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 $\mathbf{J_{train}}(\Theta)$ and $\mathbf{J_{CV}}(\Theta)$ will be high. Also, $\mathbf{J_{CV}}(\Theta) \approx \mathbf{J_{train}}(\Theta)$.

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

The is summarized in the figure below: