In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
```

In [2]:
```
df = pd.read_csv('HousingData.csv')
df
```

Out[2]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRAT
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1	296	15
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2	242	1
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2	242	1
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3	222	18
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3	222	18
...	...	...	...	...	...	...	...	...	...	...	
501	0.06263	0.0	11.93	0.0	0.573	6.593	69.1	2.4786	1	273	21
502	0.04527	0.0	11.93	0.0	0.573	6.120	76.7	2.2875	1	273	21
503	0.06076	0.0	11.93	0.0	0.573	6.976	91.0	2.1675	1	273	21
504	0.10959	0.0	11.93	0.0	0.573	6.794	89.3	2.3889	1	273	21
505	0.04741	0.0	11.93	0.0	0.573	6.030	NaN	2.5050	1	273	21

506 rows × 14 columns

In [3]:
```
df.shape
```

Out[3]:
```
(506, 14)
```

In [4]:
```
df.isnull().sum()
```

Out[4]:
```
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
```

In [5]:
```
df['CRIM'] = df['CRIM'].fillna(df['CRIM'].mean())
df['ZN'] = df['ZN'].fillna(df['ZN'].mean())
```

```
df['INDUS'] = df['INDUS'].fillna(df['INDUS'].mean())
df['CHAS'] = df['CHAS'].fillna(df['CHAS'].mean())
df['AGE'] = df['AGE'].fillna(df['NOX'].mean())
df['LSTAT'] = df['LSTAT'].fillna(df['LSTAT'].mean())
df
```

Out[5]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	I
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	0.554695	2.5050	1	273	

506 rows × 14 columns

In [6]:
```
df.isnull().sum()
```

Out[6]:
```
CRIM       0
ZN         0
INDUS      0
CHAS       0
NOX        0
RM         0
AGE        0
DIS        0
RAD        0
TAX        0
PTRATIO    0
B          0
LSTAT      0
MEDV       0
dtype: int64
```

In [7]:
```
x = df.drop('MEDV', axis=1)
x
```

Out[7]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	I
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	0.554695	2.5050	1	273	

506 rows × 13 columns

In [8]:
```
y = df['MEDV']
y
```

Out[8]:
```
0      24.0
1      21.6
2      34.7
3      33.4
4      36.2
       ...
501    22.4
502    20.6
503    23.9
504    22.0
505    11.9
Name: MEDV, Length: 506, dtype: float64
```

In [9]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, rar
```

In [10]:
```
x_train
```

Out[10]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX
220	0.358090	0.0	6.200000	1.000000	0.507	6.951	88.5	2.8617	8	307
71	0.158760	0.0	10.810000	0.000000	0.413	5.961	17.5	5.2873	4	305
240	0.113290	30.0	4.930000	0.069959	0.428	6.897	54.3	6.3361	6	300
6	0.088290	12.5	7.870000	0.069959	0.524	6.012	66.6	5.5605	5	311
417	25.940600	0.0	18.100000	0.000000	0.679	5.304	89.1	1.6475	24	666
...	...	...	...	...	...	...	...	...	...	...
323	0.283920	0.0	7.380000	0.000000	0.493	5.708	74.3	4.7211	5	287
192	3.611874	45.0	3.440000	0.000000	0.437	7.178	26.3	6.4798	5	398
117	0.150980	0.0	10.010000	0.000000	0.547	6.021	82.6	2.7474	6	432
47	0.229270	0.0	11.083992	0.000000	0.448	6.030	85.5	5.6894	3	233
172	0.139140	0.0	4.050000	0.000000	0.510	5.572	88.5	2.5961	5	296

404 rows × 13 columns

In [11]:
```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(x_train.values, y_train.values)
```

Out[11]:

▾ LinearRegression

```
LinearRegression()
```

In [12]:
```
y_train_pred = model.predict(x_train.values)
y_test_pred = model.predict(x_test.values)
```

In [13]:
```
y_train_pred
```

Out[13]:
```
array([32.66475357, 22.54760255, 27.92272071, 23.625425  ,  6.45861412,
       13.93671818, 21.99813652, 29.37255546, 32.26120163, 12.96973779,
       19.94017093, 21.45691431, 12.8839238 , 23.92943611,  5.97521446,
       18.93574189,  9.22524241, 45.33468083, 30.74460224, 17.25459323,
       17.76350511, 21.90996473, 23.29496036, 18.97171185, 34.91668639,
       13.50648784, 20.87214382, 35.52772443, 19.06816761, 13.54186364,
       13.76659184, 22.07218103, 14.98269752, 31.34278627, 25.39744809,
       16.1870452 , 24.86653661,  9.63533679, 15.04079584, 21.9231712 ,
       33.08970263, 28.30793582, 26.6815381 , 15.31770869, 31.83213513,
       25.30973944, 14.15787572,  7.92149041, 27.76577059, 25.30401239,
        4.99697272, 28.22349867, 16.77086549, 29.86368234, 19.11821305,
       16.15376997, 18.41077744, 12.7567695 ,  8.79391708, 19.05618572,
       35.71550638, 32.72210532, 23.71015905, 20.18648812, 22.93000843,
       26.44974296, 21.0615435 , 17.69830015, 32.39856766, 10.49365749,
       19.10820204, 31.36688112, 18.96836882, 15.76882773, 18.94519156,
       15.15847982, 24.11855199, 23.38207934, 17.3295206 , 13.10475782,
       20.54654327, 23.99183807, 17.46003754, 25.57826811, 22.75564999,
       27.96955482, 36.79911276, 16.29320092, 11.96928193, 34.98157367,
       31.2956174 , 20.32883487, 39.91898815, 28.63629469, 28.52460167,
       17.68554714, 26.84504736, 40.39261223, 27.46393012, 17.137448  ,
       37.46198772, 35.70706734, 14.06849289, 27.49265535, 24.01488559,
       24.968266  , 21.24194434, 23.22159002, 27.94396566, 29.45052215,
       13.83197008, 26.09853134, 22.80277822, 15.43676479, 13.97762078,
       25.50947859, 19.48687456, 30.44350731,  9.85025779, 24.27331225,
       17.03316039, 16.85546978, 22.75870841, 21.67495995, 12.0451091 ,
       25.08931078, 28.51617952, 22.65604474, 12.19565184, 24.93552503,
       26.58866568, 25.7705037 , 23.51770572, 25.60406486, 19.33663113,
       20.71038807, 36.06303681, 20.99110962, 36.30038206, 25.71105746,
       20.83663618, 15.40620166, 32.04196757, 21.32944187, 28.06820878,
       16.71628892, 32.72246926, 14.11501893,  1.48726866, 19.44446647,
       13.70894591, 37.55581629, 16.17814528, 14.35177526, 26.62492959,
       23.51386813, 17.58187046, 31.19908409, 25.40403936, 27.60077495,
       24.60481019, 22.86284304, 22.41781158, 11.11394138, 20.73667755,
       11.53702529, 17.62501807, 12.30439483, 27.55821134, 14.98300245,
       15.86027234, 28.61576048, 14.2952606 , 21.67971867, 12.6258741 ,
       16.4079762 , 23.3856092 , 21.14944384, 14.80325171, 17.41895461,
       14.95913785, 26.00657216, 12.54531255, 35.34831489, 14.44057714,
       43.19084197, 31.60225234, 34.73011197, 22.06549381, 15.60881839,
       26.86711745, 29.08585412, 13.6020358 , 26.62936499, 36.01124274,
       16.70502674, 11.53256998, 34.49979514, 36.02843502, 17.94009918,
       21.23466028, 20.40463658, 24.44503261, 19.5133743 , 27.09874464,
       -4.35147473, 20.83165704, 32.92028686, 35.38683579, 25.09427472,
       26.70282143, 20.19959097, 21.47888434, 16.00569814, 17.82411768,
       21.22008077, 27.93097558, 19.83756506,  6.96957231, 16.07007846,
       32.24463684, 35.49232568, 16.35221777, 18.86660548, 22.33681004,
        6.36701386, 21.42824658, 23.58756671, 15.85947528, 18.40347802,
       23.21231647, 27.04107566, 25.85228541, 32.73542374, 14.68833813,
       28.93776787, 24.93274252, 20.81833898, 38.5230573 , 21.98860617,
       23.59465047, 22.5915317 , 12.04014312, 20.06564025, 33.38017755,
       24.71481958, 17.76569636, 33.11025806, 22.08990019, 28.73314095,
       32.06058555, 36.47410146, 21.66024396, 24.05946361, 23.1696524 ,
       32.0392582 , 22.19777583, 18.26850685, 21.89849598, 29.33625032,
       22.89607891, 21.98997098, 16.9860062 , 17.32403378, 16.95639466,
       16.85650119, 16.67797165, 31.93962811, 23.06540444, 17.48840171,
       19.06901983, 34.20518995, 13.92961901, 26.13376776, 16.98878425,
       30.66239417, 29.94233138, 23.11218925, 20.15856534, 36.1991215 ,
```

```
       20.53732926, 33.46685682, 21.36666915, 31.50394589, 30.09643429,
       37.30345689, 25.71187931, 20.88627074, 29.11779833, 15.97053177,
       25.91460539, 21.48266931, 29.92258458, 10.29951201, 31.2335619 ,
        6.23492083, 15.21271299, 20.37088814, 35.76335679, 31.79152748,
       12.22466543, 13.67981558, 21.98115843, 34.69693923, 18.75887204,
       18.38805663, 14.72038213, 25.298637  , 40.95303912, 25.39285876,
       42.04574424, 25.45406537, 20.88512916, 11.87425463, 15.8524752 ,
       14.04805806, 18.44010864,  3.0485567 , 27.64307522, 26.43528674,
       41.75366915, 21.65531543, 21.07349544, 34.06526064, 32.73156545,
        9.46651233, 24.80881062, 43.77303166, 21.73707107, 17.66971023,
       26.3438443 , 18.42979496,  6.36551293, 18.82126102, 35.63631667,
       16.10479431, 23.92928569, 13.10217538, 24.45122275, 18.1733537 ,
       17.16243484, 18.27651925, 32.98016225, 19.24753909, 29.60002147,
       31.76788565, 43.45274978, 18.39829662, 15.77094546, 38.32218921,
       17.48890093, 10.4567689 , 14.58291612, 25.32215453, 19.39038299,
       16.3931107 , 26.4981961 , 15.21641805,  5.99624195, 18.72341049,
       11.00565791, 28.43940705,  4.77977595, 28.49842529, 32.7749635 ,
       22.71279076, 16.39172307, 17.70378296, 21.20658832, 33.91580167,
       28.3465387 , 19.40882851, 20.33459157,  6.88538961, 29.06990391,
       25.17119662, 22.45813448, 13.53193   , 24.48063603, 19.39198825,
        8.76491126, 26.75622464, 15.84398325, 31.60691698, 33.593711  ,
       24.99304656, 18.41963172, 30.42821065, 21.24240722, 26.09533173,
       24.3152015 , 31.15075678, 24.44459048, 31.50609222, 17.48431929,
       19.54265449, 18.76350478, 41.32674441, 25.65378283, 19.17369501,
       33.43036639, 23.57405103, 18.03491836, 23.12408505])
```

In [14]:
```
model.predict([[0.00632, 18.0, 2.31, 0.0, 0.538, 6.575, 65.2, 4.0900, 1.0, 2
```

Out[14]:
```
array([30.66239417])
```

In [15]:
```
y_test_pred
```

Out[15]:
```
array([26.38244903, 22.48142477, 28.9150927 , 11.51311019, 21.55596144,
       19.39569936, 20.24684687, 21.42696075, 19.34116377, 19.68860665,
        4.16870305, 15.92252628, 16.82679893,  5.33336826, 39.08414873,
       33.13236137, 21.86276797, 36.51777073, 31.70654122, 23.61115389,
       24.93638896, 23.41076277, 20.78702452, 30.60639121, 22.78779124,
        8.34225949, 17.46512364, 17.83410415, 35.88821362, 21.01664412,
       17.72326132, 17.42852689, 19.15036073, 23.30738941, 30.794513  ,
       19.22448935, 11.2795003 , 23.85638994, 17.65920118, 15.27836886,
       26.42841366, 21.60671364, 23.86193607, 14.66954994, 23.89469709,
       24.73879055, 19.95659189, 23.04414555, 10.49937272, 24.42914586,
       23.54775421, 18.98321991, 24.46540719, 31.13192075, 12.69208308,
       22.46866718, 21.36471519, 15.97301174, 12.04261875, 22.54049973,
       18.20501757, 21.91741417, 32.62538174, 31.43041916, 17.56480551,
       33.25033675, 21.22233526, 19.67388402, 19.97829012, 24.072029  ,
       22.59941828, 24.13111571, 30.83037261, 28.84034313, 25.01388616,
        5.68203177, 38.85648038, 24.12681527, 27.6468537 , 19.64454572,
       28.67492372, 18.62889753, 17.47846418, 37.87598241, 39.37598   ,
       24.26550781, 25.2577793 , 16.66424155, 25.32136054, 16.69295872,
       16.37096093, 13.29262768, 24.62082096, 31.00936186, 23.93931001,
       20.41960539,  0.89355306, 25.32071273, 15.40869795, 17.51079031,
       25.88556368, 22.24344716])
```

In [16]:
```
y_train
```

Out[16]:
```
220    26.7
71     21.7
240    22.0
6      22.9
417    10.4
       ...
323    18.5
192    36.4
117    19.2
47     16.6
172    23.1
Name: MEDV, Length: 404, dtype: float64
```

In [17]:
```
y_test
```

Out[17]:
```
329    22.6
371    50.0
219    23.0
403     8.3
78     21.2
       ...
56     24.7
455    14.1
60     18.7
213    28.1
108    19.8
Name: MEDV, Length: 102, dtype: float64
```

In [18]:
```
df1 = pd.DataFrame({'Actual': y_train, 'Predicted': y_train_pred})
df2 = pd.DataFrame({'Actual': y_test, 'Predicted': y_test_pred})
```

In [19]:
```
df1
```

Out[19]:

	Actual	Predicted
220	26.7	32.664754
71	21.7	22.547603
240	22.0	27.922721
6	22.9	23.625425
417	10.4	6.458614
...	...	...
323	18.5	19.173695
192	36.4	33.430366
117	19.2	23.574051
47	16.6	18.034918
172	23.1	23.124085

404 rows × 2 columns

In [20]:
```
df2
```

Out[20]:

	Actual	Predicted
329	22.6	26.382449
371	50.0	22.481425
219	23.0	28.915093
403	8.3	11.513110
78	21.2	21.555961
...	...	...
56	24.7	25.320713
455	14.1	15.408698
60	18.7	17.510790
213	28.1	25.885564
108	19.8	22.243447

102 rows × 2 columns

In [21]:
```
from sklearn.metrics import mean_squared_error, r2_score
mse = mean_squared_error(y_test, y_test_pred)
mse
```

Out[21]:
```
35.89364343464623
```

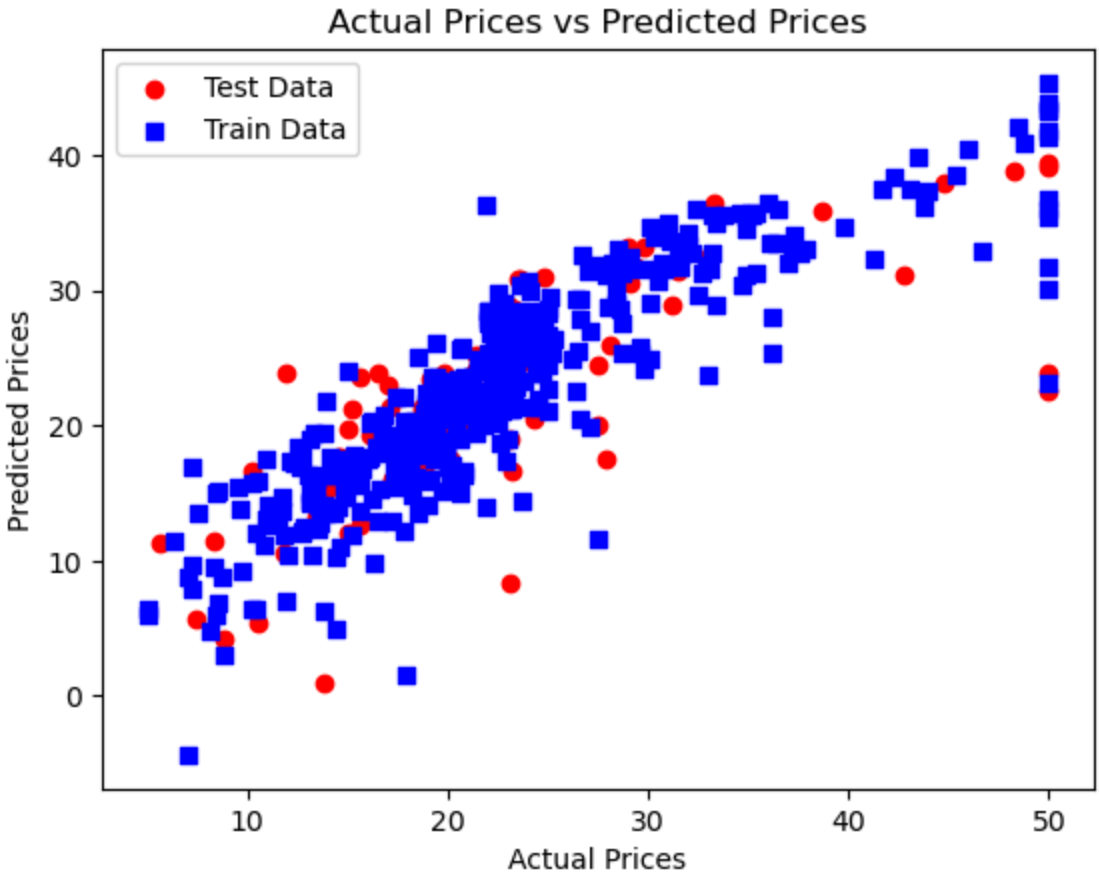
In [22]:
```
mse = mean_squared_error(y_train, y_train_pred)
mse
```

Out[22]:
```
19.805844906182962
```

In [23]:
```
r2 = r2_score(y_test, y_test_pred)
r2
```

Out[23]:
```
0.5592001535561668
```

In [24]:
```
plt.scatter(y_test, y_test_pred, c='red', marker='o', label='Test Data')
plt.scatter(y_train, y_train_pred, c='blue', marker='s', label='Train Data')
plt.xlabel('Actual Prices')
plt.ylabel('Predicted Prices')
plt.title('Actual Prices vs Predicted Prices')
plt.legend(loc='upper left')
plt.plot()
plt.show()
```



In [ ]: