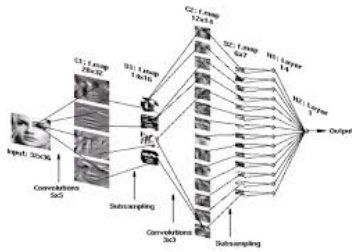


*Course Outline**Course Details and Topics*

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**Problem Sheets**

- I am going to provide many problem sheets
- One problem sheets will be marked and worth 20% (you will know which one this is)
- The other problem sheets are optional, but some small proportion of the questions will be on the exam
- I will go through the problem sheets, but if you have not attempted the questions you won't learn that much

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**Cracking the Code**

- Mathematics is the language of machine learning
- You can do machine learning without mathematics, but if you want to develop and understand advanced algorithms then you have no choice
- This course invites you on a journey to crack the code of mathematics for machine learning
- If this isn't a challenge you want, then this is probably not the course for you

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**Topics Continued**

- Optimisation
  - ★ Newton/Quasi-Newton Methods: convergence rates
  - ★ SGD, momentum, ADAM
- Constrained Optimisation
  - ★ KKT conditions
  - ★ Duality Linear/Quadratic Programming
  - ★ SVMs
- Convexity
  - ★ Convex sets: linear constraints, PD matrices
  - ★ Convex functions
  - ★ SVMs, Lasso
  - ★ Jensen's inequality

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**What's in the Course**

- Lectures
  - ★ Tuesday 14:00-14:45 (02/1039)
  - ★ Thursday 16:00-16:45 (54/5025)
  - ★ Friday 17:00-17:45 (35/1005)
- Assessment
  - ★ 80% Exam
  - ★ 20% Problem Sheet
- This course is going to cover the core principles and mathematics behind machine learning
- It is not going to explicitly teach different machine learning algorithms, although some will be covered
- We are not looking at advanced algorithms but cover the principles fish
- There are very good implementation available (e.g. scikit-learn)
- Along the way though we will meet (often many times) particular algorithms

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**Topics**

- Learning Theory
  - ★ Bias-Variance
  - ★ Overfitting, symmetry and regularisation
  - ★ Ensembling, bagging and boosting
- Mathematics
  - ★ Function Spaces: Kernel Methods and Gaussian Processes
  - ★ Linear Algebra, embeddings, positive definiteness, subspace, determinants

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**Topics Continued**

- Probability
  - ★ Naive Bayes
  - ★ Gaussian Processes
  - ★ Dependencies and Graphical Models
  - ★ Expectations and MCMC
- Variational Methods
  - ★ Divergences: KL and Wasserstein
  - ★ VAEs and GANs
  - ★ Entropy and information theory
  - ★ Variational Approximation

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