

## Diagnosing Bias vs. Variance

In this section we examine the relationship between the degree of the polynomial  $d$  and the underfitting or overfitting of our hypothesis.

- We need to distinguish whether **bias** or **variance** is the problem contributing to bad predictions.
- High bias is underfitting and high variance is overfitting. Ideally, we need to find a golden mean between these two.

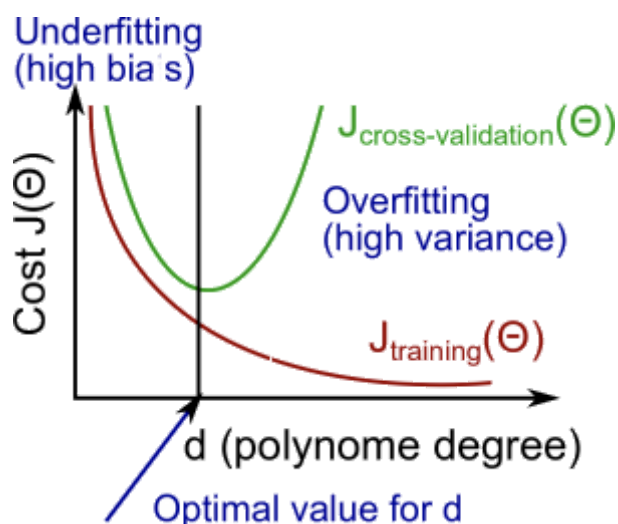
The training error will tend to **decrease** as we increase the degree  $d$  of the polynomial.

At the same time, the cross validation error will tend to **decrease** as we increase  $d$  up to a point, and then it will **increase** as  $d$  is increased, forming a convex curve.

**High bias (underfitting):** both  $J_{train}(\Theta)$  and  $J_{CV}(\Theta)$  will be high. Also,  $J_{CV}(\Theta) \approx J_{train}(\Theta)$ .

**High variance (overfitting):**  $J_{train}(\Theta)$  will be low and  $J_{CV}(\Theta)$  will be much greater than  $J_{train}(\Theta)$ .

This is summarized in the figure below:



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