Deep Learning

Lecture 8: Test Sets, Validation Sets, and Overfitting

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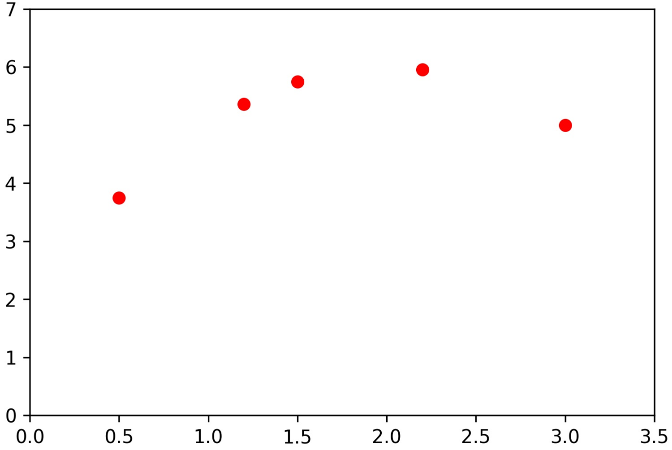
Consider the following data (x, y).



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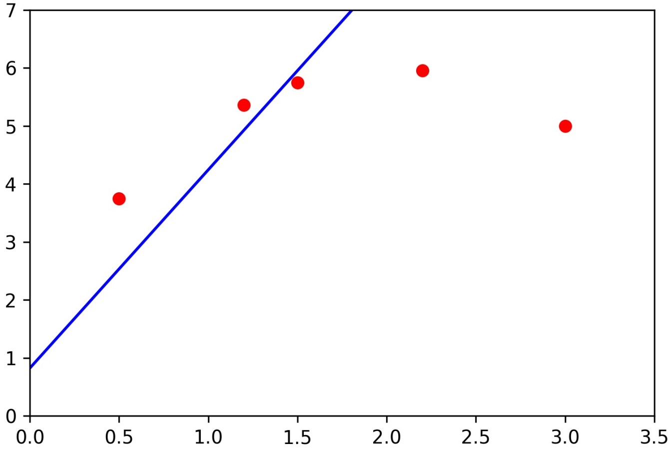
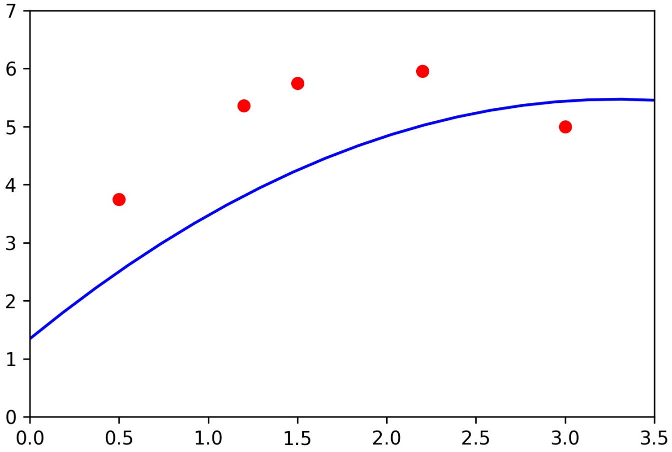
2. Quadratic estimator, i.e., $\hat{y} = w_0 + w_1 x + w_2 x^2$

3. Higher order estimator, i.e., $\hat{y} = \sum_{i=0}^{20} w_i x^i$

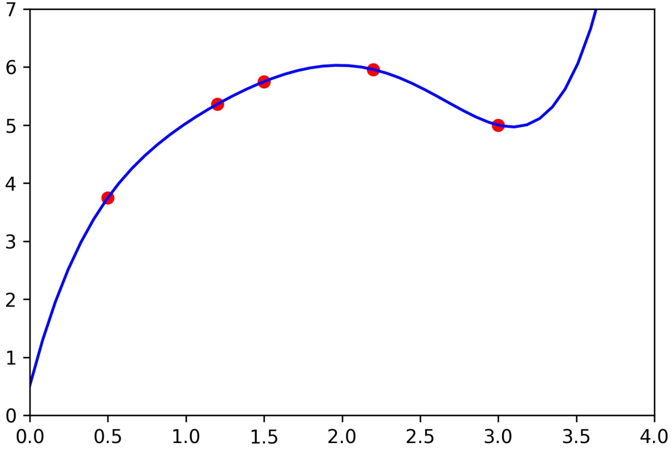
If we use linear estimator we have,

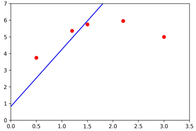


If we use Quadratic estimator we have,

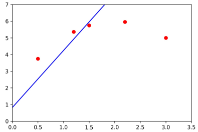


If we use polynomail of degree 5 estimator we have,

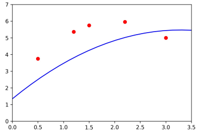


1. 

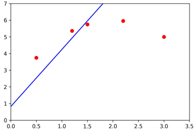
Underfitting

1. 

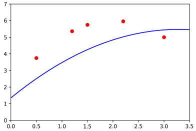
Underfitting

2. 

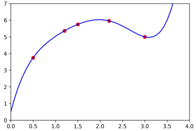
Appropriate Capacity

1. 

Underfitting

2. 

Appropriate Capacity

3. 

Overfitting

Generalization error

The **generalization error (test error)** is defined as the expected value of the error on a new input. Here the expectation is taken across different possible inputs.

The factors determining how well a machine learning algorithm will perform are its ability to:

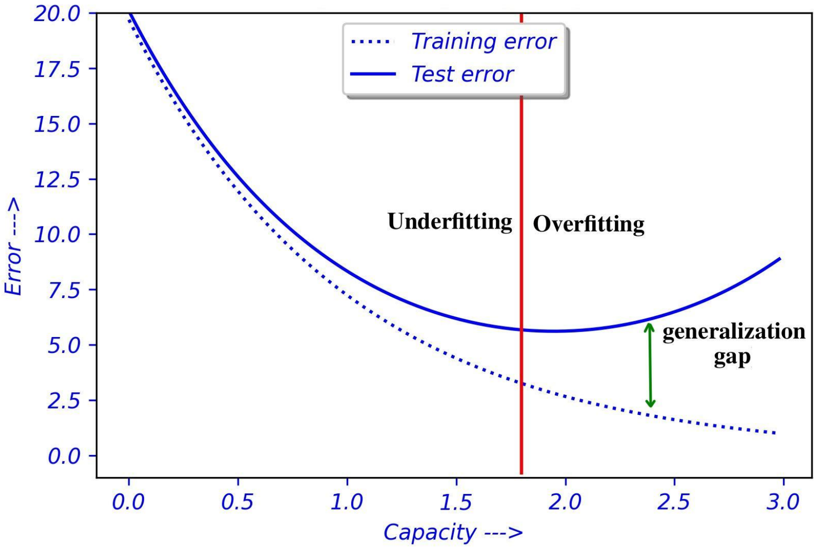
1. Make the training error small.

2. Make the gap between training and test error small.

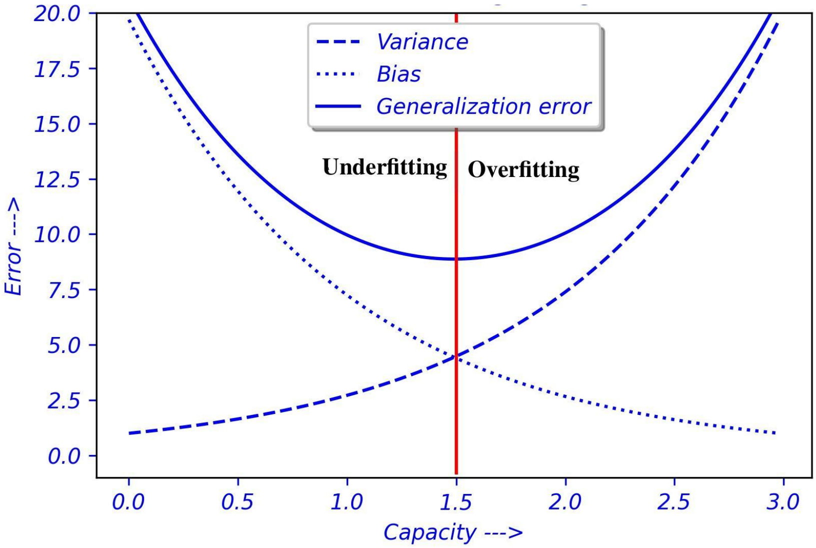
Thus

1. **Underfitting:**model is not able to obtain a sufficiently low error value on the trainig set.

2. **Overfitting:**the gap between the training error and test error (**generalization gap**) is too large.



20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Error --->
Training error
Test error
Underfitting
Overfitting
generalization gap
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Capacity --->


Variance
Bias
Generalization error
Underfitting
Overfitting
Error --->
Capacity --->
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0

Thank You