

IAML DL - Study Guide - Week 3

Sambit Paul, Pavlos Andreadis, Nigel Goddard

January 2022

1 Introduction

Week 3 of the course focusses on the *generalisation* of models over varied data and the *evaluation* of models. This involves using techniques to improve the overall reliability of our models and assessing the performance.

2 Generalisation & Evaluation

- Generalisation refers to the reliability of the model's outcomes. Simply put, the more generalised a model is, the more it can correctly predict unseen data.
To understand the concept of generalisability, the bias-variance trade-off is a key concept that needs to be clarified. You can refer to this [article](#) for a quick refresher. [Hastie et al. \[2009\]](#) Chapter 7, Sections 7.2 and 7.3 provides a good explanation of the bias-variance relationship.
- **Over-fitting & Under-fitting:** When a model is not well generalised, it is implicitly understood that the model is either over-fitted to the training data, or under-fitted to the problem. A visual representation is provided in [Figure 1](#)
 - Over-fitting: Fits very well to the training data, but performs poorly on unseen data. Usually happens when the model has high variance and low bias.
 - Under-fitting: Cannot fit well to the training data itself. Usually happens when the model has high bias and low variance.
- The dataset used for machine learning problems is split for 3 purposes:
 - Training set: Used to construct the model.
 - Validation set: Used to determine the hyperparameters of the model.
 - Test set: Used to estimate the generalisability of the model.

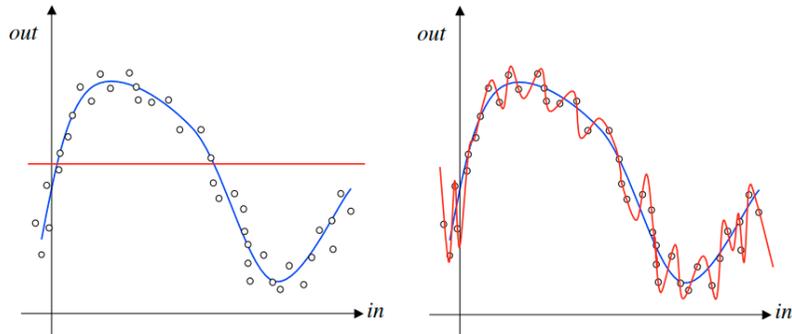


Figure 1: The left plot shows (in red) how an under-fitted model would perform, and the right plot shows (in red) how an over-fitted model would perform. The line in blue is the representation of the function.

Please refer to [Hastie et al. \[2009\]](#) Chapter 7, Page 222 to read about dataset splitting. In case of problems, which are not data-rich, we use cross validation which you can read about [Hastie et al. \[2009\]](#) Section 7.10.

- Model evaluation is done in the form of metrics. To know more about such metrics, you can refer to this [article](#).
- Reading List:
 - [Goodfellow et al. \[2016\]](#) pp. 105 - 117
 - [Witten et al. \[2011\]](#) pp. 31 - 35

References

- Ian Goodfellow, Yoshua Bengio, and Aaron Courville. *Deep learning*. MIT press, 2016.
- Trevor Hastie, Robert Tibshirani, and Jerome Friedman. *The elements of statistical learning: data mining, inference, and prediction*. Springer Science & Business Media, 2009.
- Ian H Witten, Eibe Frank, and Mark A Hall. *Data mining: Practical machine learning tools and techniques*, 2011.