Regression Examples

October 11, 2021

[ ]:
```
# import all the required libraries and put matplotlib in inline mode to plot␣
↪on the notebook
import pandas as pd
import numpy as np
import math
import matplotlib.pyplot as plt
%matplotlib inline

# linear regression
from sklearn import linear_model

# nearest neighbor
from sklearn import neighbors

# regression trees (simple and ensemble)
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import AdaBoostRegressor

from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
```

[ ]:
```
# define the random seed if needed
random_seed = 1234

# define the figure size and the font size
fig_width = 12
fig_height = 9
fig_font_size = 16
```

[ ]:
```
df = pd.read_csv('housing.csv')
df.describe(include='all')
```

[ ]:

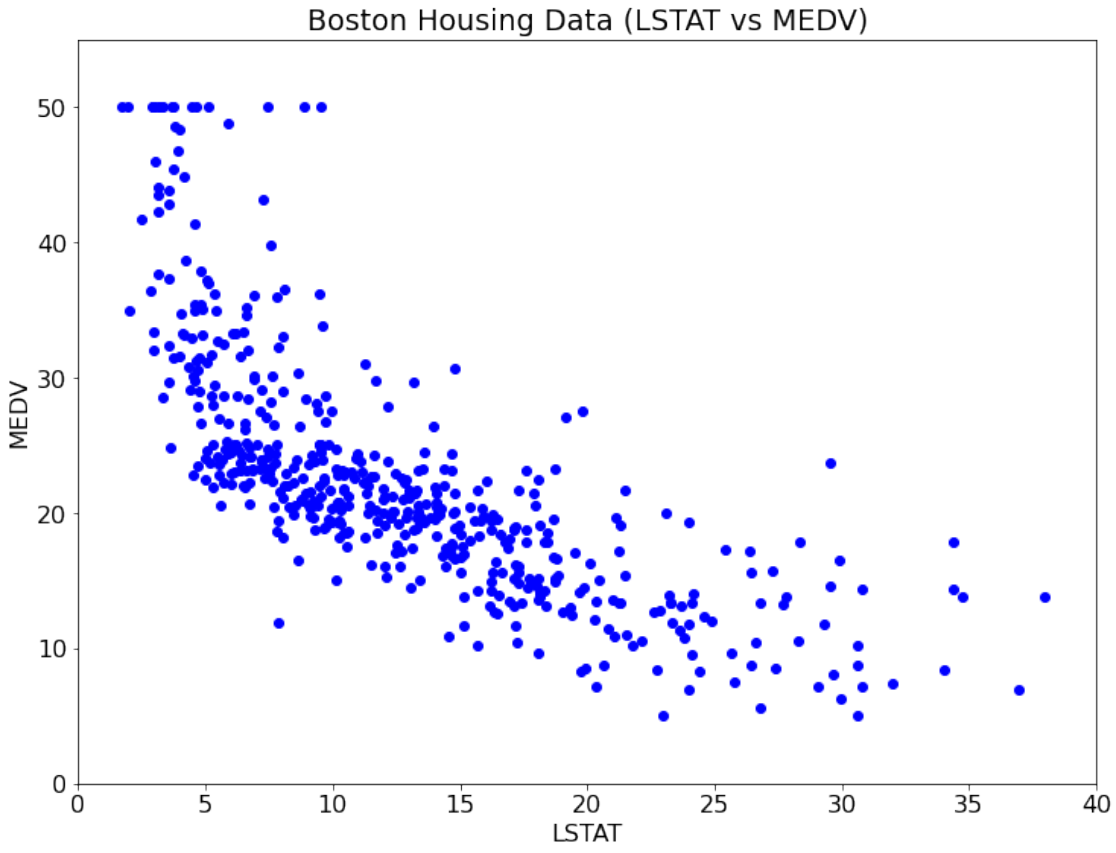
	CRIM	ZN	INDUS	CHAS	NOX	RM	\
count	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	
mean	3.613524	11.363636	11.136779	0.069170	0.554695	6.284634	
std	8.601545	23.322453	6.860353	0.253994	0.115878	0.702617	
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	
25%	0.082045	0.000000	5.190000	0.000000	0.449000	5.885500	

```
50%      0.256510    0.000000    9.690000    0.000000    0.538000    6.208500
75%      3.677083   12.500000   18.100000    0.000000    0.624000    6.623500
max     88.976200  100.000000   27.740000    1.000000    0.871000    8.780000

              AGE         DIS         RAD         TAX     PTRATIO           B  \
count  506.000000  506.000000  506.000000  506.000000  506.000000  506.000000
mean    68.574901    3.795043    9.549407  408.237154   18.455534  356.674032
std     28.148861    2.105710    8.707259  168.537116    2.164946   91.294864
min      2.900000    1.129600    1.000000  187.000000   12.600000    0.320000
25%     45.025000    2.100175    4.000000  279.000000   17.400000  375.377500
50%     77.500000    3.207450    5.000000  330.000000   19.050000  391.440000
75%     94.075000    5.188425   24.000000  666.000000   20.200000  396.225000
max    100.000000   12.126500   24.000000  711.000000   22.000000  396.900000

            LSTAT        MEDV
count  506.000000  506.000000
mean    12.653063   22.532806
std      7.141062    9.197104
min      1.730000    5.000000
25%      6.950000   17.025000
50%     11.360000   21.200000
75%     16.955000   25.000000
max     37.970000   50.000000
```

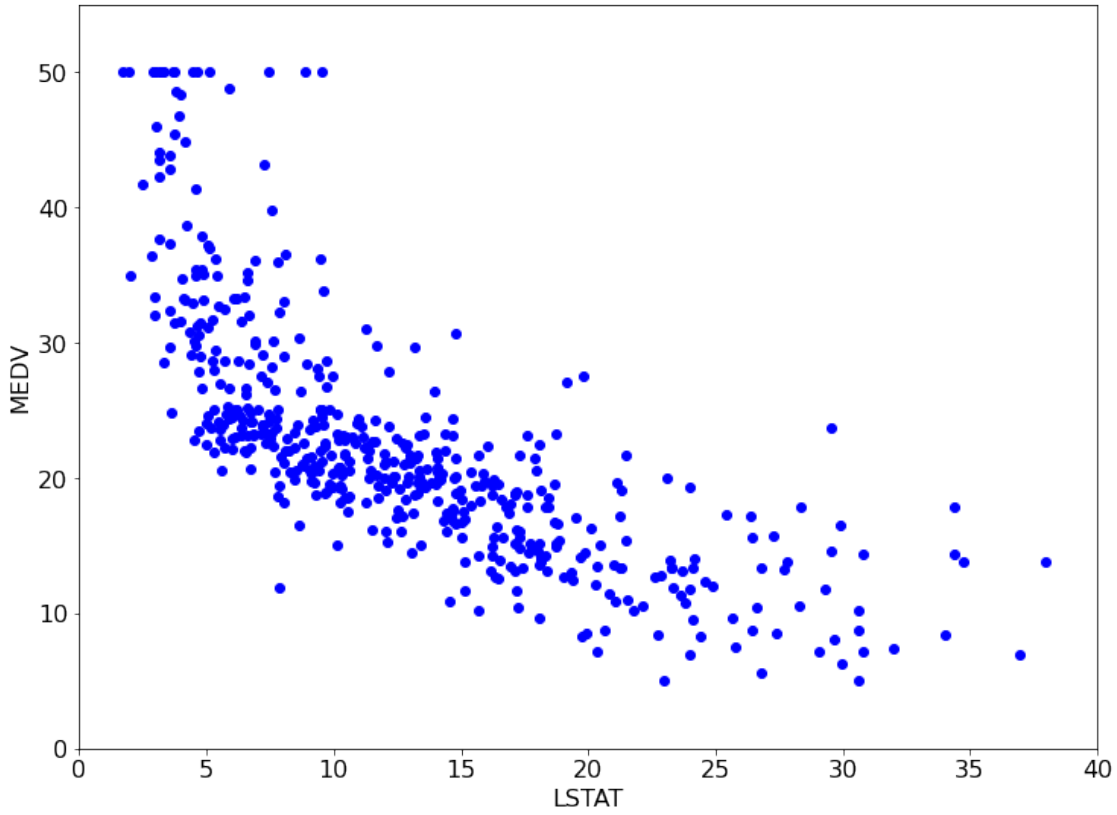
[ ]:
```python
def plot_prediction(x,y,xp=None,yp=None,title=""):
    """Plots the original data (x,y) and a set of point (xp,yp) showing the␣
 ↪model approximation"""

    plt.figure(figsize=(fig_width,fig_height))

    font = {'family' : 'sans', 'size'   : fig_font_size}
    plt.rc('font', **font)

    plt.scatter(x, y,  color='blue')

    if (not xp is None) and (not yp is None):
        plt.plot(xp, yp, color='red', linewidth=3)

    plt.xlabel("LSTAT")
    plt.ylabel("MEDV")

    plt.title(title)

    plt.xlim([0,40])
    plt.ylim(0,55)

    plt.show()
```

[ ]:
```
# compute the data inputs
X = df['LSTAT'].values.reshape(-1,1)
y = df['MEDV'].values.ravel()

# input values used to plot the predicted model
X_test = np.linspace(np.min(X), np.max(X), 500)[:, np.newaxis]
```

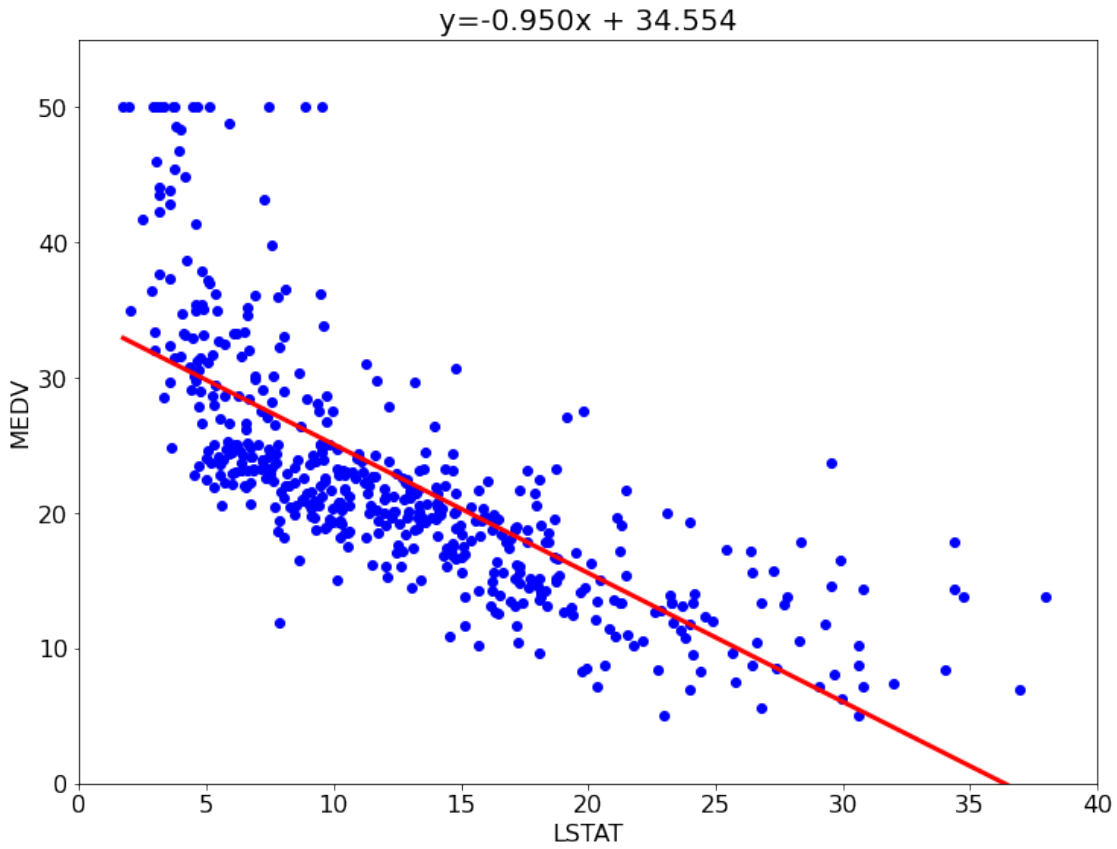
[ ]:
```
plt.figure(figsize=(fig_width,fig_height))

font = {'family' : 'sans', 'size'   : fig_font_size}
plt.rc('font', **font)

plt.scatter(X, y,  color='blue')

plt.xlabel("LSTAT")
plt.ylabel("MEDV")

plt.title("Boston Housing Data (LSTAT vs MEDV)")

plt.xlim([0,40])
plt.ylim(0,55)

plt.show()
```



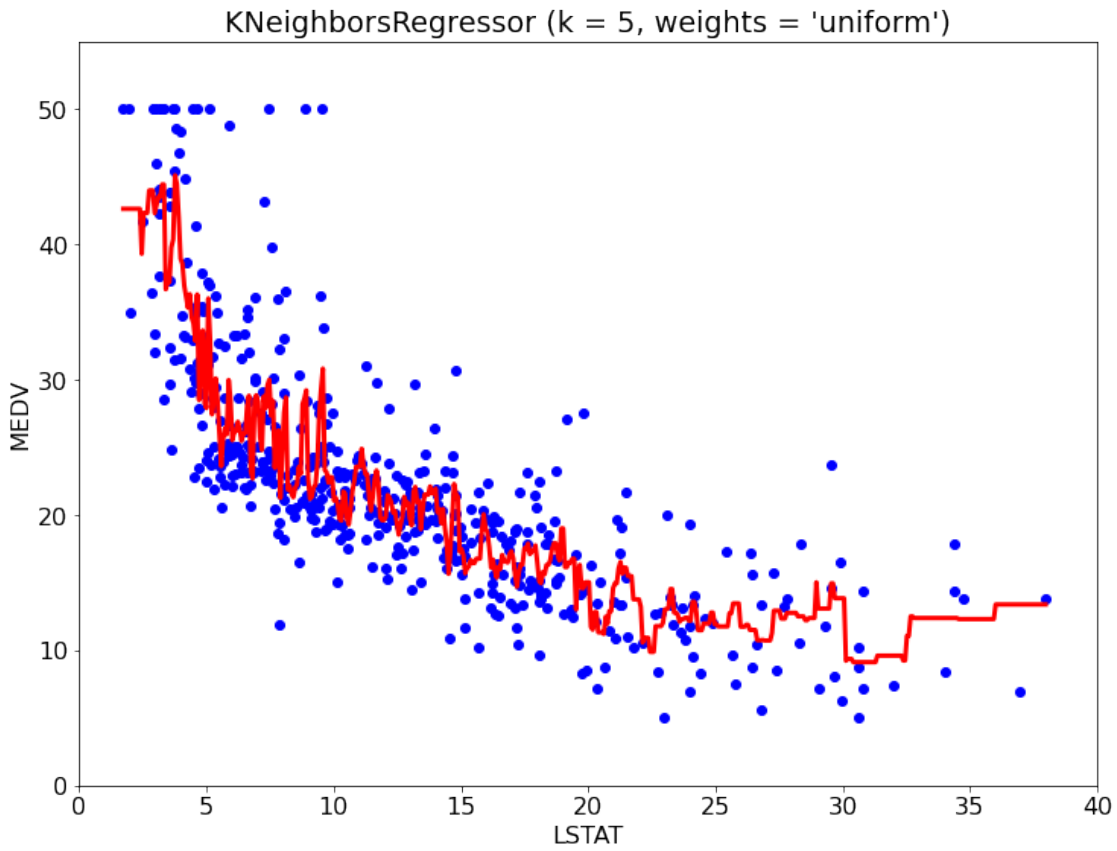
[ ]:
```
plot_prediction(X,y);
```



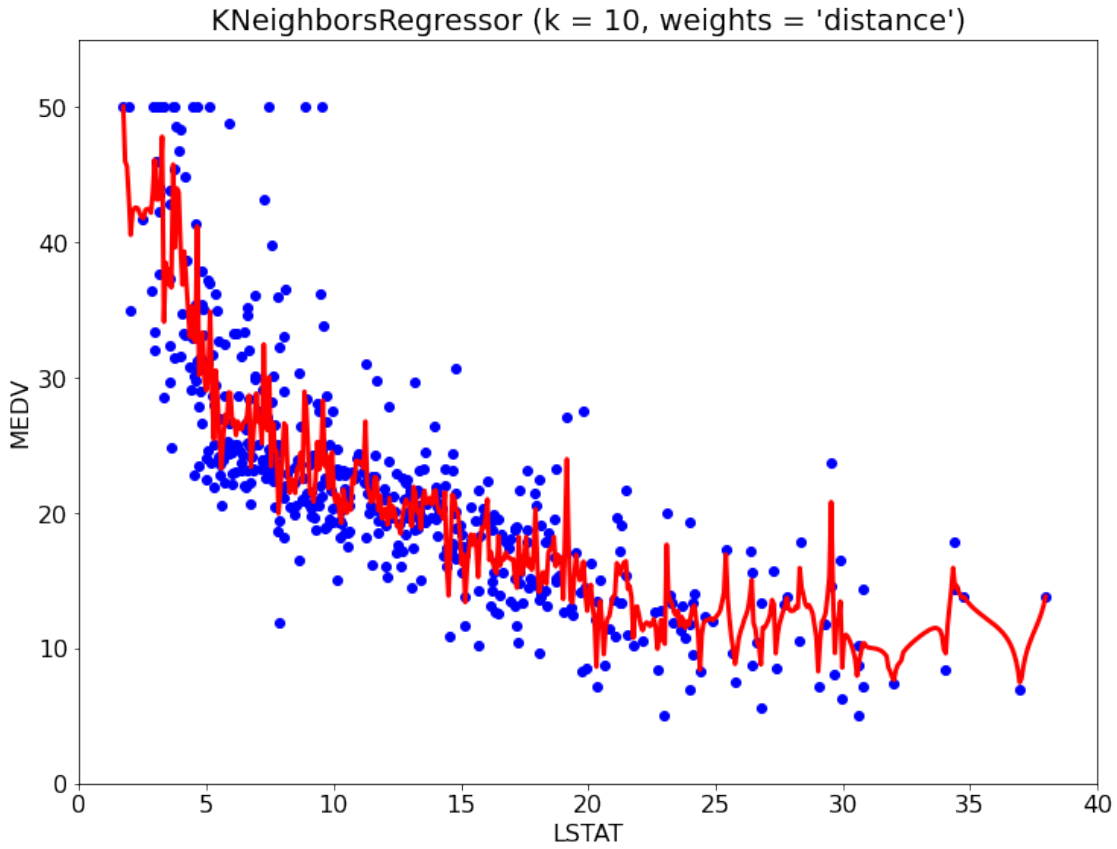
[ ]:
```
# simple linear regression
regr = linear_model.LinearRegression()
regr.fit(X, y)

# model output for the input data
y_test = regr.predict(X_test)

# plot the result
plot_prediction(X, y, X_test, y_test, "y=%.3fx + %.3f" % (regr.coef_[0],regr.
 ↪intercept_));
```



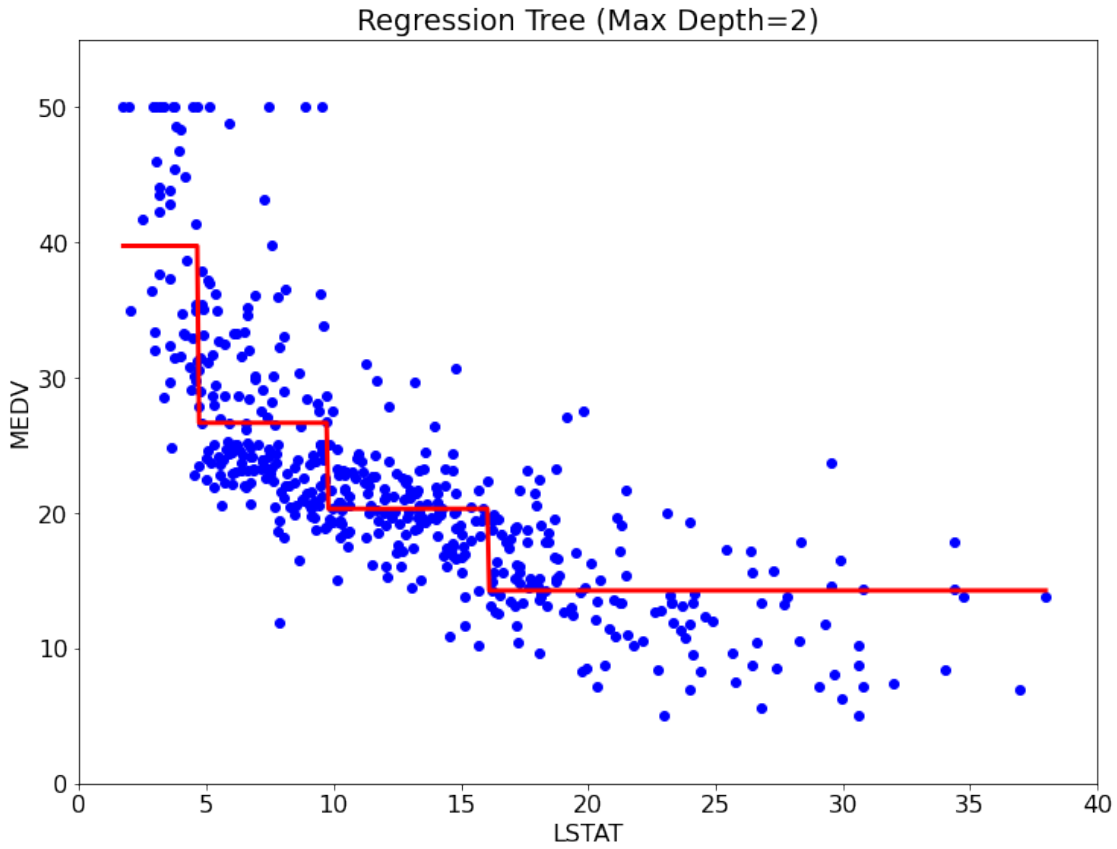
[ ]:
```
knn = neighbors.KNeighborsRegressor(5, weights='uniform')

knn.fit(X, y)

y_test = knn.predict(X_test)

plot_prediction(X,y,X_test,y_test, "KNeighborsRegressor (k = 5, weights =␣
↪'uniform')");
```



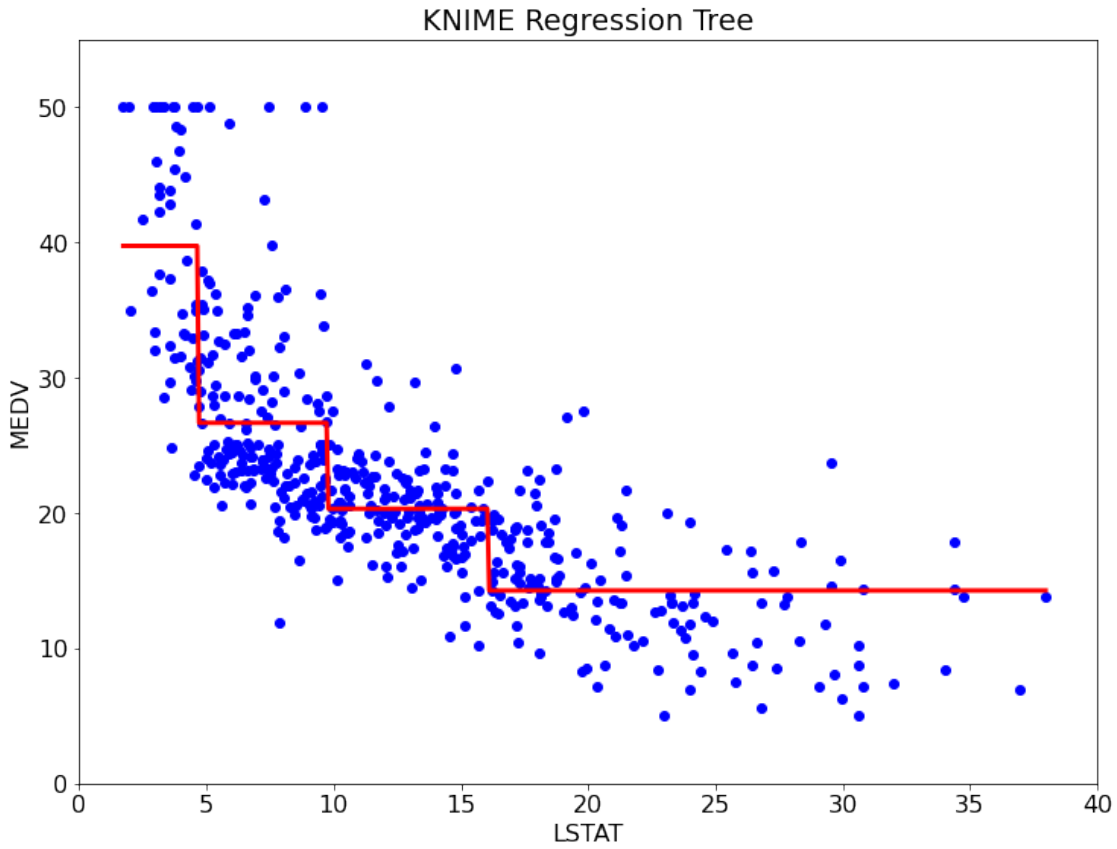
[ ]:
```
knn = neighbors.KNeighborsRegressor(10, weights='distance')

knn.fit(X, y)

y_test = knn.predict(X_test)

plot_prediction(X,y,X_test,y_test, "KNeighborsRegressor (k = 10, weights =␣
↪'distance')");
```



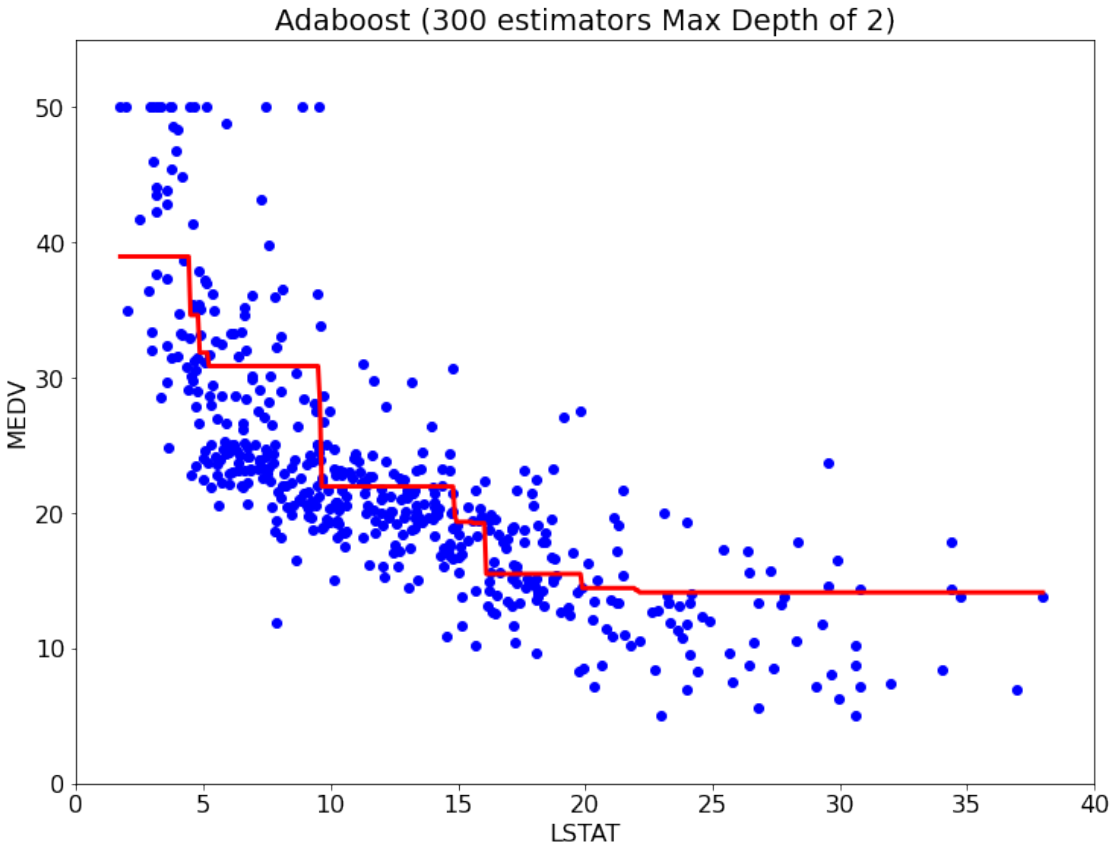
[ ]:
```
regression_tree = DecisionTreeRegressor(max_depth=2)
regression_tree.fit(X,y.ravel())
y_test = regression_tree.predict(X_test)

plot_prediction(X,y,X_test,y_test, "Regression Tree (Max Depth=2)");
```



[ ]:
```
# implementation of the model developed using KNIME

def TreeModel(x):
    if (x<=9.725):
        if (x<=4.65):
            return 39.718
        else:
            return 26.6463
    else:
        if (x<=16.08):
            return 20.302
        else:
            return 14.2618


y_test = np.vectorize(TreeModel)(X_test)

plot_prediction(X,y,X_test,y_test, "KNIME Regression Tree");
```



[ ]:
```
adaboost_model = AdaBoostRegressor(DecisionTreeRegressor(max_depth=2),␣
↪n_estimators=300, random_state=random_seed)
adaboost_model.fit(X, y.ravel())

y_test = adaboost_model.predict(X_test)

plot_prediction(X, y, X_test, y_test, "Adaboost (300 estimators Max Depth of␣
↪2)");
```


Adaboost (300 estimators Max Depth of 2)
MEDV
LSTAT
0
10
20
30
40
50
0
5
10
15
20
25
30
35
40