CS 515 – Deep Learning

2023 Spring

Catalogue Data: This course covers the theory and foundations of Artificial Neural Networks (ANN) and **various shallow neural network architectures**, including the single and multi-layer perceptrons, Hopfield and Kohonen networks, and **deep learning architectures** (convolutional neural networks, recurrent networks, autoencoders, generative adversarial networks, transformers). Students will be expected to develop deep learning systems for machine learning problems in computer vision and/or natural language understanding areas.

Prerequisite: CS412 or CS512 or EE566 or equivalent – or instructor approval

Instructors: Berrin Yanıkoğlu (berrin@sabanciuniv.edu)

References:

- Jurafsky book (Online) – Very accessible for the basics of NN
- Ethem Alpaydin book (Online book available through IC) – General ML book
- Haykin book (On SuCourse) – Famous book/author, signal processing perspective
- Neural Networks and Deep Learning – long and detailed, limited in scope but good for covered parts
- http://www.deeplearningbook.org/ - not as readable as the above, but more coverage of DL topics
- Blogs and YouTube tutorials will also be shared per topic.

Tentative Grading:

- **Midterm exam**: 30% (10th week)
- **Homeworks**: 30% (There will be 3 or 4 programming homeworks with Python, see below.)
- **Group Project**: 15% - (1 or 2 person groups only)
- **Quizzes**: 15% (on last topics or read/presented papers)
- **Paper presentations**: 10% (may be optional depending on number of students in class)
- **Up to 5% Bonus** for extra work (homeworks, shared tools, …)

See tentative outline below. Lectures will be standard lectures in the first weeks with more and more student participation and presentations after the 4th week.

Week	Topic	Slides	Assigned Reading	Homework
Week1	Course Information Neural Networks – Motivation Perceptron Learning Rule Perceptron Limitations	nn1 nn2 nn3		
Week2	Multi-layer Perceptrons Backpropagation Backpropagation Alternatives	nn4	Reference books	**Hw1-GradientDescent**
Week3	Intro. To Deep Learning Convolutional Neural Networks	nn5	Reference books	
Week4	Convolutional Neural Networks Well-known Architectures	nn6	Papers will be assigned	**Hw2-Transfer Learning w/ ConvNets**
Week5	Object Detection and Classification	nn7	Papers will be assigned	
Week6	Object Detection and Classification cont.	papers		Tentative/Bonus: Hw3a-Object Detection (Yolo or Fast RCNN variants)
Week7	Unsupervised Learning Paradigm Auto-encoders Word embeddings	nn8	Papers will be assigned	Tentative/Bonus: Hw3b-Homework-Auto-Encoders or Word Embeddings
Week8	Unsupervised learning cntd. Generative Models (GANs)	nn9	Papers will be assigned	
Week9	Sequence Learning Recurrent Neural Networks LSTMs (briefly)	nn10		
Week9	Transformers	nn11	Tutorials/papers	**HW4-Transformers**
Week10	Transformers		Tutorials/papers	
Week11	**Midterm**	slides		**Project Selection**
Week12	Work on your projects along with some extra lectures/papers	slides		
Week13		slides		
Week14		slides		
Finals Week (No final)	**Project Presentations**			