QUANTUM

Our Global **Data Science Practice**

Neural Networks Training: December 2019

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Welcome

On behalf of Quantum and our partners C2D3, we would like to welcome you to our newest training programme on Neural Networks.

Over the coming months you will have access to world-class academics, support to learn new skills and in applying them to your work.

You are one of a select few individuals who have been given this opportunity – well done. You have been identified as someone who will most of the training and share what you have learned with others.

Feedback is key and enables us to improve, so please take notes and be sure to share your thoughts with us.

Anna Dalglish
Partnerships Lead

2. Prerequisites & Refreshers

No prior knowledge of deep learning or neural networks is required.

A basic working knowledge of linear algebra and differentiation will be expected. Skimming through Grant Sanderson's YouTube playlists listed below would be a great way to refresh your memory on these topics:

- Essence of linear algebra
- Essence of calculus
- Multivariable calculus

Some of the course material is heavily based on the book "Artificial Intelligence Engines" by Jim Stone. You will receive a free copy of this book to take home with you. The preface and first chapter are available online . Reading this before you arrive will provide useful historical and motivational background.

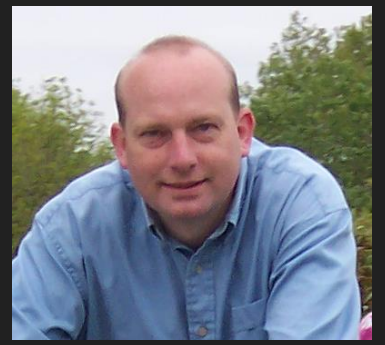
The course includes a practical session for which you should bring your own laptop with a Python development environment pre-installed. We can support R or MatLab but be sure your environment is set up before you arrive.

3. Course Facilitators

Dr. Stephen Eglen

Dr. Eglen is a Reader in Computational Neuroscience at the University of Cambridge Department of Applied Mathematics and Theoretical Physics. He is course director for the MPhil in Computational Biology. His undergraduate degree was in cognitive science, psychology and computer science (Nottingham), followed by doctorate in computer science and artificial intellegence (Sussex). His research interests focus on understanding the development of the nervous system: How do neurons form connections with each other into structured networks?

Dr. Jim Stone



Dr. Stone is a Reader in Vision and Computational Neuroscience at the University of Sheffield. His principal research interests are the generic computational principles which underpin visual perception and the relationship between learning and evolution. He recently published the book “Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning”.

4. Schedule Overview

December 10th

Centre for Mathematical Sciences, Wilberforce Road

Schedule is subject to minor change

13:00 Arrival & lunch – *report to the reception of the Centre for Mathematical Sciences*

14:00 Introduction to Deep Learning and AI: What it is, what it can, and cannot do (1 hour)

Learning objective: a high-level understanding of how neural networks are built, and what they can be used for

17:00 Overview: from linear networks to convolutional networks (1 hour)

Learning objective: a mathematical description of individual neurons, and how the neurons can be composed into multiple layers; convolution operation

16:00 *Coffee break*

16:30 Short talks from Aviva participants outlining their work (1 hour)

19:00 College Dinner

Schedule Overview

December 11th

Centre for Mathematical Sciences, Wilberforce Road

Schedule is subject to minor change

09:00 *Arrival & coffee*

10:00 Deep Learning using gradient descent: What it is, and how it can fail. Backprop, overfitting and vanishing gradients (1 hour)

Learning objective: understanding what an energy function is, and how it can be minimised by taking derivative with respect to each weight in the network.

11:00 Dimensionality reduction methods (1 hour) [was reinforcement learning]

Learning objective: how we can visualise high-dimensional input spaces to discover their inherit structure. Demonstration using the MNIST hand-written digits dataset.

12:00 *Lunch*

13:00 Lab tutorial session (2 hours)

Learning objective: practical introduction to how to code neural networks using Python or R to solve classification problems with MNIST dataset. Discussion of frameworks for advanced usage.

15:00 Wrap-up

15:30 *Depart*

5. Arrival in Cambridge

Sessions start at 13:00

- **Where to fly to:** London Stansted Airport
  - From the airport train station, take the direct train to Cambridge
  - Average journey time is 34 mins, with 40 trains per day
  - Single fare c.£6.50
  - Then on arrival in Cambridge, take a taxi to the venue (see below*)

- **Where to get the train to:** Cambridge
  - If coming from London, we recommend the 11:12 or 11:42 trains from Kings Cross (49 mins direct)
  - If coming from Norwich, we recommend the 10:40 train (1hr 19mins direct)
  - If coming from York, we recommend the 09:30 CrossCountry train (London Kings X), changing at Peterborough (Stansted Airport) and arriving at 12:08
  - Take a taxi from the train station to the venue, there is a taxi rank directly in front of the train station*
    - Fare will be <£10
    - Keep a receipt for your expenses

6. What's next?

- Ensure you have completed the prerequisites and if necessary, the refresher videos (section 2 in this deck)
- Microsoft Teams group: you will receive an invitation
- Introductory WebEx: you will receive an invitation
  - Introduce yourself
  - Brainstorm and log potential use cases for discussion
- Complete and return the 'Tell us about you' (section 8)

7. Tell us about you…

- What is your role at Aviva?
- What has motivated you to participate in this training?
- How do you think neural networks could be used in your team or across Aviva?

- Do you have any dietary requirements or allergies?
- When will you be arriving in Cambridge?
- Do you need accommodation for the 9th December (night before the training)?
- Contact number

Send your details to anna.l.dalglish@aviva.com by Friday 22nd November