Mathematics for Machine Learning: Course Overview

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Goal

In this course you will learn mathematical principles used to

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Key skills

- Probability meets linear algebra, i.e. multiple variables
- Linear algebra and statistics underlying learning algorithms
- Probability to analyse learning algorithms

Follows on from:

- Course book: Mathematics for Machine Learning (`https://mml-book.github.io`)
- We have to assume knowledge of vector spaces & linear algebra (ch 2-3)
- Problem driven: We introduce mathematical techniques in the context of fundamental ML methods.

Prerequisites

This course follows on from:

- `40016` - Y1 - Calculus
- `40017` - Y2 - Linear Algebra
- `50008` - Y2 - Probability & Statistics

An incomplete collection of skills that will be assumed:

- Linear Algebra (e.g. change of basis, eigenvectors)
- Differentiation & Integration
- Probability and basic stats (maximum likelihood)

We collected exercises to support you in revising this.

Logistics: In-person teaching

Two lecturers: Myself, and Dr Yingzhen Li.

Teaching schedule:

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- In-person TA sessions on Fri 10-11am.

Coursework

Two courseworks.

- Coding exercise, designed to put the theory into practice.
- Code submission to LabTS, where it will be automatically graded by unittests.
- Feedback provided by TAs.

Exercise sheet

- Unassessed but crucial for your practice.
- TAs are here **every week** to provide feedback.
- But, your responsibility to instigate.

TA sessions

- Your opportunity ask questions, discuss exercises, get feedback.
- This is **student led**: up to you to make the most of it. Suggestion:
  - Discuss specific questions about the course material.
  - Go through (selection of) exercises. You explain your solution to the TAs. TA gives feedback on your solution.
  - Discuss differences to the solution provided.
  - Discuss steps you are uncertain about (e.g. why is a step needed).
- You will need to sign up to a specific TA beforehand (to be communicated over EdStem).

EdStem

You can also ask questions on EdStem, and TAs or lecturers will respond.

Course overview

In this course, we will consider two machine learning problems:

- Supervised learning
- Unsupervised learning

We will teach you the mathematics needed to **implement** and **analyse** the methods, e.g.:

- Linear Regression
  - Differentiation, Optimisation (implementation)
  - Probability and Statistics (analysis)

We care catering to students with a wide variety of backgrounds. Some need to catch up, so there is a lot of material. Focus on the skills needed for implementation if it is too much.

Course materials

- The **only** link you need for material:
  `https://scientia.doc.ic.ac.uk/2223/modules/70015`
- This links to all our materials on GitHub:
  `https://github.com/markvdw/mml-autumn-2022`
- All LaTeX sources are on GitHub too.
- Please do suggest improvements to exercise solutions, fix typos, etc. Just fork and submit a PR.
- For those who contribute, there will be cake.