Introduction to neural networks

Training aspects

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Roadmap

1. Performance measurement
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3. Performance metrics
4. Overfitting

Performance measurement

- The central challenge in machine learning is that we must perform well on new, **previously unseen** inputs.
- The ability to perform well on previously unobserved inputs is called **generalization**.
    - Dataset split
    - Metric
    - Significance

Performance measurement

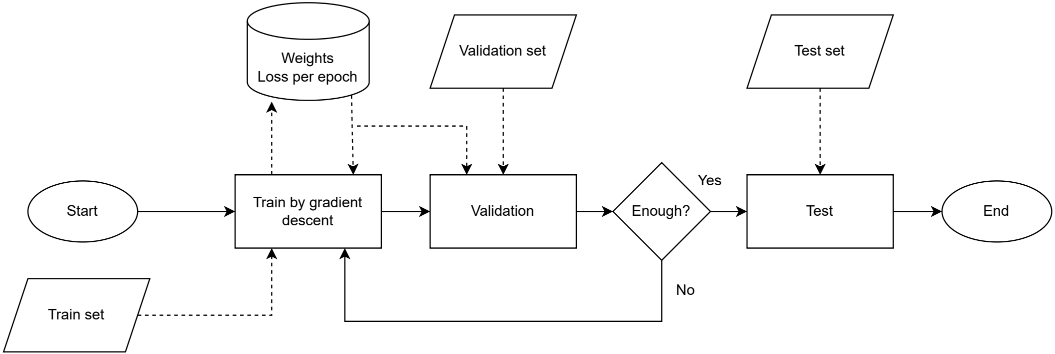


Figure: Train and test workflow

Roadmap

Dataset split

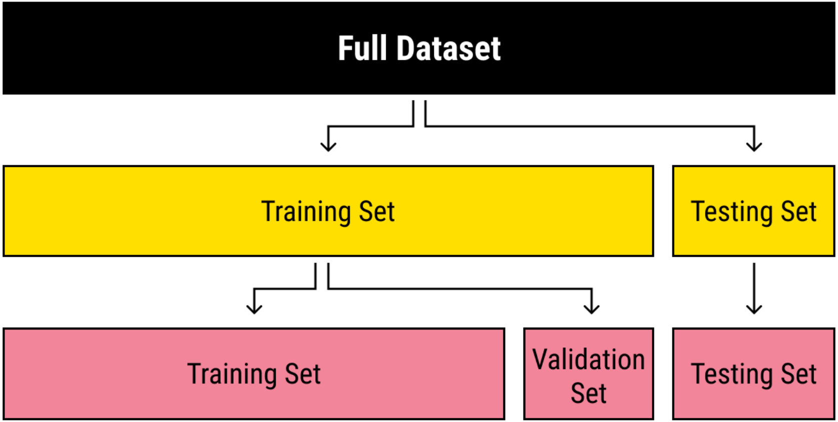


Figure: Dataset split [HJC]

Dataset split

- Lets suppose a dataset, $X_\Omega = \{x_1, \ldots, x_m\}$, with positive examples
- We could use a subset of our set of observations as an estimate of the performance

$$X = x_1, \ldots, x_n$$

$$X' = x_{n+1}, \ldots, x_m$$

  , X is the **training set** and X' is usually called the **validation set** [Smola].
- Typically, one uses about 80% of the training data for training and 20% for validation [GoodFellow]

Roadmap

Performance metrics

Common measurements for categorical outputs

- Accuracy
- Precision
- Recall
- F1 score

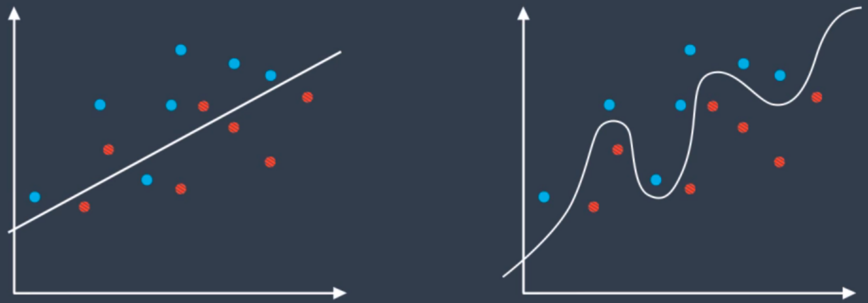
Significance

Significance

Roadmap

Overfitting problem

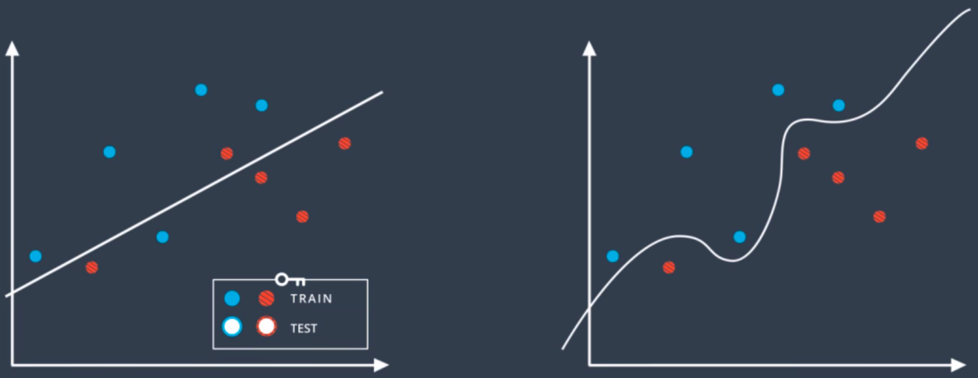
Which model is better?



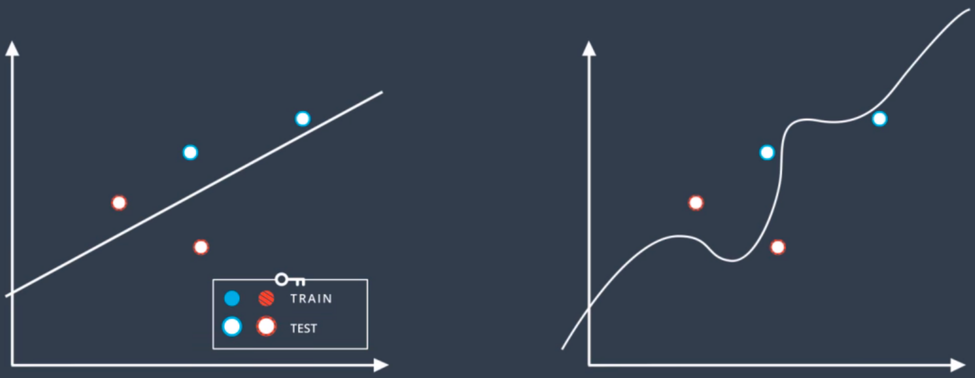
TRAIN
TEST

Overfitting problem

The importance of testing



The importance of testing



Overfitting and generalization

- **Underfitting** occurs when the model is not able to obtain a sufficiently low error value on the training set.
- **Overfitting** occurs when the gap between the training error and test error is too large.
- A model's **capacity** is its ability to fit a wide variety of functions.

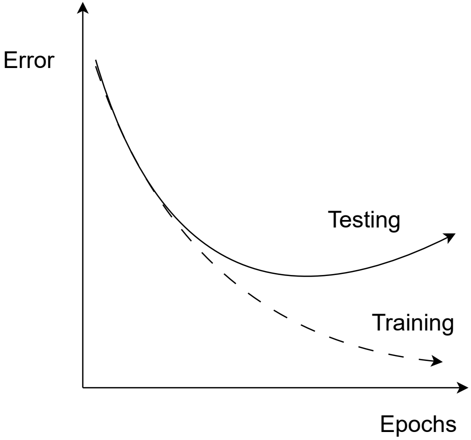


Figure: Loss as epochs advance.

Regularization

- **Regularization** is any modification we make to a learning algorithm that is intended to reduce its generalization error but not its training error.
    - Early termination
    - L1, L2
    - Dropout

Regularization
Early termination

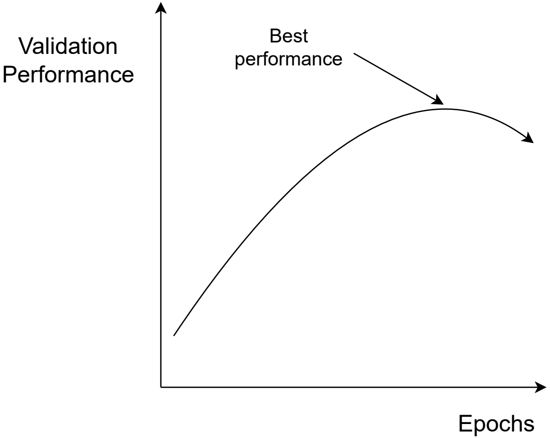
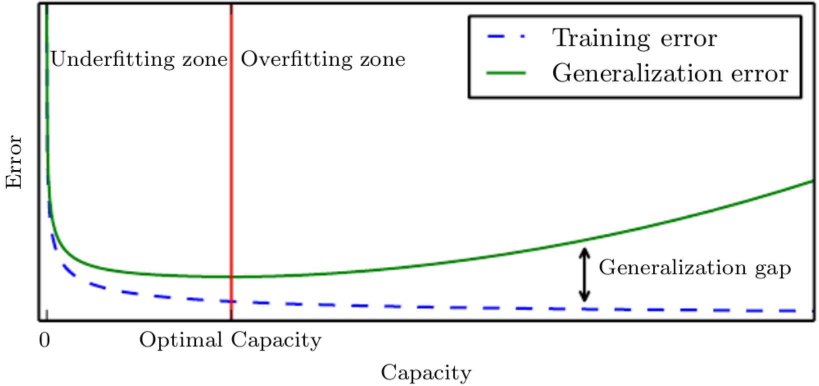


Figure: Performance as epochs advance.

Model Capacity Selection

- Usually select the simplest model
- The optimal model is the one that has the same capacity than the problem.



Lectures

- Chapter 5 Machine Learning Basics. Ian Goodfellow, et al. Deep Learning. MIT
- Chapter 2 Training feed-forward neural networks. Buduma. Fundamentals of deep learning.

References

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vastava Srivastava, N., Hinton, G., Krizhevsky, A., Sutskever, I., & Salakhutdinov, R. (2014). Dropout: a simple way to prevent neural networks from overfitting. The Journal of Machine Learning Research, 15(1), 1929-1958.

HJC https://houstonjobconnection.com/article/what-is-a-dataset-in-machine-learning