MARMARA UNIVERSITY - FACULTY OF ENGINEERING

2022-2023 Spring

CSE4079 Introduction to Deep Learning

COURSE DESCRIPTION FORM

Offering Department	Department of Computer Engineering		Undergraduate technical elective course (7th-8th semesters)
Course Code	CSE4079		
Course Name	Introduction to Deep Learning		
Language of Instruction	English		
ECTS	5		
Contact Hours	Theoretical (T): 3	Practice (U): 0	Laboratory(L): 0
Pre-requisites	Calculus, Linear Algebra, Probability and Statistics, programming skills, basic machine learning concepts		
Instructor, Assistant	**Instructor**	Çiğdem Eroğlu Erdem	
	E-mail	cigdem.erdem@marmara.edu.tr	
	Assistant	-	
Course Website	We will use **Google Classroom** for this course. Lecture notes, weekly reading assignments, announcements and homeworks will be shared via the course web page. It is the responsibility of the student to visit the web page regularly (several times a week) and download the course materials. Please visit the below link and click on the plus sign at the top right corner to join the class using the class code: Link: https://classroom.google.com Class code: **ebholth** (Do not share the code with others.) OR you may use the below link https://classroom.google.com/c/NTYyNzUyODY2Mjgx?cjc=ebholth To access the lecture notes and homeworks click on the "Classwork" tab at the top of the page.		
Course Materials	**Mandatory**	Lecture notes will be available at the course web page. **ZOOM Lectures:** Monday 15:00 – 16:50 https://zoom.us/j/91852611445?pwd=d0JPSTRJUzJRYm9UaWJIczFwVzZ1Zz09 Meeting ID: 918 5261 1445 Passcode: 094259 Thursday 14:00 – 15:00 https://zoom.us/j/95013249464?pwd=aFlwOFZzTVVwN3ZPdUljdUJXTWc3dz09 Meeting ID: 950 1324 9464 Passcode: 974229 The videos of the lectures will be uploaded to UES.	
	Recommended	The content of this course does not exactly follow any one textbook. However, some reading assignments will be given from several of the books given below: • **Deep Learning**, Ian GoodFellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016. (available online: https://www.deeplearningbook.org/) • **Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow**: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly, third edition, 2022. • **Deep Learning with Python,** Francois Chollet, Second Edition, Manning Publishing, 2021, ISBN: 9781617296864 • **Machine Learning with PyTorch and Sckit-Learn,** Sebastian Raschka, Yuxi (Hayden) Liu, Vahid Mirjalili, Packt Publishing, 2022, ISBN 978-1-80181-931-2. • **Dive into Deep Learning (online book),** https://d2l.ai/ • **Understanding Deep Learning, Simon J. D. Prince,** to be published by MIT Press, 2023, https://udlbook.github.io/udlbook/ • **Speech and Language Processing,** Dan Jurafsky, James H. Martin, 3rd edition, https://web.stanford.edu/~jurafsky/slp3/	
Course Objectives	This is an undergraduate level introductory course in deep learning, which will give an overview of many theoretical and practical concepts in deep learning. Three major types of deep neural networks will be studied: Multi-layer Perceptrons, Convolutional Neural Networks, and Recurrent Neural Networks. The applications of these three deep learning models to various machine learning problems will be discussed with an emphasis on applications in computer vision.		
Course Content	Mathematical foundations; basics of machine learning; artificial neurons, multi-layer perceptrons; Introduction to Keras and Tensorflow; Training deep neural networks: gradient descent, the vanishing/exploding gradients problems, reusing pretrained networks, optimizers, avoiding overfitting through regularization; Convolutional Neural Networks (CNNs): convolutional layers, pooling layers, padding and stride, CNN architectures (AlexNet, VGG, GoogLeNet, ResNet etc.) pretrained models for transfer learning, Applications of CNNs: Classification and localization, object detection, semantic segmentation, face recognition; Deep Learning for time series: Recurrent Neural Networks (RNNs), Training RNNs, Modern RNNs: Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU)		
Learning Outcomes	**LO1**	Explain theoretical mathematical concepts of deep learning (optimization, regularization etc.)	

	LO2	Describe and apply multi-layer perceptrons to machine learning problems that involve classification and regression.
	LO3	Explain basic concepts of convolutional neural networks (convolutions, padding, stride, pooling etc.).
	LO4	Explain modern CNN architectures (AlexNet, VGG GoogLeNet, ResNet etc.)
	LO5	Describe and apply CNNs to machine learning problems in computer vision (e.g. classification, object detection, semantic segmentation, face recognition).
	LO6	Describe and apply recurrent neural networks to machine learning problems that involve time series problems.

Program Outcomes		**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**LO6**
PO1	Adequate knowledge in mathematics, science (a) and computer engineering subjects (b) pertaining to the relevant discipline (1); ability to use theoretical and applied information in these areas to model and solve engineering problems (2).	1b	1b	1b	1b	1b	1b
PO4	Ability to devise (a), select, and use (b) modern techniques and tools needed for engineering practice (1); ability to employ information technologies effectively (2).		1b			1b	1b
PO5	Ability to design (a) and conduct experiments, gather data (b), analyze and interpret results for investigating engineering problems (c).		abc			abc	abc

	No	**Week**	**Subjects (tentative, subject to change)**	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**LO6**
Subjects (Knowledge, Skills and Behaviours), **Contributions of Subjects to Learning Outcomes,** **Assessment Methods**	**S1**	1	Introduction and overview						
	S2	2	Review of basic machine learning and mathematical concepts						
	S3	3	Artificial neurons, perceptron, logistic regression						
	S4	4	Logistic Regression, Cross-entropy						
	S5	5	Shallow Neural Networks						
	S6	6	Deep Neural Networks						
	S7	7	Optimization Algorithms, MLP with Keras						
	S8	8	Hyperparameters, Batch Norn						
	S9	9	Error Analysis, Bias-Variance						
	S10	10	Convolutional Neural Networks						
	S11	11	Applications of CNNs: Object Detection						
	S12	12	Applications of CNNs: Face Recognition, Neural Style Transfer						
	S13	13	RNN, GRU, LSTM						
	S14	14	Project presentations						

	No	**Type**	**Weight**	**Implementation Rule**	**Make-up Rule**
Assessment Methods and Weights	**MF**	Midterm, Final	75%	Exams will be closed books and notes. The students will be allowed to use or will be provided formula pages and calculators.	Marmara University regulations will be followed for make-up exams.
	Q	Quizzes	10%	There will be announced short quizzes during lectures.	There are no make-ups for the quizzes.
	H	Homeworks		Homeworks will be given for self-study, but they will not be graded. However, the students will be responsible from the concepts covered in the homeworks.	
	P	Project	15%	The project work will consist of three stages: (i) Topic selection and proposal (ii) Midterm report (iv) Final report, demonstration and oral presentation.	
	R	Report			
	S	Presentation			
	A	Participation/ Interaction		**Attendance to at least 70% of the lectures is mandatory to pass the course. Otherwise your letter grade from the course will be DZ.**	
	L	Class/ Laboratory/ Field Work			
	O	Other			
	TOTAL		100%		

Determining Letter Grades

- The letter grades will be determined based on the midterm and final exams, quizzes and homeworks.
- In order to determine the letter grade, a curve or catalog based method will be followed based on the total average scores of the students.
- The final exam score and the total average score of the student must be at least 35 to pass the course.
- According to Marmara University Undergraduate regulations, the weight of the final exam must be at least 40 out of 100.

Assessment	Midterm	Quizzes/Polls	Project	Final	TOTAL
Weight	35	10	15	40	100

Teaching Method, Student Work Load

Tme Applied by Instructor

No	Method	Explanation	Hours
1	Lectures	Lectures are given in class using the board or via presentations. Example questions are solved to enhance the concepts.	14x3=42
2	Problem Session/ Practice	Problems related to the course topics are solved on the board.	
3	Laboratory	Experiments are done in the laboratory or theoretical concepts covered during the lectures are practiced using computer exercises.	
4	Interactive Courses	Questions are asked to students during lectures and they are encouraged to guess the answers (peer learning is also in this category)	
5	Field Work	Students attend activities outside the campus.	
6	Ara Sınav	Midterm exam is given during the midterm week.	2x2=4
7	Final	Final exam is given during the final exam week.	2
Öğrencinin ayırması beklenen tahmini süre			
8	Poject	The students carry out research about the problem given in the project, design and implement their solution and prepare a report.	
9	Homeworks	The students solve the problems given as homework.	3x10=30
10	Pre-class learning of Course Material	The students study and learn the new subjects from course materials.	
11	Review of Course Material	Students review the course subjects from course materials to prepare for the exams and homeworks.	45
12	Office Hour	Students ask questions to the instructor or the assistant during office hours.	2
TOPLAM			125

Academic Honesty

Violations of scholastic honesty include, but are not limited to cheating, plagiarizing, fabricating information or citations, facilitating acts of dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students.

In case academic dishonesty is observed, the first authority is the instructor of the course. The instructor may decide to give the student zero for the homework(s)/lab(s)/exam(s), give the letter grade FF, or may take disciplinary action.