



Course Code: AIN3002

Course Name: Deep Learning

SYLLABUS¹

Instructor

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Course Information

Period : Fall
Time : Wednesday 19.00 – 21.50
Course Credit / ECTS : 3 / 6
Classroom : D305
Mode of Delivery: : Online
Course type : Must
Course ECTS Page Link : https://akts.bau.edu.tr/bilgipaketi/index/ders/ders_id/46998/program_kodu/04142101/s/6/st/M/In/en/print/1/

Course Objectives

Deep learning has become a primary tool for AI tasks in different domains such as computer vision, pattern recognition, natural language processing, machine translation, bioinformatics, and game playing. It has penetrated different industries, like healthcare, finance, self-driving cars, entertainment, social media, and games, with its enormous potential impact. As a result, it has become a highly demanded skill in both research and industry.

In this course, we will learn the basics of neural networks and their applications in various domains. The course will mainly focus on supervised learning-based methods. It will start with multi-layer perceptrons and gradually and eventually discuss more advanced topics such as attention and transformers.

Course Learning Outcomes

By the end of the course, students are expected to know the fundamentals of Deep Learning and be able to apply Deep Learning to different tasks. Besides, they will have a strong basis enabling them to understand the related work in the literature and extend it through further studies.

Contribution of the Course to the Program

This course will provide students with theoretical and practical background in deep learning. It will help students use theoretical and applied knowledge to identify, define, formulate, and solve problems using deep learning techniques and tools. Besides, it will contribute to students' skills and abilities in conducting experiments including data collection, analysis, and interpretation.

Course Structure

The course consists of two main components: learning foundations of deep learning and gaining hands-on experience in implementing the deep learning models. We will learn the foundations via in-class discussions. Each lecture will have some resources that will provide us with the details of the topic. These resources will be made

¹ It is essential that the syllabus announced at the beginning of the term is not changed except when necessary. When a requirement occurs, the curriculum can be changed by the lecturer of the course by notifying this situation in writing or verbally beforehand. It is the student's responsibility to follow the current program.

available before the class, and you are strongly urged to go through them before the in-class discussion. We will gain hands-on experience by implementing the concepts and building deep learning models using PyTorch as an integral part of the classes.

Course Policies

Communication Channels and Methods:

All the communication (announcements, discussions, submissions, etc.) will go through Itslearning course site.

- You are strongly encouraged to post your questions and comments in the course’s discussion forums. If you have any personal issues that you cannot post in the course discussion forum, you can contact your instructor via email.
- You must submit all your work via Itslearning course site. Hard copy submissions and submissions via email will not be accepted.

Usage of Digital Tools:

You are requested **NOT to use** your electronic devices (phone, tablet, laptop etc.) during in-class discussions.

Attendance:

Attendance is not compulsory, yet highly recommended. There is a strong correlation between class attendance and success in the course since it provides a unique experience of interaction and discussion, which promotes learning.

Disabled Student Support:

You can contact me directly regarding the issues that may be an obstacle for you (vision, hearing, etc.). In addition to this, there is a Disabled Student Unit to minimize the difficulties that our disabled students will encounter due to their disabilities and to eliminate the obstacles. You should contact this unit regarding your situation.

Oral and Written Communication Ethics:

You must express yourself respectfully in your communication with everyone in the class. In addition, you are responsible for maintaining this respect in discussions and correspondence on the online platform.

Privacy and Copyright:

In accordance with the Personal Data Protection Law, it is strictly forbidden to register the participants (students and instructors) during the course.

Course Resources

There are no specific books or resources that we will follow in this course. Yet, some recommended sources are listed below. Apart from that, we will have different resources specific to each topic. These resources will be made available through Itslearning course site at least one week before the class that the topic will be covered.

Type	Name	Description
Textbook	<u>Deep Learning (Goodfellow et al., 2016)</u>	The Deep Learning textbook is a resource intended to help students and practitioners enter the field of machine learning in general and deep learning in particular.
Textbook	<u>Dive into Deep Learning (Zhang et al., 2021)</u>	Interactive deep learning book with code, math, and discussions
Framework	<u>PyTorch</u>	An open-source machine learning framework that accelerates the path from research prototyping to production deployment.

Additional resources will be announced/made available via Itslearning course site.

Grading and Evaluation

Assignment	Description	Weight (%)
Pop-up Quizzes	<ul style="list-style-type: none"> There will be 10 pop-up quizzes in the class, weighted equally. Each quiz may cover topics of previous weeks and the current week. 	10
Programming Certificates	<ul style="list-style-type: none"> Two Kaggle certificates (2 points) One HackerRank certificate (2 points) Please see the weekly schedule for the required certificates, details of which will be announced during the semester 	4
Programming Assignments	<ul style="list-style-type: none"> There will be three programming assignments, weighted equally. Programming parts will be auto graded using scripts. You must follow the submission guidelines; otherwise, you may get zero. Programming assignments may also include written parts. Solutions to these parts must be in PDF format and typeset in LaTeX. Selected solutions will be invited to present in the class. 	12
Project	<ul style="list-style-type: none"> The project will be announced around week-3. The project will be conducted as a group of two people. You are required to form your group by the end of week-3. Final code and report (14 points) <ul style="list-style-type: none"> Submission deadline: 04.06.2023 @23.59 The report is strictly limited to four pages including references. <ul style="list-style-type: none"> Should include: Introduction, Related works, Materials and methods, Results, Discussion, References The report must be in PDF format following NeurIPS paper style and typeset in LaTeX. https://neurips.cc/Conferences/2022/PaperInformation/StyleFiles Online editors such as Overleaf may be helpful in writing reports: https://www.overleaf.com. Code must be deposited at the GitHub and have a step-by-step explanation in README to reproduce the results. <ul style="list-style-type: none"> Tips for publishing research code and example README file: https://github.com/paperswithcode/releasing-research-code Final presentation (10 points) <ul style="list-style-type: none"> During the last week of the semester in the class <ul style="list-style-type: none"> The order of presentations will be based on group registration time: last-come-first-serve. It is strictly limited to 5 minutes <p>Should include: Introduction, Related works, Materials and methods, Results, Discussion, References</p>	24
Midterm Exam	There will be one midterm exam covering all subjects in the first 8 weeks. It will be given during Week-9.	10
Final Exam	There will be one final exam covering all subjects. It will be given during final exams.	40
TOTAL		100

Course Calendar

Resources specific to each topic will be announced/made available via Itslearning course site.

Week	Course Topic	Assignments
W1	Introduction to Deep Learning Learning and intelligence Machine learning (ML) and ML taxonomy (unsupervised to supervised) ML tasks (generative vs. discriminative) Linear separability (decision boundary) Linear transformation (matrix multiplication) Data space vs. feature space	HackerRank certificate-I
W2	Artificial neural networks Activation functions Multi-layer perceptron Shallow vs. deep networks NNs are universal approximators	Kaggle certificate-I
W3	Training neural networks Gradient descent Backpropagation	
W4	Loss functions Optimization (Learning rate and optimizers - SGD, ADAM, etc.) Loss surfaces Weight initialization	Assignment-I
W5	Full cycle of a deep learning project Diagnostics of neural networks (overfitting vs. underfitting / memorizing vs. generalizing / bias vs. variance) Hyperparameter tuning Regularization (weight decay, dropout)	
W6	Convolutional neural networks Image filtering Parameter sharing Hierarchical representations Pooling Receptive field	Kaggle certificate-II
W7	Normalizing inputs and activations Batch normalization Residual connections Training and visualizing CNNs	Assignment-II
W8	Modern CNN architectures Applications of CNNs	
W9	Recurrent Neural Networks (RNNs) Parameter sharing Unrolling and backpropagation	
W10	Training RNNs Long Short Term Memory (LSTM) Gated Recurrent Units (GRUs)	Assignment-III
W11	Applications of RNNs	
W12	Attention and Transformers	
W13	Advanced topics in deep learning I / Buffer I	
W14	Advanced topics in deep learning II / Buffer II	

Matters Needing Attention

- Read all weekly course materials before coming to the class and get prepared for in-class discussions.
- Attend the lectures actively every week.
- Participate in and contribute to in-class activities and discussions.

Academic Integrity, Cheating and Plagiarism

Academic integrity is a serious matter in this course. Any violation will be reported to the university's highest levels and maximum punishment will be argued for.

You are encouraged to form study groups to discuss quizzes and programming assignments. However, you must write down your own solutions without referring to the notes taken during discussions. It is a violation of academic integrity to copy, refer to or look at written solutions and code from another student or any other sources. It is also a violation of academic integrity to post your solutions and code online. Besides, you should write down the names of your collaborators in your submissions.

You are expected to comply with the University Policy on Academic Integrity and Plagiarism. Violations of the university policy can result in severe penalties, including failing this course and possible expulsion from Bahçeşehir University. If you have any questions about this policy and any work you are doing in the course, please feel free to contact your instructor for help.

ARTICLE 25 – (1) In case it is doubled that a student cheats or attempts to cheat, commits plagiarism or similar violations defined in the applicable disciplinary regulation in any exam, assignment or other assessment activities, a disciplinary proceeding is brought against the student. Such activity is not assessed during the proceedings. A student who is found guilty is assigned zero point in addition to the disciplinary punishment. If the student is found innocent because of disciplinary proceeding, the exam taken by the student shall be assessment or a make-up exam or activity is provided.

[You can access Bahçeşehir University and Higher Education Institution Regulations by clicking this sentence.](#)

Prepared by: Mustafa Ümit ÖNER
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