



A ONE DAY INTRODUCTION TO MACHINE LEARNING

Friday 15th February 2019, The Studio, Birmingham

PROGRAMME

- 09:00 – 09:30 **Coffee and registration**
- 09:30 – 09:40 **Introduction**
Jonathan Taylor, Sheffield Teaching Hospitals
- 09:40 – 10:10 **Introduction to machine learning: Basic Concepts**
Dr Sarah Gulliford, University College London Hospitals NHS
Foundation Trust
- 10:10 – 10:50 **Principles of Training and Validation**
Dr James Leighs, University Hospitals Southampton
- 10:50 – 11:00 **Discussion**
- 11:00 – 11:20 **Coffee**
- 11:20 – 11:50 **Classical Algorithms for Classification Tasks**
Dr David Towey, Northampton General Hospital
- 11:50 – 12:30 **Neural Networks**
Prof Nasir Rajpoot, Warwick University
- 12:30 – 12:40 **Discussion**
- 12:40 – 13:30 **Lunch**
- 13:30 – 14:10 **Applications in Medical Physics**
Dr Jorge Cardoso, King's College London
- 14:10 – 14:50 **Development of Machine Learning Algorithms: Worked
Examples**
Dr Zach Eaton-Rosen, King's College London
- 14:50 – 15:00 **Discussion**
- 15:00 – 15:20 **Coffee**
- 15:20 – 15:50 **Challenges of Clinical Implementation**
Jonathan Taylor, Sheffield Teaching Hospitals
- 15:50 – 16:15 **Questions/discussion**
- 16:15 **Close**

Programme subject to change

Introduction to machine learning: Basic Concepts

Dr Sarah Gulliford, University College London Hospitals NHS Foundation Trust

Machine learning is a broad term describing the use of computational algorithms to learn from data. It is not a new concept with publications stretching back to the 1940s. This presentation will introduce some background, terminology and basic concepts of machine learning including; supervised vs unsupervised approaches; classification vs regression; objective functions and regularisation.

Principles of Training and Validation

Dr James Leighs, University Hospitals Southampton

One of the most fundamental concepts in Machine Learning is knowing how to appropriately and accurately assess the performance of your models in a meaningful way. You want to be reassured that your model has identified the patterns in the data but at the same time that it has not just picked up a load of noise i.e. you want to minimise both bias and variance. This talk will cover common methods for critiquing your model performance and understanding how it can be improved; this will also lay the foundations for you to make your own comparisons between the various machine learning techniques covered in later sessions.

Topics:

- Cross-validation
- Performance metrics
- Learning curves & bias-variance trade-off
- Sample selection & size
- Feature selection

Classical Algorithms for Classification Tasks

Dr David Towey, Northampton General Hospital

Classification tasks occur in nearly all medical fields. They can range in complexity from simple normal ranges of a clinical index, up to multi-factorial and computationally intensive tasks. In this talk I will be presenting some of the classical algorithms that have been used to classify one of more groups of data. For each of the examples we'll look at the theory behind the classifier and how it is applied and some of the pitfalls from the approaches.

The following areas will be discussed:

- Feature extraction and dimensionality reduction
- Single feature classifications
- Two group single feature classifications (and the ROC curve)
- Single group multiple features
- Group-prototype
- Mahalanobis distance
- Logistic regression
- Probability distributions at boundaries
- Naïve Bayes
- Choice of prior and its effect on the Bayes classifier
- Support Vector machine (SVM) - Decision plane, fat margin
- The kernel trick

Neural Networks

Prof Nasir Rajpoot, Warwick University

The visual cortex of human brain is an incredibly powerful computing machine, fantastic at recognising people and objects and building an understanding of the natural world around us. However, it is not ideally suited for objectively measuring what we see and nor for recognising complex spatial patterns that may be hidden in plain sight. Artificial Neural Networks (ANNs), particularly deep convolutional ANNs, have recently been phenomenally successful in solving various vision related problems. In this talk, I will give an introduction to ANNs and deep convolutional ANNs, followed by some snippets of computational pathology research in my group to demonstrate the value of deep convolutional ANNs based analytics of information-rich whole-slide images for cancer diagnosis and prognosis.

Awaiting abstract

Development of Machine Learning Algorithms: Worked Examples
Dr Zach Eaton-Rosen, King's College London

Awaiting abstract

Challenges of Clinical Implementation

Jonathan Taylor, Sheffield Teaching Hospitals

The literature suggests that machine learning technology has demonstrated impressive performance in a wide range of healthcare applications. However, results are often derived from small datasets, using research rather than clinical data, without considering the particular requirements of the clinical environment. Routine, clinical use of machine learning tools remains limited. This talk seeks to provide an insight into the many challenges associated with translating promising algorithms into clinical practice, focusing on both technical limitations of current machine learning technology and wider issues related to regulations, data, workflows and heterogeneity of the clinical environment.