



2021 Cambridge AI+ Academic Programme (online)

Neural networks and deep learning

syllabus

Course Dates

27th September-5th November, 2021

Course Duration

6 Weeks

Course Hours

48 hours in total

It includes: 6 hours of pre-learning, 16 hours of professor live teaching, 8 hours of professor supervisions/office hour, 2 hours of professor evaluation, and 16 hours of group work and self-study.

Prerequisites

A background in basic computer science knowledge is required for the course. Programming experience is helpful but not necessary.

Assessment

Assessed individually and in groups through group projects.

Skills Trained

Problem Solving, Teamwork, Presentation, Communication.

Materials Required

Internet connection and laptop for writing, researching and preparing presentations.



Course Aim

The aim of this course is to provide an introduction to neural networks and deep learning, with an emphasis on foundational material.

Artificial neural networks (ANNs) mimic the human brain through a set of algorithms. A neural network is comprised of four main components: inputs, weights, a bias or threshold, and an output. Neural networks help us cluster and classify. They help to group unlabeled data according to similarities among the example inputs, and they classify data when they have a labelled dataset to train on. Deep learning is the name we use for “stacked neural networks”; that is, networks composed of several layers. As with other machine learning methods, neural networks have been used to solve a wide variety of problems, such as machine vision and speech recognition. These are problems that are difficult to solve by traditional rule-based programming.

Course Outlines

- Introduction to neural networks and deep learning
- Perceptron and Linear Classification
- Decision Trees and Decision Support Systems
- Spectral Graph Theory and Spectral Clustering
- Spatio-temporal neural networks
- Generative adversarial networks
- Graph and multiscale neural networks
- AI application examples and topic suggestions

Goals & Objectives

At the end of the course students should have a thorough understanding of the context of deep learning and Neural Networks:

- Understanding of powerful Neural Networks such as generative adversarial networks, graph neural networks and temporal neural networks
- Experience in reading about and presenting advanced topics related to Deep Learning and Neural Networks



Course Structure

Modules	Date	Contents	Hours
Pre-learning	One Week before	Pre-learning Materials	6
Module 1	Week 1-3	Professors Live Lectures	8
		Professors Supervision	4
Module 2	Week 4-6	Professors Live Lectures	8
		Professors Office Hour	4
Evaluation	Week 6	Presentations	2

Lecturer:

Prof. Pietro Lió

Professor in Computational Biology in the Computer Laboratory, University of Cambridge
Member of the Artificial Intelligence group of the Computer Laboratory

Research Interests:

- Focuses on developing Artificial Intelligence and Computational Biology models
- to understand diseases complexity and address personalised and precision medicine
- Current focus is on Graph Neural Network modeling.

Assessment:

Group presentation and paper assignments

Final Project:

Final project will be a group presentation.

Topics TBC

Format

Zoom will be the primary tool to conduct the lectures and supervisions.

Reading List

A. Blum, J. Hopcroft and R. Kannan

Foundations of Data Science

<https://www.cs.cornell.edu/jeh/book.pdf>

G. James, D. Witten, T. Hastie, and R. Tibshirani.



An Introduction to Statistical Learning.
Springer, 2014.
<http://www-bcf.usc.edu/~gareth/ISL/>

J. Leskovec, A. Rajaraman, J.~D. Ullmann
Mining of Massive Datasets.
3rd edition, Cambridge University Press, 2020.

S. Shalev-Shwartz and S. Ben-David
Understanding Machine Learning: From Theory to Algorithms
Cambridge University Press, 2014.

<https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf>