Queen Mary
University of London

DR ADRIAN BEVAN

PRACTICAL MACHINE LEARNING

INTRODUCTION

QMUL Summer School: https://www.qmul.ac.uk/summer-school/
Practical Machine Learning QMplus Page: https://qmplus.qmul.ac.uk/course/view.php?id=10006

institute of CODING

LECTURE PLAN

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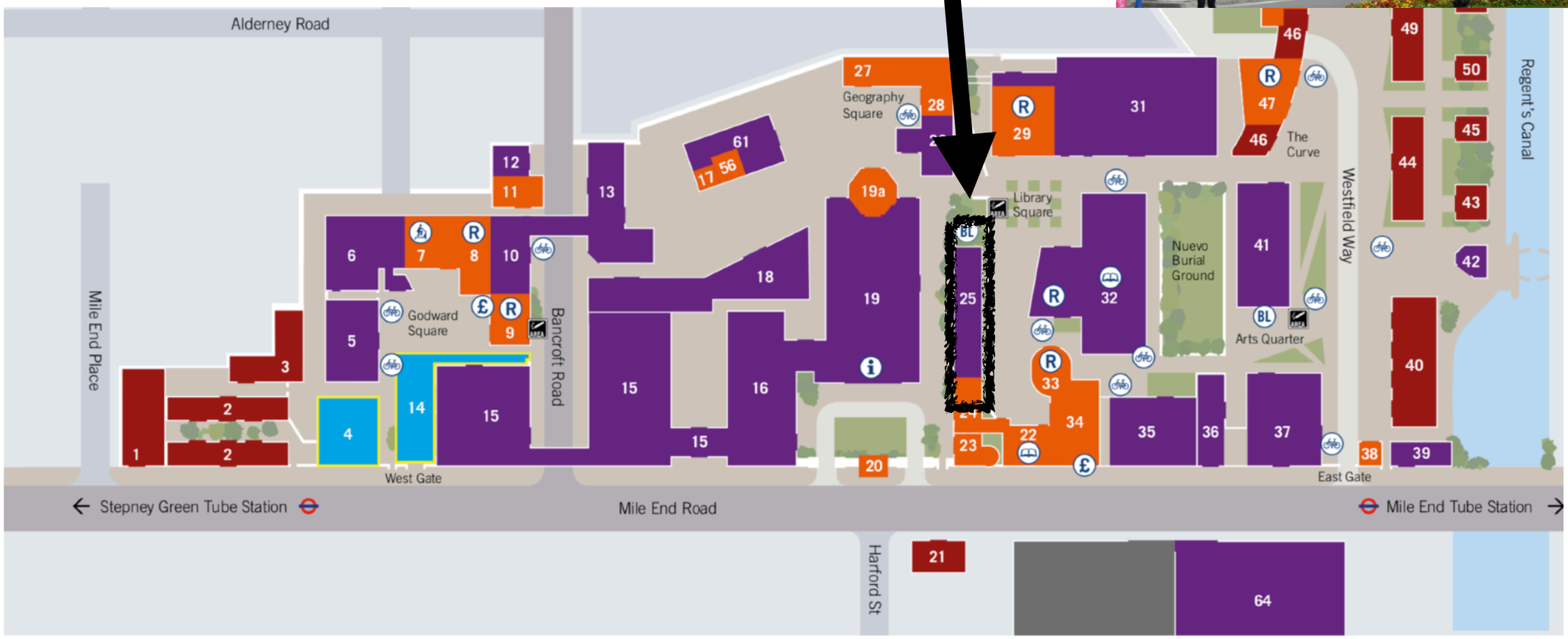
QMUL Summer School: https://www.qmul.ac.uk/summer-school/
Practical Machine Learning QMplus Page: https://qmplus.qmul.ac.uk/course/view.php?id=10006

OVERVIEW

- This course is taught by:
  - Dr Adrian Bevan
  - Room 403, G. O. Jones Building
  - a.j.bevan@qmul.ac.uk
  - Office: 0207 882 6549



OVERVIEW

- The course will be a mix of lectures and practical (PC lab) sessions.
- Over the next 3 weeks we will introduce material that will be developed so that your understanding of machine learning concepts will grow alongside your technical ability.
- The difficulty of the level of work required for assessment will also increase throughout the course.
- Teaching Assistants will be on hand to help with questions.
- Today we also have IT assistants to help with account related matters.

OVERVIEW

- We will be using:
  - Python 3.7
  - TensorFlow 1.13.1
  - Spyder 3.3.5 as an IDE
  - zip files will be used by you to collect together your portfolio of submitted work for marking.

AIMS

- This is a practical module that provides an introduction to the concepts of machine learning and application of algorithms to several types of available data samples.
- You will be introduced to the Python programming language and key concepts related to the TensorFlow™ programming toolkit from Google.
- At the end of the module students will have learned how to train machine learning algorithms and evaluate their performance on image data and scientific data from the Large Hadron Collider.
- Programming skills will be developed during this module in order to explore the potential benefits of deep learning algorithms.

LEARNING OUTCOMES

- Learn basic commands in python and learn how to manipulate data using this programming language.
- Learn how to use tensor flow tools to optimise neural networks and convolutional neural networks as examples of machine learning algorithms.
- Develop comprehension of machine learning algorithms and their use.

SKILLS

- Understand the principles of optimisation algorithms and the role of activation functions in neural networks.
- Understand the concept of overtraining of hyperparameters (HPs) for a machine learning algorithm, and how that can be spotted using data samples.
- Understand the concepts of accuracy and the Receiver Operating Characteristic (ROC) curve and how the area under this curve can be used to select models based on the ability to separate signal from background.

ATTRIBUTES

- Expertise will be demonstrated through the portfolio of work that you will create during this module, and application of your skills to problem solving.
- Rounded intellectual development will be achieved via all aspects of this module, including self study, directed reading, in session quizzes to test incremental assimilation of knowledge and the final critical presentation of what the student has learned and achieved during the module.
- Research capacity will be developed via the application of core principles on machine learning to example data sets. This will allow the critical analysis of your data in terms of specific problems using modern techniques.
- Clarity of communication will be evaluated via the oral presentation component, where students will give a 5 minute presentation on what they have learned during the module, including main results obtained; and will respond to questions on the presentation.

PROGRAMME

- Introduction [context] ← We are going through this now
- Introductory Python [coding]
- Introductory Tensor Flow [coding]
- Linear discriminants [algorithms]
- Introduction to Neural Networks [algorithms]
- Classification problems with Neural Networks [algorithms]
- Regression problems with Neural Networks [algorithms]
- More Tensor Flow [coding]
- Function approximation with neural networks [problem]
- Optimisation [algorithms]
- Deep Learning with Tensor Flow: Multilayer Perceptrons [coding]
- Convolutional Neural Networks [algorithms]
- Deep Learning with Tensor Flow: Convolutional Neural Networks [coding]
- Higgs to ττ [problem]
- Resources [context]
- Ethics [context]

Types of material covered include:
- Context
- Algorithms
- Coding

ASSESSMENT

- 3 strands of assessment:
  - 25% in course tests - Quizzes managed through QMplus.
  - 50% portfolio of work - upload work done on 5 tasks in 3 tranches:
    - Deadlines end of weeks 1, 2 and 3.
  - 25% end of session oral exam:
    - Marks split between slides and oral presentation.
- More details on the QMplus page for this course [1].

[1] https://qmplus.qmul.ac.uk/course/view.php?id=10006

(RE)ASSESSMENT

- For students who fails to pass this model there is a re-assessment route.
- This will take the form of a detailed essay on a specific subject related to the course.
- Details will be posted on the QMplus page as required (after the end of this course) [1].

[1] https://qmplus.qmul.ac.uk/course/view.php?id=10006

HOUSEKEEPING

- You're here to learn - so I expect you to try, make mistakes, ask questions!
- Everyone should have a log in for the computers - if you have not gotten one then identify yourself to us now so that we can rectify that.
- Sometimes there are issues with the computers, so you should find a computer and log in as soon as you enter the room; and if your machine is broken - move to a working one and let us know that there is an issue, so that it can be reported.
- At the end of each week you are required to upload your work to QMplus so that your portfolio of work can be marked.
- Make sure that you save your work to a subfolder on your desktop:
  - YOUR_NAME_PML_Week1
  - YOUR_NAME_PML_Week2
  - YOUR_NAME_PML_Week3

Zip files of your work should be uploaded on a weekly basis; each week corresponds to a given set of tasks.

Understanding what you have done is tested by reflective parts of the assignments.

TIMETABLE: WEEK 1

Queen Mary University of London

Practical Machine Learning

Session 2: 22 July - 9 August 2019

There will be campus tours running from 10am to 12pm from the Queens' Building Reception on 22 July!

Week 1				
	Monday 22 July	**Tuesday 23 July**	**Wednesday 24 July**	**Thursday 25 July**
10am - 12pm	Enrolment **Student Enquiry Centre CB01 Queens' Building**	Class 1 **Room: Queens W2.07**	Class 3 **Room: Queens W2.07**	Class 5 **Room: Queens W2.07**
12pm - 1pm	Lunch break			
1pm - 3pm	Welcome talk and orientation **Room: tbc**	Class 2 **Ethical AI** (Prof. R. Ashcroft guest lecture) **Room: tbc**	Class 4 **Room: Queens W2.07**	Class 6: **AI in Healthcare** (Prof. M Barnes guest lecture) **Room tbc**
3pm - 4pm	Class induction **Room: Queens W2.07**	Personal study	Personal study	Personal study
4pm - 6pm	**Welcome Party aboard a Thames Cruise** Meet outside the Queens' Building for the coach at 4pm	**Jack the Ripper tour** Meet outside the Whitechapel Gallery (E1 7QX) at 5pm	Free	**East End curry night** Meet outside the Queens' Building for the coach at 4pm

TIMETABLE: WEEK 2

Queen Mary University of London

Practical Machine Learning

Session 2: 22 July - 9 August 2019

Spaces are limited for some of our social programme events; check our website to book a place!

Week 2				
	Monday 29 July	**Tuesday 30 July**	**Wednesday 31 July**	**Thursday 1 August**
10am - 12pm	Class 7 **Room: Queens W2.07**	Class 9 **Room: Queens W2.07**	Class 11 **Room: Queens W2.07**	Class 13 **Room: Queens W2.07**
12pm - 1pm	Lunch break			
1pm - 3pm	Class 8 **Room: Queens W2.07**	Class 10 **Room: Queens W2.07**	Class 12 **Room: Queens W2.07**	Class 14 **Data Science at the Alan Turing Institute** (Dr. Nick Barlow guest lecture)
3pm - 4pm	Personal study	Personal study	Personal study	Personal study
4pm - 6pm	**Globe Theatre show TBC** Meeting point TBC	**Junkyard Golf Club** Meet outside the Queens' Building at 4pm	Free	**Visit to Buckingham Palace** Meet outside Green Park station at 4pm

TIMETABLE: WEEK 3 – NOTE DIFFERENT ROOM!

Queen Mary University of London

Practical Machine Learning
Session 2: 22 July - 9 August 2019

NOTE: Oral Exams will be scheduled for 8th and 9th of August.

Week 3				
	Monday 5 August	**Tuesday 6 August**	**Wednesday 7 August**	**Thursday 8 August**
10am - 12pm	Class 15 **Room: Bancroft 1.23**	Class 17 **Room: Bancroft 1.23**	Class 19 **Room: Bancroft 1.23**	Class 21 **Room: Bancroft 1.23**
12pm - 1pm	Lunch break			
1pm - 3pm	Class 16 **Room: Bancroft 1.23**	Class 18 **Room: Bancroft 1.23**	Class 20 **Room: Bancroft 1.23**	Class 22 **Room: Bancroft 1.23**
3pm - 4pm	Personal study			
4pm - 6pm	Free	**Trip to Genesis Cinema**	Free	**Farewell Party** Venue TBC

SUMMARY

- These slides have given an overview of the broad structure of the course.
- You now know where my office is - you are encouraged to come and find me if you have questions out of class.
  - Caveat - it may be more effective use of your time to e-mail me a question or catch up with me before the next session starts:
    - e-mail address: a.j.bevan@qmul.ac.uk
    - I aim to be in this room 30mins before each morning session starts so that you can ask questions.
- Now we move on to some coding...