The Hong Kong University of Science and Technology

UG Course Syllabus (Spring 2025-26)

[Course Title] Deep Learning in Computer Vision

[Course Code] COMP 4471 / ELEC 4240

[No. of Credits] 3-credit

[Any pre-/co-requisites] (COMP1023 OR COMP 2011 OR COMP 2012 OR COMP 2012H) AND (MATH 2111 OR MATH 2121 OR MATH 2131 OR MATH 2350)

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Course Description

Deep learning has significantly advanced the performance of computer vision system from object recognition to image processing. This course covers the basics and various applications of deep learning in computer vision. Students will study the details of convolutional neural networks as well as recurrent neural networks and train deep networks with end-to-end optimization, and learn deep learning based approaches for both high-level and low-level computer vision tasks such as image recognition and image enhancement. Through programming projects, students will implement, train, and test deep neural networks on cutting-edge computer vision research. Students would be required to study or do research in a final course project related to deep learning and computer vision and present their work by the end of the course.

List of Topics

Topic	**Title**
1	**Course introduction** Computer vision overview Historical context Course logistics
2	**Image classification** Data-driven approach K-nearest neighbor Linear classification I
3	**Loss function and optimization** Linear classification II

	Higher-level representations, image features Optimization, stochastic gradient descent
4	**Introduction to neural networks** Backpropagation Multi-layer Perceptrons The neural viewpoint
5	**Convolutional neural networks** History Convolution and pooling ConvNets outside vision
6	**Training neural networks, part I** Activation functions, initialization, dropout, batch normalization
7	**Training neural networks, part II** Update rules, ensembles, data augmentation, transfer learning
8	**Deep learning hardware & software** Caffe, Torch, Theano, TensorFlow, Keras, PyTorch, etc
9	**CNN architectures** AlexNet, VGG, GoogLeNet, ResNet, etc
10	**Recurrent neural networks** RNN, LSTM, GRU Language modeling Image captioning, visual question answering Soft attention
11	**Detection and segmentation** Semantic segmentation Object detection Instance segmentation
12	**Visualizing and understanding** Feature visualization and inversion Adversarial examples Style transfer
13	**Generative models** PixelRNN/CNN Variational Autoencoders Generative Adversarial Networks Diffusion Models

14	**Attention and Transformers**
15	**Video Models**
16	**Self-supervised Learning**
17	**Generative AI for Visual Content Generation**
18	**Deep 3D Vision**
19	**Denosing Diffusion Model**
20	**Deep Reinforcement Learning for Robots**

Intended Learning Outcomes (ILOs)
By the end of this course, students should be able to:

1. Understand the basics of deep neural networks
2. Train deep neural networks on several computer vision tasks
3. Use deep learning as a tool to solve a research problem of their interests

Assessment and Grading
This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessment Task	Contribution to Overall Course grade (%)
3 Programming Assignments	36%
End-term exam	35%
Final Project	29%
Total	100%

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Assessed Task 1, 2, 3	ILO1, ILO2, ILO3	These task assesss students' ability to explain and apply deep learning concepts (ILO 1, 2), evaluate their applications (ILO 3)

Grading Rubrics

Available in the course web.

Final Grade Descriptors:

N/A

Course AI Policy
AI tools may be used for improving English and phrasing in reports, but otherwise not allowed in projects and exams.

Communication and Feedback
Assessment marks for individual assessed tasks will be communicated directly to students within two weeks of submission. Feedback on assignments will include specific details, e.g., strengths, areas for improvement. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy
No resubmission.

Required Texts and Materials
Textbooks
Ian Goodfellow, Yoshua Bengio and Aaron Courville. *Deep Learning*, MIT Press, 2016.
Aston Zhang, Zachary C. Lipton, Mu Li, Alexander J. Smola. Dive into Deep Learning. 2021
https://d2l.ai/

Academic Integrity
Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources
N/A