

Machine Learning I

MATH60629

Machine Learning fundamentals — **Summary**
— Week #2

Three main components

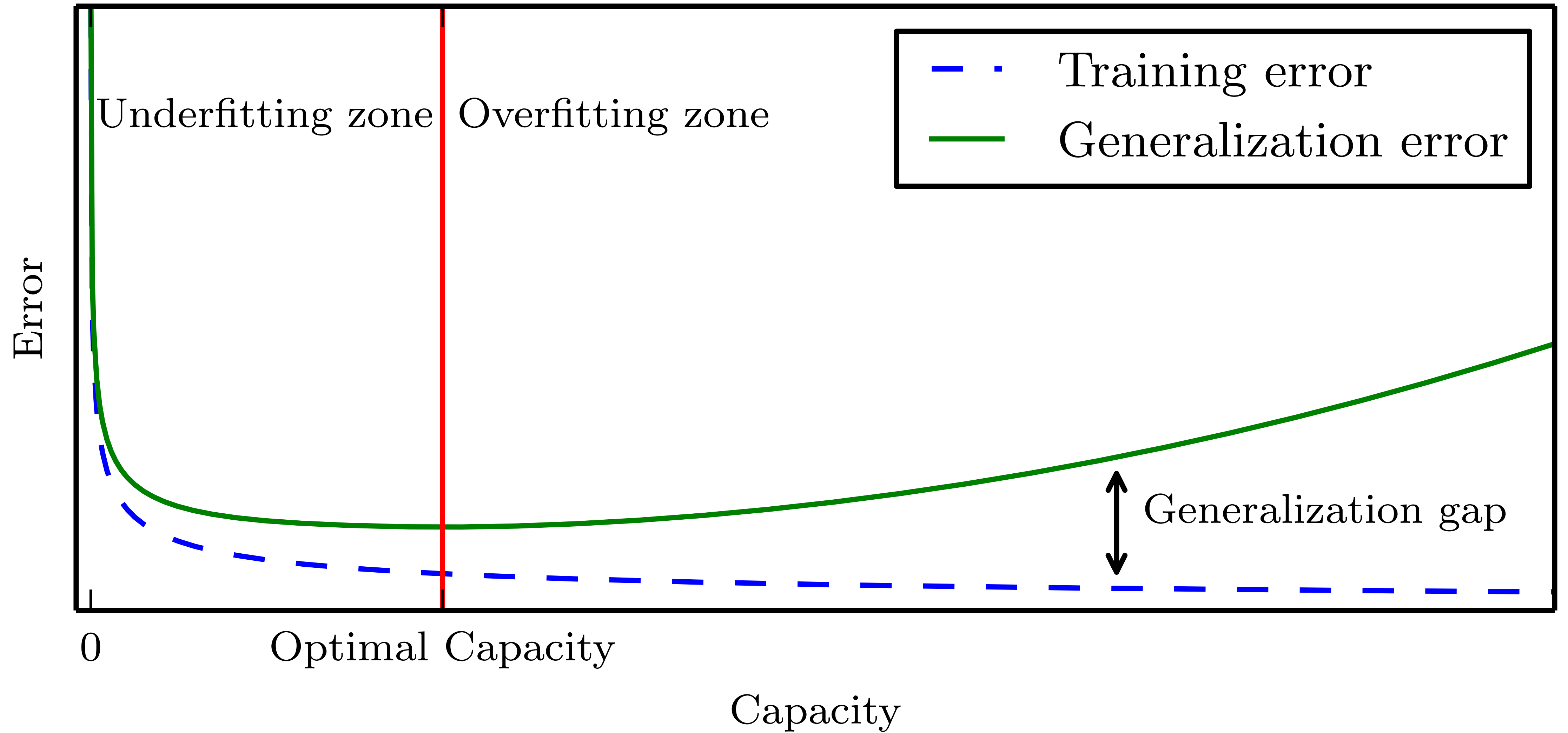
1. Task (T). The question you are answering.
 - Model. How to parametrize?
2. Performance measure (P). How good is the model?
3. Experience (E). What type of data do you have access to?

Three types of experiences

- Supervised $\{(x,y)\}$. e.g., regression, classification. $f: X \rightarrow Y$ •
- Unsupervised $\{(x)\}$. e.g., clustering, dim. reduction, density estimation
- Reinforcement learning. Agent takes actions in an environment.

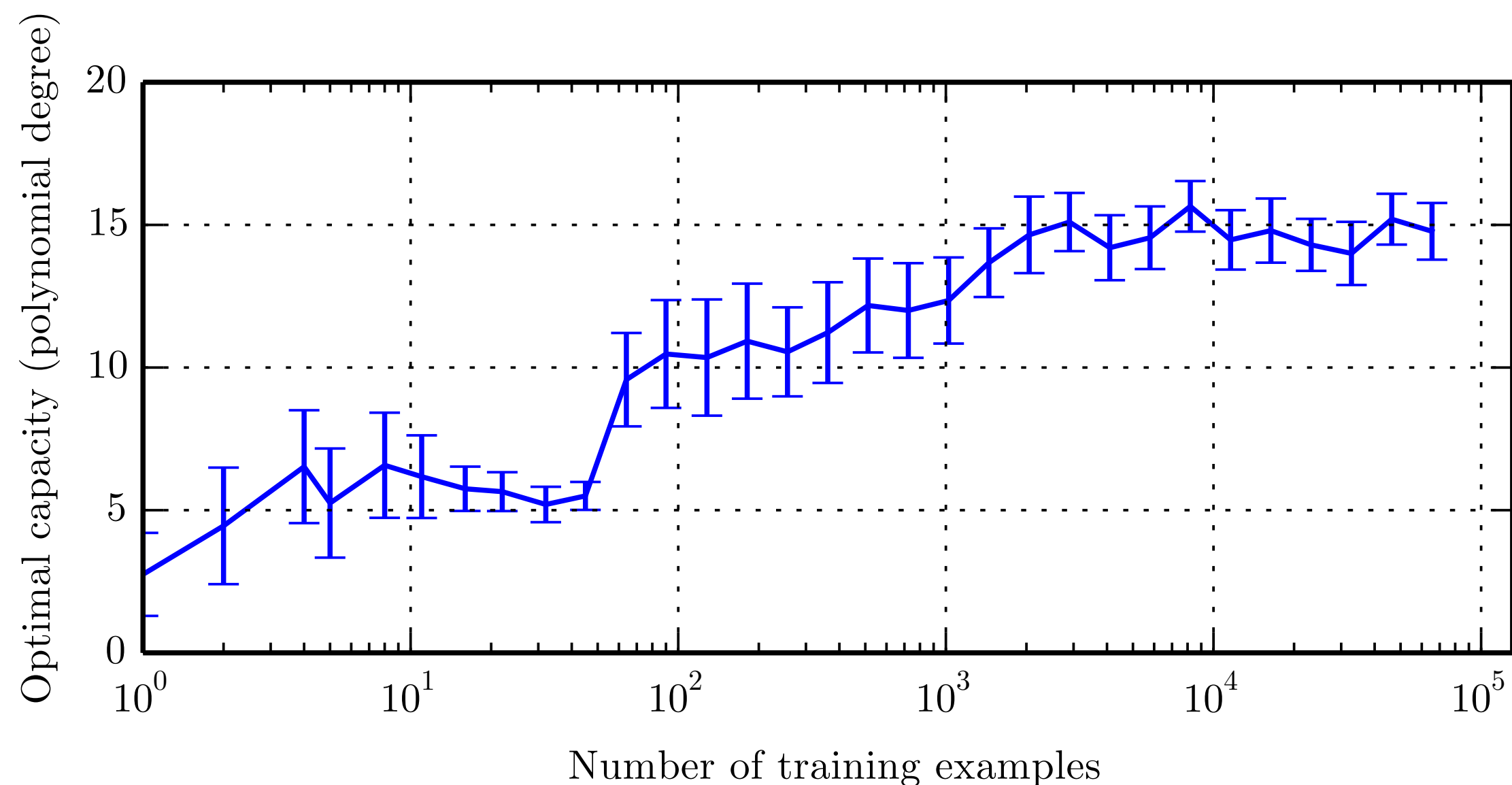
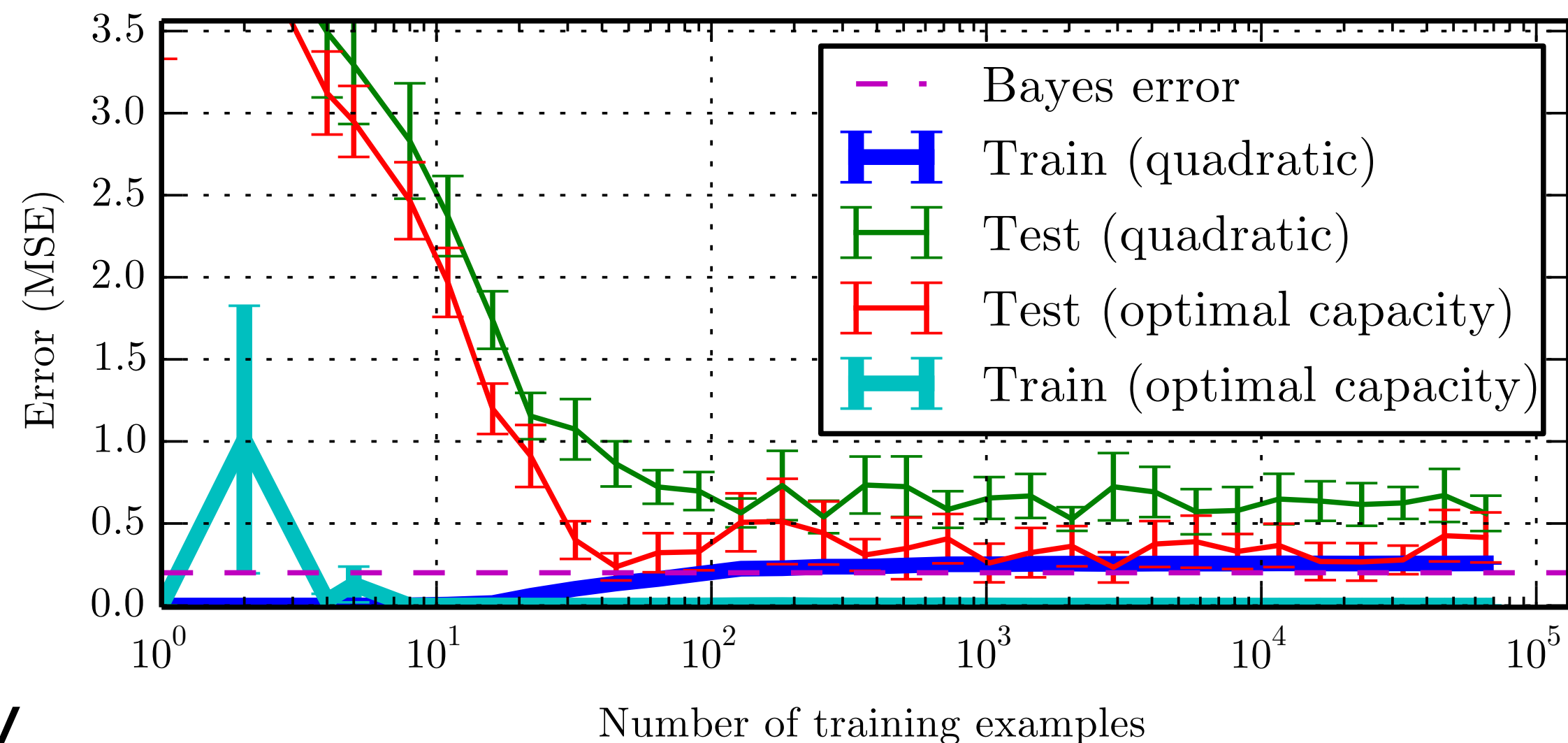
Model Evaluation

- Given:
 - A performance measure
 - A train dataset
 - A model
- Can calculate:
 - Train error: used to learn (to train).
 - Train error cannot be used to evaluate your model
 - Must use a separate dataset for evaluation



Synthetic data is generated using a degree 5 polynomial $y = w_5x^5 + w_4x^4 + w_3x^3 + w_2x^2 + w_1x^1$

Training set size also plays an important role in a model's capacity to generalize



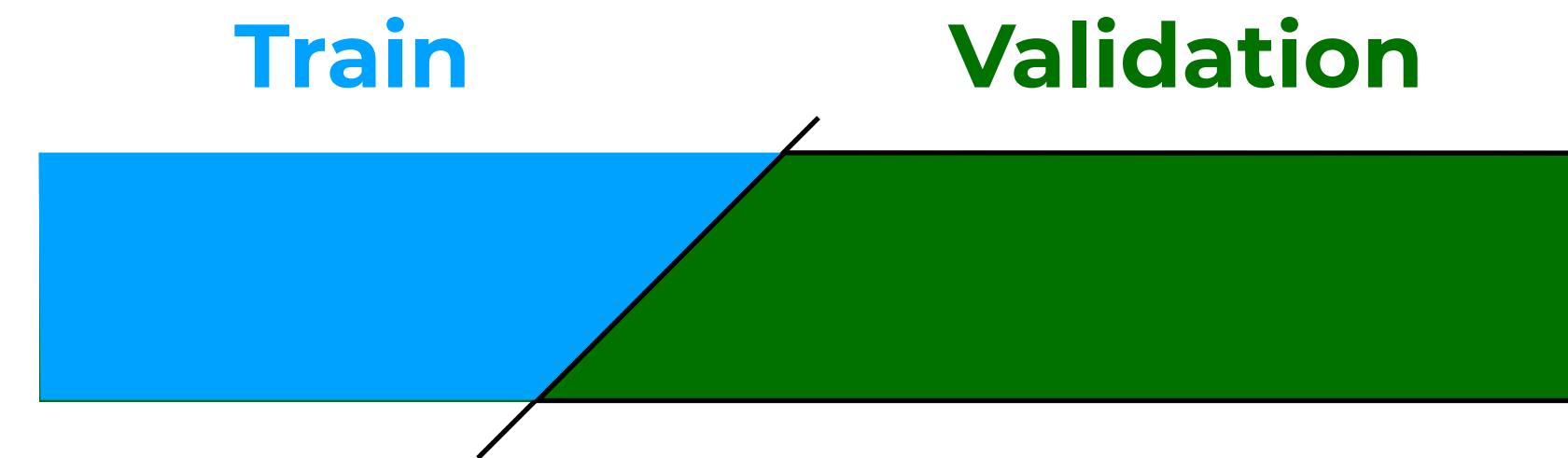
[Figure 5.4, Chapter 5, Deep Learning]

Regularization

- Can be thought of as way to limit a model's capacity
- $\text{Loss} := \text{MSE}^{\text{train}} + \lambda \mathbf{w}^T \mathbf{w}$

Validation set

- How do we choose the right model and set its hyper parameters (e.g. λ)?
 - Use a validation set
 - Split the original data into two:
 1. Train set
 2. Validation set
 - Proxy to the test set
 - Train different models/hyperparameter settings on the train set
 - Pick the best according to their performance on the validation set



Bias / Variance

- The goal is to hit the bull's eye
- Each blue dot represents the “performance” of a fixed model on different data from the same distribution

