Data Exploration -
Statistical Analysis

```
Size of data?  506
Number of features?  13
Minimum Value  5.0
Maximum Value  50.0
Calculate mean  22.5328063241
Calculate median  21.2
Calculate standard deviation  9.18801154528
```

Evaluating Model Performance

Performance Metric:
To evaluate performance of model I am using mean_squared_error. This metric penalizes large differences between predicted values and true values.

Testing/Training Split:
I have split data set into **Testing/Training** to evaluate the model on the data it has not seen. I am holding out 40% for testing and retaining 60% for training.
I am using cross_validation.train_test_split to separate the data set into Training features and labels and test features and labels

Cross Validation & Gridsearch

I am using 3 fold **Cross validation** & grid search to find and evaluate best tuning parameter

Analyzing Model Performance

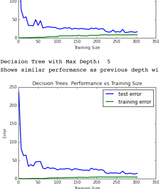
Learning Curves and Training Analysis

After fitting a model with 60% of training data and testing with 40% data of data I tested `Decision Tree with Max Depth from 1 to 10.`

Learning Curves and Bias & Variance Analysis

```
Decision Tree with Max Depth:  1
With Max Depth of 1 we can see that model has both high test and training error
```


```
Decision Tree with Max Depth:  2
Has lower training error than depth 1 but still very high
```

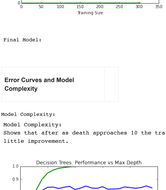



```
Decision Tree with Max Depth:  3
Shows higher than optimal test training error
```

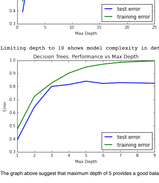

```
Decision Tree with Max Depth:  4
Shows good balance between training and test errors with low training error
```


```
Decision Tree with Max Depth:  5
Shows similar performance as previous depth with lower training error.
```

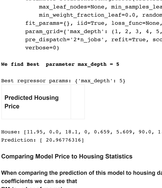

```
Decision Tree with Max Depth:  6
Models 6 and onward show very low training error indicating high baist models
```




```
Decision Tree with Max Depth:  7
```




```
Decision Tree with Max Depth:  8
```




```
Decision Tree with Max Depth:  9
```



```
Decision Tree with Max Depth:  10
```



```
Final Model:
```

Error Curves and Model Complexity

```
Model Complexity:
Model Complexity:
Shows that after as death approaches 10 the training error disappears while test error shows
little improvement.
```



```
Limiting depth to 10 shows model complexity in detail
```


The graph above suggest that maximum depth of 5 provides a good balance between Bias and variance

Picking the Optimal Model

```
Using grid search and default cross validation of 3 we examine the affects of parameters on the model while re-fitting with each irritation.

Final Model:
GridSearchCV(cv=3, error_score='raise',
       estimator=DecisionTreeRegressor(criterion='mse', max_depth=None, max_features=None,
           max_leaf_nodes=None, min_samples_leaf=1, min_samples_split=2,
           min_weight_fraction_leaf=0.0, random_state=0, splitter='best'),
       fit_params={}, iid=True, loss_func=None, n_jobs=1,
       param_grid={'max_depth': (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)},
       pre_dispatch='2*n_jobs', refit=True, score_func=None, scoring=None,
       verbose=0)
```

We find Best parameter max_depth = 5

```
Best regressor params: {'max_depth': 5}
```

Predicted Housing Price

```
House: [11.95, 0.0, 18.1, 0, 0.659, 5.609, 90.0, 1.385, 24, 680.0, 20.2, 332.09, 12.13]
Prediction: [ 20.96776316]
```

Comparing Model Price to Housing Statistics

When comparing the prediction of this model to housing data we can see that the prediction is inline with training data set. Looking at the training data and after obtaining coefficients we can see that
RM (number of rooms)
CHAS: Charles River dummy variable (= 1 if tract bounds river; 0 otherwise)
RAD: index of accessibility to radial highways
ZN: proportion of residential land zoned for lots over 25,000 sq.ft.

are the main determinators of the house prices.

We can see that the our predicted house price of 20.96 follows a similar hose

'CRIM'	'ZN'	'INDUS'	'CHAS'	'NOX'	'RM'	'AGE'	'DIS'	'RAD'	'TAX'	'PTRATIO'	'B'	'LSTAT'	Prediction
1.00245	0	8.14	0	0.538	6.674	87.3	4.239	4	307	21	380.23	11.98	21