

The Chinese University of Hong Kong
Faculty of Engineering & Faculty of Science

Summer Courses 2021
Course Outline

STEM1040 A Trilogy of Hands-on Machine Learning
親身體驗機器學習三部曲

Introduction:

Artificial intelligence (AI) is all the rage these days. We are promised a future of more gadgets and services with AI-powered features such as intelligent chatbots, virtual assistants, and self-driving cars. The current AI boom was largely fuelled by breakthroughs in an area known as machine learning. It involves training computers to perform tasks based on examples rather than programming by a human. A branch of this approach called deep learning has made it more promising for solving perceptual problems such as image classification, face recognition, and natural language processing.

This course offers a hands-on exploration of machine learning through a trilogy approach: mathematical concepts, algorithms, and programming. We will begin with introducing what machine learning is, how it works, and what it can achieve. With a comprehensive treatment of the mathematics and theories involved, we will walk through typical implementations of artificial neural networks to see how the theories turn into practice. Then we will move on to teaching students to make some interesting AI applications (e.g. games) using the Python programming language and machine learning frameworks such as TensorFlow and Keras.

近年來，人工智能（AI）浪潮席捲全球。未來，智能聊天機器人，虛擬助手和自動駕駛汽車等人工智能設備和服務將逐步融入我們的生活。「機器學習」領域中的突破是目前 AI 迅速發展的主要驅動力。機器學習利用樣本數據來訓練計算機自主完成任務，而非依賴人工編程。作為機器學習的一個重要分支，「深度學習」在解決如圖像分類，人臉識別和自然語言處理等智能認知問題上取得了豐碩的成果。

本課程透過「三部曲」（數學概念，算法和編程）訓練讓同學親自動手探索機器學習。首先，我們會介紹什麼是機器學習、它如何運作及其應用層面。之後，我們會講解機器學習背後的數學和理論基礎，並分析「人工神經網絡」的代碼，以展示如何將理論轉化為實踐。最後，我們會教導學員使用 Python 編程語言，TensorFlow 和 Keras 等機器學習框架來實現一些有趣的 AI 應用（例如：遊戲）。

Medium of Instruction: English supplemented with Cantonese

Organizing Unit: Faculty of Engineering & Faculty of Science

Teacher: Dr. LAM King Tin
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Course Content:

26 July 2021 (Monday)	9:30 am - 12:30 pm	<ul style="list-style-type: none">• Mathematics Lecture	Functions, Vectors, Matrices and Tensors
	12:30 pm - 1:30 pm	<ul style="list-style-type: none">• Lunch	
	1:30 pm - 4:30 pm	<ul style="list-style-type: none">• Engineering Workshop	Python Basics and Data Structures
27 July 2021 (Tuesday)	9:30 am - 11:30 pm	<ul style="list-style-type: none">• Mathematics Lecture	Vector Spaces
	11:30 am - 12:30 pm	<ul style="list-style-type: none">• Mathematics Tutorial	Functions, Vectors, Matrices, Tensors, and Vector Spaces
	12:30 pm - 1:30 pm	<ul style="list-style-type: none">• Lunch	
	1:30 pm - 4:30 pm	<ul style="list-style-type: none">• Engineering Workshop	Python Classes and Objects; Module and Packages; NumPy
28 July 2021 (Wednesday)	9:30 am - 11:30 am	<ul style="list-style-type: none">• Mathematics Lecture	Linear transformation and Norms
	11:30 am - 12:30 pm	<ul style="list-style-type: none">• Guest Talk	
	12:30 pm - 1:30 pm	<ul style="list-style-type: none">• Lunch	
	1:30 pm - 4:30 pm	<ul style="list-style-type: none">• Engineering Workshop	NumPy, SciPy, Data Visualization
29 July 2021 (Thursday)	9:30 am - 12:30 pm	<ul style="list-style-type: none">• Mathematics Lecture	Eigenvalues, Eigenvectors, and Singular Value Decomposition
	12:30 pm - 1:30 pm	<ul style="list-style-type: none">• Lunch	
	1:30 pm - 4:30 pm	<ul style="list-style-type: none">• Engineering Workshop	TensorFlow and Keras
30 July 2021 (Friday)	9:30 am - 11:30 pm	<ul style="list-style-type: none">• Mathematics Lecture	Differentiation, Partial Differentiation and Gradients
	11:30 am - 12:30 pm	<ul style="list-style-type: none">• Mathematics Tutorial	Linear transformation, Norms, Eigenvalues, Eigenvectors, Singular Value Decomposition, Differentiation, Partial Differentiation, and Gradient
	12:30 pm - 1:30 pm	<ul style="list-style-type: none">• Lunch	
	1:30 pm - 4:30 pm	<ul style="list-style-type: none">• Engineering Workshop	Artificial neural networks; Multilayer perceptron

2 August 2021 (Monday)	9:30 am - 12:30 pm	• Mathematics Lecture	Convex function and Gradient Descent Method
	11:30 am - 12:30 pm	• Guest Talk	
	12:30 pm - 1:30 pm	• Lunch	
	1:30 pm - 4:30 pm	• Engineering Workshop	Deep learning; Convolution Neural Net (CNN)
3 August 2021 (Tuesday)	9:30 am - 11:30 pm	• Mathematics Tutorial	Convex function and Gradient Descent Method
	11:30 am - 12:30 pm	• Engineering Workshop	ML Applications
	12:30 pm - 1:30 pm	• Lunch	
	1:30 pm - 2:30 pm	• Assessment(Mathematics)	
	2:30 pm - 4:30 pm	• Assessment(Engineering)	
4-5 August 2021* (Wednesday & Thursday)	Make-up Class		

Duration	7 whole day sessions (total 42 contact hours)
Date	26 - 30 July, 2 - 3 August 2021; 4 - 5 August 2021 * (reserved for make-up class)
Time	9:30 am – 4:30 pm
Teaching Mode[#]	Face to Face (The Chinese University of Hong Kong)
Enrollment	40
Expected applicants	Students studying S4-S6 or equivalent who must have taken at least one science course which include Biology, Chemistry, Combined Science, Physics, Information and Communication Technology, Design and Applied Technology, Mathematics Extended Module 1 or 2
Tuition Fee	HKD 3500.00 (Students who have attended all sessions will be granted a HKD 500 scholarship)
Credit	2 University Units Certificates or letters of completion will be awarded to students who attain at least 75% attendance.

* This date is reserved for make-up classes in case there is any cancellation of classes due to unexpected circumstances.

This course is offered face-to-face lessons at CUHK campus. It may switch to online teaching in accordance with the pandemic development and the policy of the university.