The Chinese University of Hong Kong
Faculty of Engineering and Faculty of Science
Science Academy for Young Talent

Summer Courses 2024
Course Outline

STEM1070 Introduction to Artificial Intelligence
人工智能導論

Introduction:	Artificial Intelligence is revolutionizing various industries, from healthcare and finance to transportation and entertainment. This course aims to provide you with a solid foundation in both the mathematical concepts necessary for AI and the practical skills required for machine learning.

We will cover essential mathematical topics such as linear algebra, calculus, and probability theory, exploring how they relate to AI and its algorithms. Once we have established a mathematical and statistical foundations, we will delve into the exciting world of machine learning. You will learn about different types of machine learning algorithms, including supervised and unsupervised learning, and understand how these algorithms can be used to make predictions, recognize patterns, and make intelligent decisions. This course will incorporate hands-on projects and practical exercises. You will have the opportunity to apply your knowledge to real-world problems, working with popular machine learning libraries and tools. By engaging in these practical activities, you will develop valuable skills in data analysis, model development, and evaluation.

人工智能正在革新各個行業，從醫療保健和金融到交通運輸和娛樂。本課程旨在提供人工智能所需的數學概念和機器學習所需的實踐技能的基礎。

本課程涵蓋線性代數、微積分和概率論等基本數學主題，探索它們與人工智能及其算法的關係。在建立了數學和統計基礎之後，我們將深入探索人工智能世界。學習不同類型的機器學習算法，包括監督學習和無監督學習，並了解這些算法如何用於預測、識別模式和做出智能決策。本課程將結合實踐項目和實際練習。應用所學知識於現實世界的問題，並使用流行的機器學習庫和工具進行工作。通過參與這些實踐活動，發展出有價值的數據分析、模型開發和評估技能。

Medium of Instruction:	English supplemented with Cantonese
Organising Unit:	Department of Electronic Engineering, Faculty of Engineering, CUHK Department of Mechanical and Automation Engineering, Faculty of Engineering, CUHK Department of Statistics, Faculty of Science, CUHK

Teachers:

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Course Content:

24 July 2024 (Monday)	9:30 am – 12:30 pm	**Fundamentals of linear algebra for AI: (Dr. Liu)** 1. Scalars, vectors, and matrices 2. Vector operations (addition, subtraction, scalar multiplication) 3. Matrix operations (addition, subtraction, multiplication) 4. Matrix transformations 5. Solving systems of linear equations
	1:30 pm – 4:30 pm	**Lab 1: Linear algebra (Dr. Liu)** 1. Basic data types and operations 2. Variables, loops, and conditionals 3. Input/output and basic functions 4. Introduction to software libraries for linear algebra
25 July 2024 (Monday)	9:30 am – 12:30 pm	**Calculus and Probability in AI: (Dr. Liu)** 1. Differentiation and its role in optimization 2. Partial derivatives and gradients 3. Chain rule 4. Common discrete and continuous random variables 5. Probability mass function (PMF) and probability density function (PDF) 6. Expected value and variance
	1:30 pm – 4:30 pm	**Lab 2: Calculus, Probability and Visualization (Dr. Liu)** 1. Implementing differentiation in Python 2. Solving basic optimization problems using calculus 3. Visualizing functions 4. Generating random samples from distributions 5. Visualizing and analyzing data using probability distributions
26 July 2024 (Monday)	9:30 am – 12:30 pm	**Linear regression: (Dr. Liu)** 1. Simple linear regression 2. Multiple linear regression 3. Model evaluation (R-squared, adjusted R-squared) 4. Assumptions and diagnostics
	1:30 pm – 4:30 pm	**Lab 3: Linear Regression (Dr. Liu)** 1. Implementing linear regression 2. Model evaluation using different metrics 3. Visualization techniques for regression
29 July 2024 (Monday)	9:30 am – 12:30 pm	**Fundamentals of AI (Prof. Lee)** 1. What is AI 2. Basic principles of AI 3. Modern AI technologies
	1:30 pm – 4:30 pm	**Lab 4: Face recognition (Dr. Han)** 1. Familiarize the procedures of face recognition with Machine Learning 2. Investigate a demo code of Face recognition 3. Complete hands-on tasks by studying an open-source project of face recognition

Date	Time	Content
30 July 2024 (Monday)	9:30 am – 12:30 pm	**Basics of Machine Learning (ML) (Prof. Lee)** 1. Vision AI 2. Language AI 3. Sound AI
	1:30 pm – 4:30 pm	**Lab 5: Neural Machine Translation (NMT) (Dr. Han)** 1. Study the procedures to build a NMT model in a toy example 2. Introduce a pre-trained model and learn the procedure of fine-tuning with custom datasets 3. Understand the factors affecting the model performance
31 July 2024 (Monday)	9:30 am – 12:30 pm	**Data in AI (Dr. Han)** 1. Preliminaries of Data 2. Data in the world: Storages, types, and impact 3. Workflow in data analysis 4. Review and conclusion
	1:30 pm – 4:30 pm	**Lab 6: Voice cloning (Dr. Han)** 1. Understand the background and motivation of Text-to-Speech 2. Understand the basic procedure of Text-to-Speech 3. Be aware of different models for Text-to-Speech 4. Try to clone your own voice by using given open-source voice cloning interface
1 August 2024 (Monday)	9:30 am – 12:30 pm	Evaluation through project presentation and project report **(Dr. Liu)**
	1:30 pm – 4:30 pm	Evaluation through project presentation and project report **(Dr. Han)**
2August 2024 (Monday)	9:30 am – 4:30 pm	Make-up class

Date	24 – 26, 29 – 30 July, 1, 2* August 2024 (42 hours)
Time	9:30 am – 12:30 pm & 1:30 pm – 4:30 pm
Teaching Mode	Face to Face (The Chinese University of Hong Kong)
Enrollment	25 – 30
Expected Applicants	Students studying S4-S6 or equivalents
Tuition Fee	HKD 3,500.00
Credit	2 University Unit(s) *Students who complete the course and meet its requirement can opt for credit exemption when studying at CUHK.*

Grading Methods		Certificate	Assessment	Attendance	Credit(s)
	A to A-	*Certificate of Distinction*	*Excellent*	*>75%*	*2*
	B+ to D	*Certificate of Merit*	*Pass*	*>75%*	*2*
	Attended	*Certificate of Attendance*	*Fail*	*>75%*	*0*
	F	*N/A*	*Fail*	*N/A*	*0*

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