442	2903	341872.755824
1443	2904	374666.965953
1444	2905	94257.508999
1445	2906	210456.160406
1446	2907	117604.511717
1447	2908	131626.796280
1448	2909	154793.593428
1449	2910	90602.729709
1450	2911	79959.397309
1451	2912	143212.583712
1452	2913	87766.124948
1453	2914	75954.975933
1454	2915	82324.315442
1455	2916	84298.677180
1456	2917	167620.942720
1457	2918	123952.178061
1458	2919	217032.206363

```
In [219.. y_pred.to_csv(r"C:\Users\pc planet\Desktop\AI\House-Price-Prediction-master\House-Price-Prediction-master\ML_Mo
```

```
In [221.. #storing model in pickle file
import pickle

with open('gbr.pkl','wb') as f:
    pickle.dump(gbr,f)
```