Advanced Machine Learning
Module 4, 2025-2026

Course Information

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Venue: PHBS Building, 213

Lectures:
Time: Tuesday and Friday, 15:30-17:20
Venue: PHBS Building, Room TBA

Course Website:
PHBS school CMS website: cms.phbs.pku.edu.cn

1. Course Description

1.1 Context

Course overview:
The course covers deep learning methods and algorithms, including the following topics: data manipulation, automatic differentiation and optimization with pytorch, linear neural networks for regression, linear neural networks for classification, multilayer perceptrons, neural network layers and modules in pytorch, convolutional neural networks, modern convolutional neural networks including deep convolutional neural networks (AlexNet), networks using blocks (VGG), network in network (NiN), multi-branch networks(GoogleNet), residual networks (ResNet) and ResNeXt, densely connected networks (DenseNet), recurrent neural networks, modern recurrent neural networks including long short-term memory, gated recurrent units, deep recurrent neural networks, bidirectional recurrent neural networks, machine translation, encoder-decoder architecture, sequence-to-sequence learning for machine translation, attention mechanisms, the transformer architecture, applications of transformers in vision, graphical neural networks, generative adversarial networks, Gaussian processes, etc. The course also discusses various applications of deep learning in finance.

Prerequisites: basic probability, Python programming

1.2 Textbooks and Reading Materials

Reference books:
Dive into Deep Learning, Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola, Cambridge University Press, 2023.
Deep Learning with Pytorch, Eli Stevens, Luca Antiga, and Thomas Viehmann, Manning, 2020.
Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.

2. Learning Outcomes

2.1 Intended Learning Outcomes

Learning Goals	**Objectives**	**Assessment (YES with details or NO)**
1. Our graduates will be effective communicators.	1.1. Our students will produce quality business and research-oriented documents.	Yes. The students will carry out research on the application of deep learning in finance.
	1.2. Students are able to professionally present their ideas and also logically explain and defend their argument.	Yes. The students will carry out research projects and present their findings.
2. Our graduates will be skilled in team work and leadership.	2.1. Students will be able to lead and participate in group for projects, discussion, and presentation.	Yes. The students will participate in group discussion of homework problems and group project.
	2.2. Students will be able to apply leadership theories and related skills.	No.
3. Our graduates will be trained in ethics.	3.1. In a case setting, students will use appropriate techniques to analyze business problems and identify the ethical aspects, provide a solution and defend it.	No.
	3.2. Our students will practice ethics in the duration of the program.	No.
4. Our graduates will have a global perspective.	4.1. Students will have an international exposure.	Yes. The students will learn modern deep learning methods developed by internationally renowned scientists.
5. Our graduates will be skilled in problem-solving and critical thinking.	5.1. Our students will have a good understanding of fundamental theories in their fields.	Yes. The students will learn the fundamental methods and tools in deep learning.
	5.2. Our students will be prepared to face problems in various business settings and find solutions.	Yes. The students will use advanced deep learning methods to solve problems in finance.
	5.3. Our students will demonstrate competency in critical thinking.	Yes. The students will learn to critically evaluate a deep learning model using validation and test data set.

2.2 Course specific objectives

After taking the course, the students will master comprehensive knowledge of deep learning methods and their implementation with pytorch.

2.3 Assessment/Grading Details

There will be two homework set. The students are encouraged to discuss the homework problems together, but each student need to hand in his or her own solution.

There will be a closed-book and closed-notes midterm exam. An A4-size double-sided cheat sheet is allowed in the exam.

There will be a group course project that focuses on the application of deep learning in finance. Each group can have two to four students.

The grade of the course is given by homework(15%)+midterm(40%)+project(45%).

2.4 Academic Honesty and Plagiarism

It is important for a student's effort and credit to be recognized through class assessment. Credits earned for a student work due to efforts done by others are clearly unfair. Deliberate dishonesty is considered academic misconducts, which include plagiarism; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; or altering, forging, or misusing a University academic record; or fabricating or falsifying of data, research procedures, or data analysis.

All assessments are subject to academic misconduct check. Misconduct check may include reproducing the assessment, providing a copy to another member of faculty, and/or communicate a copy of this assignment to the PHBS Discipline Committee. A suspected plagiarized document/assignment submitted to a plagiarism checking service may be kept in its database for future reference purpose.

Where violation is suspected, penalties will be implemented. The penalties for academic misconduct may include: deduction of honour points, a mark of zero on the assessment, a fail grade for the whole course, and reference of the matter to the Peking University Registrar.

For more information of plagiarism, please refer to *PHBS Student Handbook*.

AI tools requirements：
Using AI tools to complete assignments without the approval of the course instructor will be regarded as an act of academic dishonesty. Depending on the severity of the situation, penalties will be implemented in accordance with the provisions of the Peking University Graduate Student Handbook.

3. Topics, Teaching and Assessment Schedule

The midterm exam will be held during 15:30-17:20 on June 2, 2026.