Бекетов Роман ИУ5-62Б Вариант 3 РК2

```
import numpy as np
import pandas as pd
from pandas.plotting import scatter_matrix
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.svm import SVR
from sklearn.metrics import mean_squared_error, r2_score
from sklearn.preprocessing import StandardScaler
import seaborn as sns
from scipy import stats


filename = "HousingData.csv"

df = pd.read_csv(filename)
df
```

```
        CRIM    ZN  INDUS  CHAS    NOX     RM   AGE     DIS  RAD  TAX
\
0    0.00632  18.0   2.31   0.0  0.538  6.575  65.2  4.0900    1  296

1    0.02731   0.0   7.07   0.0  0.469  6.421  78.9  4.9671    2  242

2    0.02729   0.0   7.07   0.0  0.469  7.185  61.1  4.9671    2  242

3    0.03237   0.0   2.18   0.0  0.458  6.998  45.8  6.0622    3  222

4    0.06905   0.0   2.18   0.0  0.458  7.147  54.2  6.0622    3  222

..       ...   ...    ...   ...    ...    ...   ...     ...  ...  ...

501  0.06263   0.0  11.93   0.0  0.573  6.593  69.1  2.4786    1  273

502  0.04527   0.0  11.93   0.0  0.573  6.120  76.7  2.2875    1  273

503  0.06076   0.0  11.93   0.0  0.573  6.976  91.0  2.1675    1  273

504  0.10959   0.0  11.93   0.0  0.573  6.794  89.3  2.3889    1  273

505  0.04741   0.0  11.93   0.0  0.573  6.030   NaN  2.5050    1  273


     PTRATIO       B  LSTAT  MEDV
0       15.3  396.90   4.98  24.0
1       17.8  396.90   9.14  21.6
2       17.8  392.83   4.03  34.7
3       18.7  394.63   2.94  33.4
4       18.7  396.90    NaN  36.2
..       ...     ...    ...   ...
```

```
501     21.0  391.99    NaN  22.4
502     21.0  396.90   9.08  20.6
503     21.0  396.90   5.64  23.9
504     21.0  393.45   6.48  22.0
505     21.0  396.90   7.88  11.9

[506 rows x 14 columns]
```

```
missing_values = df.isna().sum()
print(missing_values)
```

```
CRIM       20
ZN         20
INDUS      20
CHAS       20
NOX         0
RM          0
AGE        20
DIS         0
RAD         0
TAX         0
PTRATIO     0
B           0
LSTAT      20
MEDV        0
dtype: int64
```

```
import pandas as pd


na_columns = ['CRIM', 'ZN', 'INDUS', 'CHAS', 'AGE', 'LSTAT']


df[na_columns] = df[na_columns].fillna(df.mean())

df
```

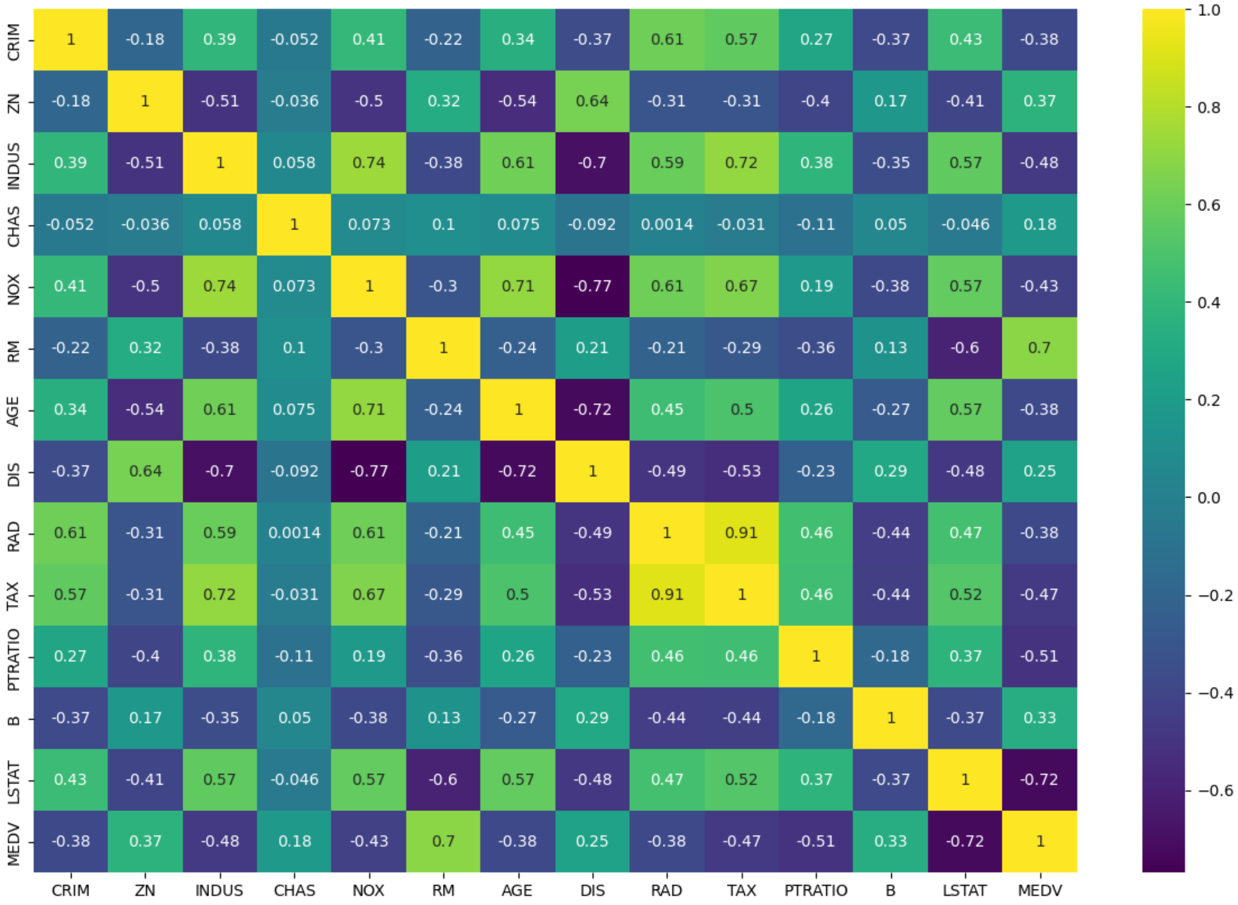
```
        CRIM    ZN  INDUS  CHAS    NOX     RM        AGE     DIS  RAD
TAX  \
0    0.00632  18.0   2.31   0.0  0.538  6.575  65.200000  4.0900    1
296
1    0.02731   0.0   7.07   0.0  0.469  6.421  78.900000  4.9671    2
242
2    0.02729   0.0   7.07   0.0  0.469  7.185  61.100000  4.9671    2
242
3    0.03237   0.0   2.18   0.0  0.458  6.998  45.800000  6.0622    3
222
4    0.06905   0.0   2.18   0.0  0.458  7.147  54.200000  6.0622    3
222
..       ...   ...    ...   ...    ...    ...        ...     ...  ...
```

```
...
501  0.06263   0.0  11.93   0.0  0.573  6.593  69.100000  2.4786    1
273
502  0.04527   0.0  11.93   0.0  0.573  6.120  76.700000  2.2875    1
273
503  0.06076   0.0  11.93   0.0  0.573  6.976  91.000000  2.1675    1
273
504  0.10959   0.0  11.93   0.0  0.573  6.794  89.300000  2.3889    1
273
505  0.04741   0.0  11.93   0.0  0.573  6.030  68.518519  2.5050    1
273

     PTRATIO       B      LSTAT  MEDV
0       15.3  396.90   4.980000  24.0
1       17.8  396.90   9.140000  21.6
2       17.8  392.83   4.030000  34.7
3       18.7  394.63   2.940000  33.4
4       18.7  396.90  12.715432  36.2
..       ...     ...        ...   ...
501     21.0  391.99  12.715432  22.4
502     21.0  396.90   9.080000  20.6
503     21.0  396.90   5.640000  23.9
504     21.0  393.45   6.480000  22.0
505     21.0  396.90   7.880000  11.9

[506 rows x 14 columns]
```

```
corr_matrix_medv = df.corr()["MEDV"]


target_corr = np.abs(df.corrwith(df["MEDV"]))
print(target_corr.sort_values(ascending=False))
```

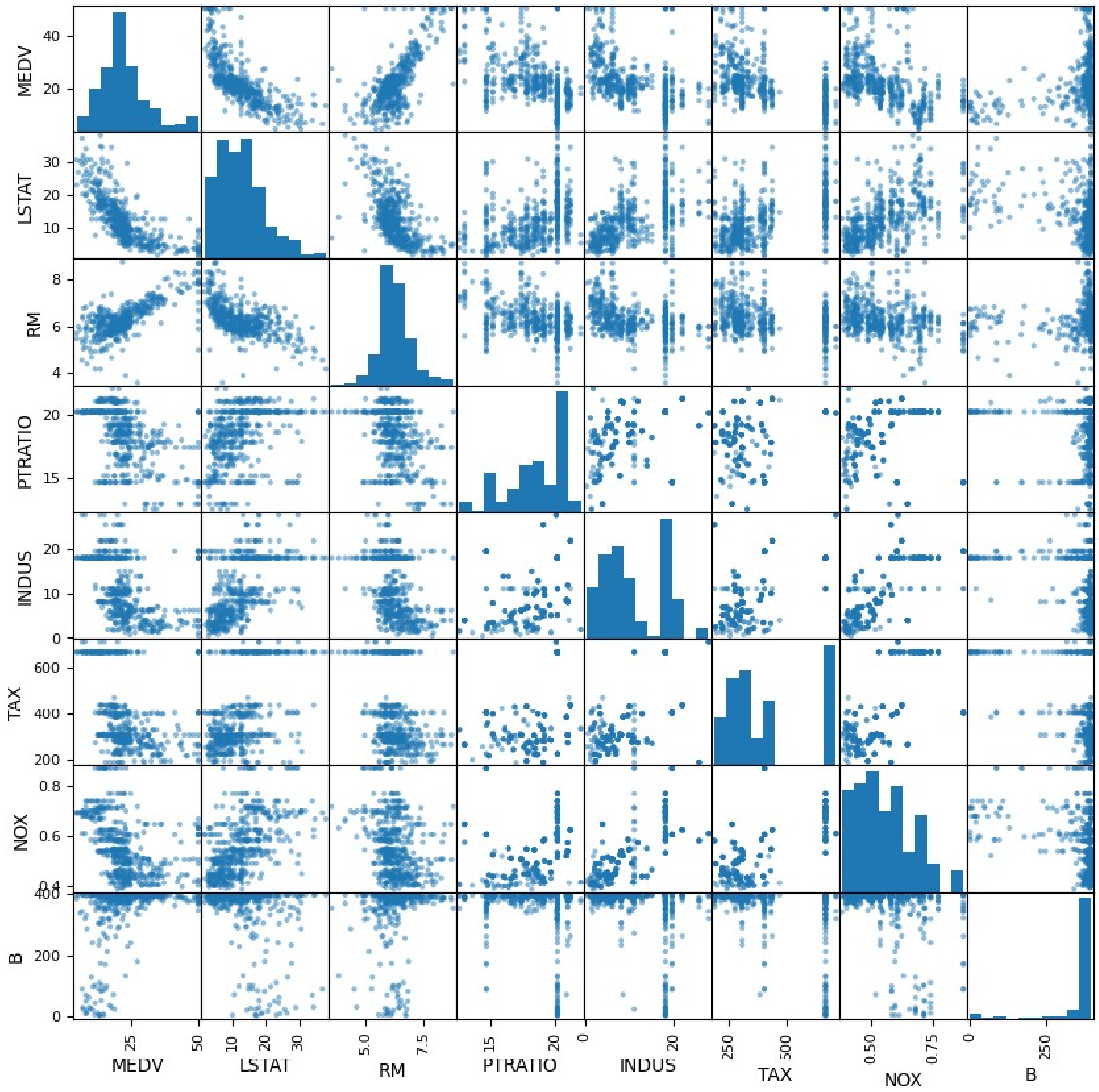
```
MEDV       1.000000
LSTAT      0.721975
RM         0.695360
PTRATIO    0.507787
INDUS      0.478657
TAX        0.468536
NOX        0.427321
RAD        0.381626
AGE        0.380223
CRIM       0.379695
ZN         0.365943
B          0.333461
DIS        0.249929
CHAS       0.179882
dtype: float64
```

```
corr_matrix = df.corr()
plt.figure(figsize=(15,10))
sns.heatmap(corr_matrix,cmap="viridis", annot=True)
plt.show()
```



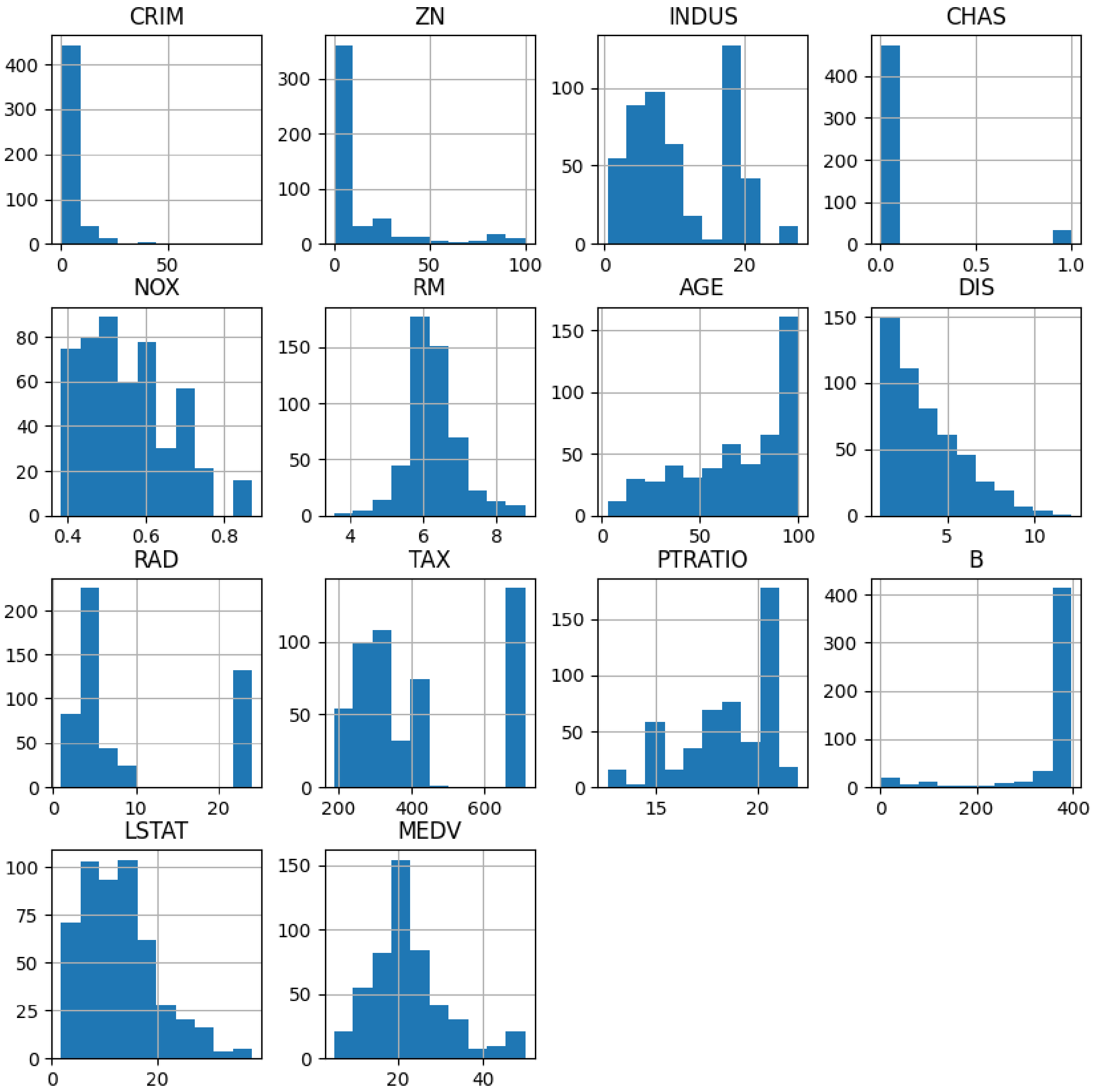
```
columns = ["MEDV", "LSTAT", "RM", "PTRATIO", "INDUS", "TAX",
"NOX","B"]
scatter_matrix(df[columns], alpha=0.5, figsize=(10,10))
```

```
array([[<Axes: xlabel='MEDV', ylabel='MEDV'>,
        <Axes: xlabel='LSTAT', ylabel='MEDV'>,
        <Axes: xlabel='RM', ylabel='MEDV'>,
        <Axes: xlabel='PTRATIO', ylabel='MEDV'>,
        <Axes: xlabel='INDUS', ylabel='MEDV'>,
        <Axes: xlabel='TAX', ylabel='MEDV'>,
        <Axes: xlabel='NOX', ylabel='MEDV'>,
        <Axes: xlabel='B', ylabel='MEDV'>],
       [<Axes: xlabel='MEDV', ylabel='LSTAT'>,
        <Axes: xlabel='LSTAT', ylabel='LSTAT'>,
        <Axes: xlabel='RM', ylabel='LSTAT'>,
        <Axes: xlabel='PTRATIO', ylabel='LSTAT'>,
        <Axes: xlabel='INDUS', ylabel='LSTAT'>,
        <Axes: xlabel='TAX', ylabel='LSTAT'>,
        <Axes: xlabel='NOX', ylabel='LSTAT'>,
        <Axes: xlabel='B', ylabel='LSTAT'>],
       [<Axes: xlabel='MEDV', ylabel='RM'>,
        <Axes: xlabel='LSTAT', ylabel='RM'>,
        <Axes: xlabel='RM', ylabel='RM'>,
        <Axes: xlabel='PTRATIO', ylabel='RM'>,
        <Axes: xlabel='INDUS', ylabel='RM'>,
        <Axes: xlabel='TAX', ylabel='RM'>,
        <Axes: xlabel='NOX', ylabel='RM'>,
        <Axes: xlabel='B', ylabel='RM'>],
       [<Axes: xlabel='MEDV', ylabel='PTRATIO'>,
        <Axes: xlabel='LSTAT', ylabel='PTRATIO'>,
        <Axes: xlabel='RM', ylabel='PTRATIO'>,
        <Axes: xlabel='PTRATIO', ylabel='PTRATIO'>,
        <Axes: xlabel='INDUS', ylabel='PTRATIO'>,
        <Axes: xlabel='TAX', ylabel='PTRATIO'>,
        <Axes: xlabel='NOX', ylabel='PTRATIO'>,
        <Axes: xlabel='B', ylabel='PTRATIO'>],
       [<Axes: xlabel='MEDV', ylabel='INDUS'>,
        <Axes: xlabel='LSTAT', ylabel='INDUS'>,
        <Axes: xlabel='RM', ylabel='INDUS'>,
        <Axes: xlabel='PTRATIO', ylabel='INDUS'>,
        <Axes: xlabel='INDUS', ylabel='INDUS'>,
        <Axes: xlabel='TAX', ylabel='INDUS'>,
        <Axes: xlabel='NOX', ylabel='INDUS'>,
        <Axes: xlabel='B', ylabel='INDUS'>],
       [<Axes: xlabel='MEDV', ylabel='TAX'>,
        <Axes: xlabel='LSTAT', ylabel='TAX'>,
        <Axes: xlabel='RM', ylabel='TAX'>,
        <Axes: xlabel='PTRATIO', ylabel='TAX'>,
        <Axes: xlabel='INDUS', ylabel='TAX'>,
        <Axes: xlabel='TAX', ylabel='TAX'>,
        <Axes: xlabel='NOX', ylabel='TAX'>,
        <Axes: xlabel='B', ylabel='TAX'>],
       [<Axes: xlabel='MEDV', ylabel='NOX'>,
        <Axes: xlabel='LSTAT', ylabel='NOX'>,
        <Axes: xlabel='RM', ylabel='NOX'>,
        <Axes: xlabel='PTRATIO', ylabel='NOX'>,
        <Axes: xlabel='INDUS', ylabel='NOX'>,
        <Axes: xlabel='TAX', ylabel='NOX'>,
        <Axes: xlabel='NOX', ylabel='NOX'>,
        <Axes: xlabel='B', ylabel='NOX'>],
       [<Axes: xlabel='MEDV', ylabel='B'>,
        <Axes: xlabel='LSTAT', ylabel='B'>,
        <Axes: xlabel='RM', ylabel='B'>,
        <Axes: xlabel='PTRATIO', ylabel='B'>,
        <Axes: xlabel='INDUS', ylabel='B'>,
        <Axes: xlabel='TAX', ylabel='B'>,
        <Axes: xlabel='NOX', ylabel='B'>, <Axes: xlabel='B',
ylabel='B'>]],
      dtype=object)
```

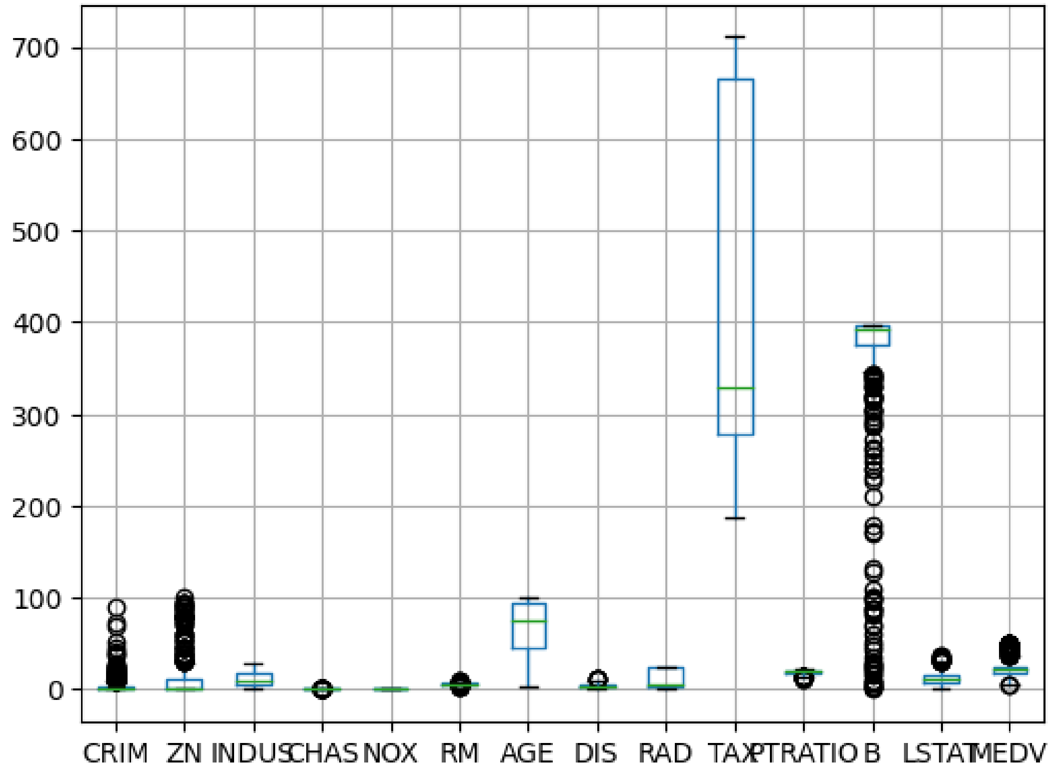


```
df.hist(figsize=(10,10))
```

```
array([[<Axes: title={'center': 'CRIM'}>, <Axes: title={'center':
'ZN'}>,
        <Axes: title={'center': 'INDUS'}>,
        <Axes: title={'center': 'CHAS'}>],
       [<Axes: title={'center': 'NOX'}>, <Axes: title={'center':
'RM'}>,
        <Axes: title={'center': 'AGE'}>, <Axes: title={'center':
'DIS'}>],
       [<Axes: title={'center': 'RAD'}>, <Axes: title={'center':
'TAX'}>,
        <Axes: title={'center': 'PTRATIO'}>,
        <Axes: title={'center': 'B'}>],
       [<Axes: title={'center': 'LSTAT'}>,
        <Axes: title={'center': 'MEDV'}>, <Axes: >, <Axes: >]],
      dtype=object)
```



```
df.boxplot()
plt.show()
```



```
df.drop(["CHAS","DIS"], axis=1, inplace=True)
df
```

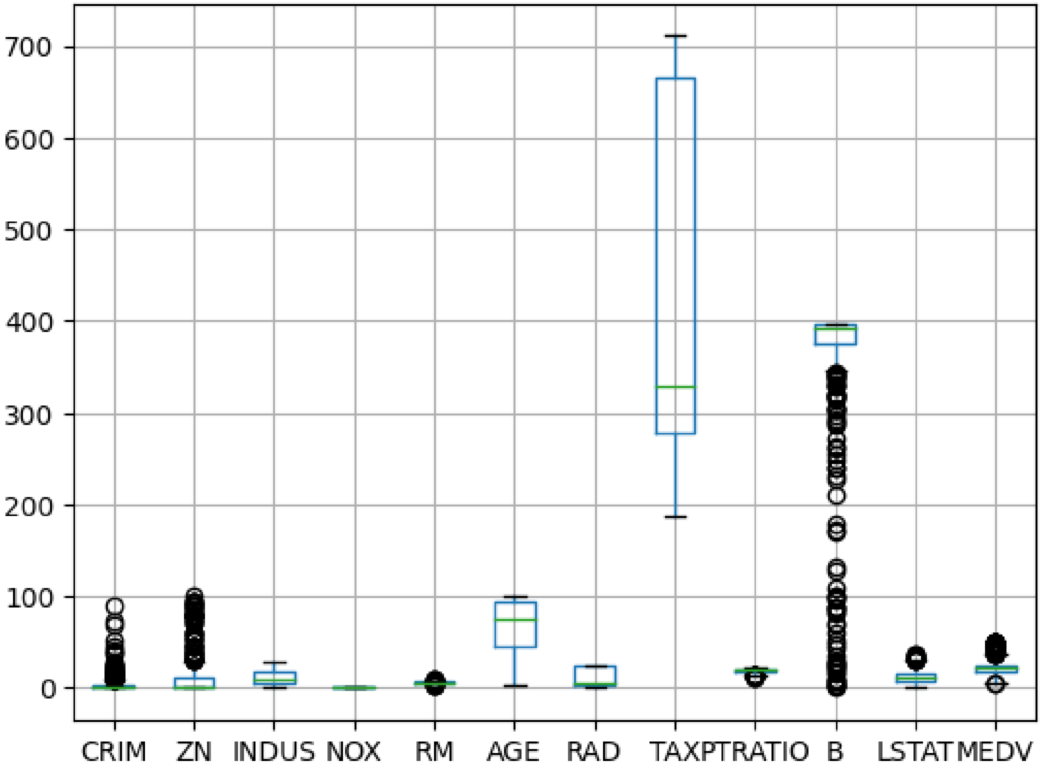
```
         CRIM    ZN   INDUS    NOX     RM        AGE  RAD  TAX  PTRATIO
B  \
0     0.00632  18.0    2.31  0.538  6.575  65.200000    1  296     15.3
396.90
1     0.02731   0.0    7.07  0.469  6.421  78.900000    2  242     17.8
396.90
2     0.02729   0.0    7.07  0.469  7.185  61.100000    2  242     17.8
392.83
3     0.03237   0.0    2.18  0.458  6.998  45.800000    3  222     18.7
394.63
4     0.06905   0.0    2.18  0.458  7.147  54.200000    3  222     18.7
396.90
..        ...   ...     ...    ...    ...        ...  ...  ...      ...
...
501   0.06263   0.0   11.93  0.573  6.593  69.100000    1  273     21.0
391.99
502   0.04527   0.0   11.93  0.573  6.120  76.700000    1  273     21.0
396.90
```

```
503  0.06076   0.0  11.93  0.573  6.976  91.000000    1  273      21.0
396.90
504  0.10959   0.0  11.93  0.573  6.794  89.300000    1  273      21.0
393.45
505  0.04741   0.0  11.93  0.573  6.030  68.518519    1  273      21.0
396.90

         LSTAT  MEDV
0     4.980000  24.0
1     9.140000  21.6
2     4.030000  34.7
3     2.940000  33.4
4    12.715432  36.2
..         ...   ...
501  12.715432  22.4
502   9.080000  20.6
503   5.640000  23.9
504   6.480000  22.0
505   7.880000  11.9

[506 rows x 12 columns]
```

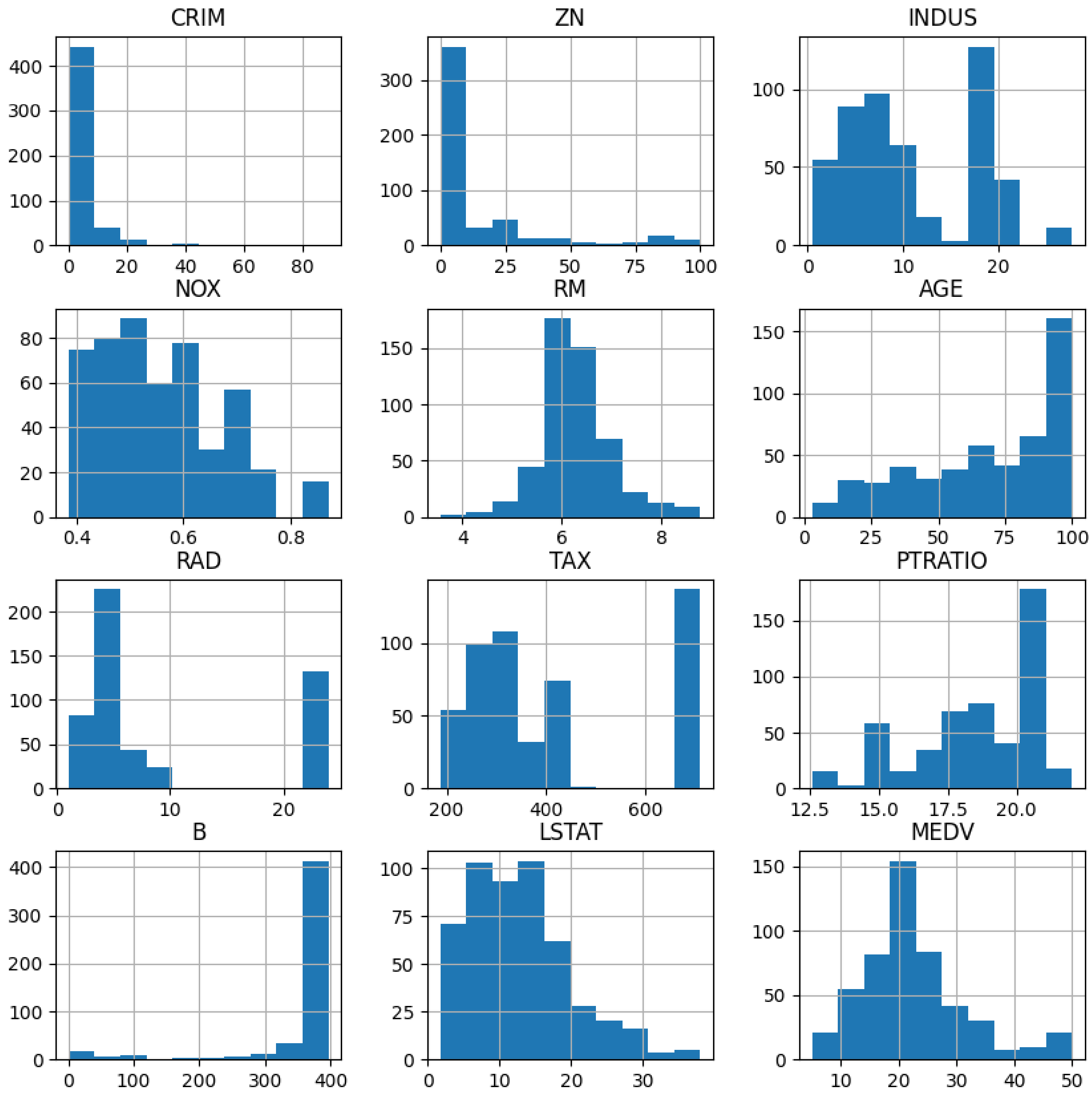
```
z_threshold = 3

df_filtered = df.loc[(stats.zscore(df) < z_threshold).all(axis=1)]

df.describe()
```

```
             CRIM          ZN       INDUS         NOX          RM
AGE  \
count  506.000000  506.000000  506.000000  506.000000  506.000000
506.000000
mean     3.611874   11.211934   11.083992    0.554695    6.284634
68.518519
std      8.545770   22.921051    6.699165    0.115878    0.702617
27.439466
min      0.006320    0.000000    0.460000    0.385000    3.561000
2.900000
25%      0.083235    0.000000    5.190000    0.449000    5.885500
45.925000
50%      0.290250    0.000000    9.900000    0.538000    6.208500
74.450000
75%      3.611874   11.211934   18.100000    0.624000    6.623500
93.575000
max     88.976200  100.000000   27.740000    0.871000    8.780000
100.000000

              RAD         TAX     PTRATIO           B       LSTAT
MEDV
count  506.000000  506.000000  506.000000  506.000000  506.000000
```

```
506.000000
mean      9.549407  408.237154   18.455534  356.674032   12.715432
22.532806
std       8.707259  168.537116    2.164946   91.294864    7.012739
9.197104
min       1.000000  187.000000   12.600000    0.320000    1.730000
5.000000
25%       4.000000  279.000000   17.400000  375.377500    7.230000
17.025000
50%       5.000000  330.000000   19.050000  391.440000   11.995000
21.200000
75%      24.000000  666.000000   20.200000  396.225000   16.570000
25.000000
max      24.000000  711.000000   22.000000  396.900000   37.970000
50.000000

#after removing outliers
df.boxplot()
plt.show()
```



```
df.hist(figsize=(10,10))

array([[<Axes: title={'center': 'CRIM'}>, <Axes: title={'center':
'ZN'}>,
        <Axes: title={'center': 'INDUS'}>],
       [<Axes: title={'center': 'NOX'}>, <Axes: title={'center':
'RM'}>,
        <Axes: title={'center': 'AGE'}>],
       [<Axes: title={'center': 'RAD'}>, <Axes: title={'center':
'TAX'}>,
        <Axes: title={'center': 'PTRATIO'}>],
       [<Axes: title={'center': 'B'}>, <Axes: title={'center':
'LSTAT'}>,
        <Axes: title={'center': 'MEDV'}>]], dtype=object)
```



```
X = df.drop(["MEDV"], axis=1)
y = df["MEDV"]
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=0)

scaler = StandardScaler()

X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

model = SVR()
model.fit(X_train_scaled, y_train)

#prediction
y_pred = model.predict(X_test_scaled)
print(y_pred)
```

```
[25.69117323 21.51473548 27.46364514 11.42647798 22.60504556
19.56599572
 20.01781172 21.92875502 16.11445511 17.979815    5.00323074
15.1903639
 17.92115009  4.63104325 38.41069244 33.88255916 22.23338886
37.43354497
 29.50436721 22.21842227 25.21566944 24.63131522 18.39816469
28.12635532
 22.68037949  5.94072    18.070583   19.92104695 35.6858979
20.35411987
 17.9852751  18.78474769 23.81926763 24.98858869 27.97315935
17.02198721
 11.5816075  19.82512086 16.81722989 15.20664726 27.72294686
21.55369674
 24.0904647  14.45980881 26.63625634 26.53526097 23.1250461
22.85469833
 11.80766452 23.22151249 20.3409109  16.40276015 23.97025654
36.11254501
 13.10959866 23.75841655 21.87581317 20.05049051 11.1236799
20.26474593
 22.4153387  22.28723937 32.95248836 29.42263477 16.96875883
30.76164445
 19.94189047 24.37443944 19.27862811 22.31262839 22.93643269
24.18665071
 29.21445077 30.04186351 25.90333672  4.91608434 37.94308161
24.42100881
 25.91955652 18.63260208 29.66694218 18.92272606 16.51606256
38.07613447
 40.02836805 24.9909603  23.59879323 14.48736037 28.29158754
17.01941252
 15.82680364 14.43502003 26.85909845 32.87613508 20.59317319
23.60222709
```

```
 -0.97691083 27.49014212 16.27837363 20.26542458 25.14238542
20.92448871]
```

```
#Mean Squared Error
mse = mean_squared_error(y_test, y_pred)
print(f"Mean Squared Error is: {mse}")
```

```
Mean Squared Error is: 40.145576883770715
```

```
rmse = mean_squared_error(y_test, y_pred, squared=False)
print(f"Root mean squared error: {rmse}")
```

```
Root mean squared error: 6.336053731130341
```

```
#R squared
r2 = r2_score(y_test, y_pred)
print(f"R2 Score: {r2}")
```

```
R2 Score: 0.5069833421066399
```

```
df
```

```
        CRIM    ZN  INDUS    NOX     RM        AGE  RAD  TAX  PTRATIO
B  \
0    0.00632  18.0   2.31  0.538  6.575  65.200000    1  296     15.3
396.90
1    0.02731   0.0   7.07  0.469  6.421  78.900000    2  242     17.8
396.90
2    0.02729   0.0   7.07  0.469  7.185  61.100000    2  242     17.8
392.83
3    0.03237   0.0   2.18  0.458  6.998  45.800000    3  222     18.7
394.63
4    0.06905   0.0   2.18  0.458  7.147  54.200000    3  222     18.7
396.90
..       ...   ...    ...    ...    ...        ...  ...  ...      ...
...
501  0.06263   0.0  11.93  0.573  6.593  69.100000    1  273     21.0
391.99
502  0.04527   0.0  11.93  0.573  6.120  76.700000    1  273     21.0
396.90
503  0.06076   0.0  11.93  0.573  6.976  91.000000    1  273     21.0
396.90
504  0.10959   0.0  11.93  0.573  6.794  89.300000    1  273     21.0
393.45
505  0.04741   0.0  11.93  0.573  6.030  68.518519    1  273     21.0
396.90

         LSTAT  MEDV
0     4.980000  24.0
1     9.140000  21.6
2     4.030000  34.7
```

```
3     2.940000  33.4
4    12.715432  36.2
..         ...   ...
501  12.715432  22.4
502   9.080000  20.6
503   5.640000  23.9
504   6.480000  22.0
505   7.880000  11.9

[506 rows x 12 columns]
```

```
custom_input = pd.DataFrame({
    'CRIM': [0.147],
    'ZN':[2],
    'INDUS': [8.50],
    'NOX': [0.53],
    'RM': [6.728],
    'AGE': [79.5],
    'RAD': [5],
    'TAX': [385],
    'PTRATIO':[20.9],
    'B':[395.0],
    'LSTAT':[9.42]
})

custom_input_scaled = scaler.transform(custom_input)

prediction = model.predict(custom_input_scaled)

print("Predicted value:", prediction[0])
```

```
Predicted value: 23.15947993650905
```

Я использовал различные метрики для оценки моделей регрессии, среднюю квадратичную ошибку (MSE), RMSE и коэффициент детерминации (R-квадрат).