

## Learning Curves

Training an algorithm on a very few number of data points (such as 1, 2 or 3) will easily have 0 errors because we can always find a quadratic curve that touches exactly those number of points. Hence:

- As the training set gets larger, the error for a quadratic function increases.
- The error value will plateau out after a certain  $m$ , or training set size.

### Experiencing high bias:

**Low training set size:** causes  $J_{train}(\Theta)$  to be low and  $J_{CV}(\Theta)$  to be high.

**Large training set size:** causes both  $J_{train}(\Theta)$  and  $J_{CV}(\Theta)$  to be high with  $J_{train}(\Theta) \approx J_{CV}(\Theta)$ .

If a learning algorithm is suffering from **high bias**, getting more training data will not (**by itself**) help much.

#### More on Bias vs. Variance

Typical learning curve for high bias (at fixed model complexity):



### Experiencing high variance:

**Low training set size:**  $J_{train}(\Theta)$  will be low and  $J_{CV}(\Theta)$  will be high.

**Large training set size:**  $J_{train}(\Theta)$  increases with training set size and  $J_{CV}(\Theta)$  continues to decrease without leveling off. Also,  $J_{train}(\Theta) < J_{CV}(\Theta)$  but the difference between them remains significant.

If a learning algorithm is suffering from **high variance**, getting more training data is likely to help.

#### More on Bias vs. Variance

Typical learning curve for high variance (at fixed model complexity):

