

# Artificial Intelligence MSc

Dr Hakan Bilen Artificial Intelligence MSc Programme Director





### Hakan Bilen

Reader

Programme Director for AI MSc

Postdoc: Oxford PhD: KU Leuven, Belgium Undergrad: Sabanci, Turkey

Research interests – machine learning, computer vision







# Freddy

"Freddy was one of the earliest robots to integrate vision, manipulation and intelligent systems as well as having versatility in the system and ease in retraining and reprogramming for new tasks."

Freddy II (1973–1976) University of Edinburgh











Freddy II https://www.nms.ac.uk/explore-ourcollections/stories/science-and-technology/freddy-the-robot/



# Freddy I (1969–1971)

### Identifying a cup





https://www.nms.ac.uk/explore-our-collections/stories/science-and-technology/freddy-the-robot/







OpenAl 2019 https://openai.com/blog/solving-rubiks-cube



### Overview

Introduction

Programme information

Course overview

Q&A





### Programme Structure

180 credit points in total. Includes 20 mandatory, 60 for your project, 100 option taught courses.





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180 credit points in total. Includes 20 mandatory, 60 for your project, 100 option taught courses.

#### **Semester 1**

Informatics Research Review <u>IRR</u> (10 credits)

+ 50 credits taught

#### Semester 2

Informatics Project Proposal <u>IPP</u> (10 credits)

+ 50 credits taught

### Summer (May - Aug)

Dissertation/Project (60 credits)



http://www.drps.ed.ac.uk/current/dpt/ptmscaintl1f.htm



# <u>Applied Machine Learning</u> (AML)

### Semester 1, 20 credits

Introduction to Machine Learning but with more focus on practical application of existing methods, than the mathematical construction and principles of the methods. The course covers both supervised and unsupervised learning. The primary aim is to provide the student with a set of practical tools that can be applied to solve real-world problems in machine learning, coupled with an appropriate, principled approach to formulating a solution.





# <u>Machine Learning and Pattern Recognition</u> (MLPR)

### Semester 1, 20 credits

This course covers some of the core principles of machine learning. It is introductory in the sense that it does not assume any prior machine learning experience. However, there are enough materials to stretch most of those with some machine learning background. It is accessible to those with non-CS backgrounds as long as you have done some programming before. Those from physics, engineering, or maths backgrounds are usually fine. Assumes you are comfortable using linear algebra, calculus, and probability theory, which will all be used in combination. If you do not have the mathematical background for MLPR, please attend IAML instead where mathematical proficiency is less critical.





# Machine Learning Practical (MLP)

### Semesters 1 & 2, 20 credits

Most students specialising in machine learning should take this course. This is not a stand-alone introduction to machine learning, and also assumes familiarity with the maths commonly used in machine learning as well as prior programming experience. If you don't have prior machine learning experience or have little programming background it will move very quickly and be very time-consuming. You might do better to plan on taking an alternative applications course that includes considerable material on neural networks.





# Many more courses!

#### NLP

Accelerated Natural Language Processing (20 credits, S1) Natural Language Understanding, Generation, and Machine Translation (20 credits, S2) Text Technologies for Data Science (20 credits, full year)

#### Speech processing

<u>Speech Processing</u> (10 credits, S1) <u>Automatic Speech Recognition</u> (10 credits, S2) <u>Speech Synthesis</u> (10 credits, S2)

#### Cognitive Science and Ethics

<u>Computational Cognitive Neuroscience</u> (10 credits, S2) <u>Ethics of Artificial Intelligence</u> (20 credits, S2)





### Many more courses!

#### Computer vision and computer graphics

<u>Computer Vision</u> (20 credits, S2)

<u>Computer Graphics: Geometry and Simulation</u> (10 credits, S2)

Computer Graphics: Rendering (10 credits, S1)

#### Robotics

Advanced Robotics (20 credits, S1)

#### More ML

<u>Reinforcement Learning</u> (20 credits, S1) <u>Machine Learning Theory</u> (10 credits, S2)







Mainly June – August

Work with staff member (sometimes industry partner) on an individual project

Some meet and discuss with a small cluster of students

Large variety of projects; from NLP, Machine Learning, Computer Vision, Cognitive Science, ...





# Example MSc projects, many Al-related

Machine Learning Meets Logic - Developing a fast logical solver Characterising uncertainty in neural network models used as digital twin simulations Detecting annotation inconsistencies using pre-trained neural Language Models Learning autonomous robotic grasping Text Specificity in Automated News Summaries Physics-informed neural networks for inversion of molecular geometry measurements Deep Inverse Reinforcement Learning Neumann Series for Autoencoders with Missing Data Surviving the ICU: Building Explainable AI models to predict and understand survival following discharge from intensive care units Generative Capsules Models for Real Data Al-Based Forecasting of Wind Farm Power Outputs Physically Plausible Multi-Object Scene Synthesis Robust estimation of Raman spectrum for cancer diagnostics with machine learning Disentangling Signal and Noise Components in a Neuroscience Dataset Towards census-independent population estimation with machine learning Sparse vector prediction for materials discovery Self-supervised learning for anomaly detection in time-series data Fair image classification





### What Do Employers Want?

"You can decide what approach in data science is best to get the job done, whether that is a cutting-edge deep learning or probabilistic models, or a simple regression."





### What Do Employers Want?

- ▶ Python + cloud stuff + Framework such as PyTorch or TensorFlow
- & Data experience: Analysis of datasets with Python libraries such as numpy, scikit-learn, pandas, ...
- & Environment: Linux, Bash scripting
- & Training and evaluating machine learning models
- & Proficiency querying data with SQL
- & A strong understanding of probability
- & Confidence communicating with both technical and non-technical audiences
- & Self-motivation in the face of challenges
- & Ability to learn new things quickly





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**Language** Demonstrate English language competency that will enable you to succeed in your studies, regardless of your nationality or country of residence.





### **International Cohort**

In previous years ~40 nationalities on the MSc programmes