CS795/895: Deep Learning in Medicine and Biology

Spring 2019, TR 11:00 – 12:15 PM

Location: ECSB 2120

Instructor:

Jiangwen Sun, Ph.D., Assistant Professor, CS Department

Office: ECSB 3204, Phone: 683-7712, Email: jsun@cs.odu.edu

Office Hours: Tuesday 10:00 – 11:00 AM (other times by appointment)

Teaching Assistant:

None

Prerequisite:

Knowledge of basic machine learning concepts/algorithms, including common supervised and unsupervised methods (such as linear/logistic regression, k-means and hierarchical clustering), model overfitting/underfitting, gradient descent and model evaluation. Basic computer skills and programming experience with Python.

Course Description:

The objective of this course is to introduce commonly used deep neural network (DNN) architectures to students, and enable them to use DNNs in real-life applications, and review the state-of-the-art literature of applying DNNs to solve computational problems in human medicine and related biology. This course covers commonly used DNN architectures, such as CNN (convolutional neural network), RN (residual network), RNN (recurrent neural network), LSTM (long short-term memory network), GAN (generative adversarial network), autoencoder, etc. and DNN applications, such as patient classification using medical images or electronic health records, cell biology data analysis, protein secondary structure detection, etc.

Approaches:

The course consists of lectures, paper reviews (writing reviews, in-class student presentations and discussion), and projects. Lectures will serve as the vehicle for the instructor to introduce basic concepts in neural networks and commonly used DNN architectures to students. Paper reviews are used to inform students of the latest research topics and techniques related to deep learning in medicine and related biology. A course project will be used for students to get profound hands-on experience by programming and training certain DNNs, aiming at solving certain computational problems in medicine or related biology identified by the instructor or students from recent literature.

Students are encouraged to form study groups for collaboratively working on course project. Each group is expected to consist of two to three students. Each group can choose to work on a project from a list provided by the instructor or a self-identified application of DNN in medicine and related biology. If a group choose to work on a self-chosen project, approval from the instructor should be acquired. A portion of the lecture time into the semester will be used for each team to update the progress, discuss and seek for solutions to problems encountered in the process of completing the course project. At the end of the semester, each team is required to present in the classroom and submit a project report, which is in the format of a regular research paper.

Topics and Tentative Schedule:

Week	Topics	Note
Week 1 *(Jan. 14 ~ Jan. 18)*	Introduction Basic concepts in neural network	
Week 2 *(Jan. 21 ~ Jan. 25)*	Basic concepts in neural network CNN, RN	
Week 3 *(Jan. 28 ~ Feb. 1)*	RNN, LSTM GAN	
Week 4 *(Feb. 4 ~ Feb. 8)*	Autoencoder Paper presentation & discussion	
Week 5 *(Feb. 11 ~ Feb. 15)*	Paper presentation & discussion	
Week 6 *(Feb. 18 ~ Feb. 22)*	Paper presentation & discussion	
Week 7 *(Feb. 25 ~ Mar. 1)*	Paper presentation & discussion	
Week 8 *(Mar. 4 ~ Mar. 8)*	Paper presentation & discussion	
Week 9 *(Mar. 11 ~ Mar. 15)*	No classes	Spring Holiday
Week 10 *(Mar. 18 ~ Mar. 22)*	Paper presentation & discussion	
Week 11 *(Mar. 25 ~ Mar. 29)*	Paper presentation & discussion	
Week 12 *(Apr. 1 ~ Apr. 5)*	Paper presentation & discussion	
Week 13 *(Apr. 8 ~ Apr. 12)*	Paper presentation & discussion	
Week 14 *(Apr. 15 ~ Apr. 19)*	Paper presentation & discussion	
Week 15 *(Apr. 22 ~ Apr. 26)*	Term project presentation	

Textbooks:

- Deep Learning (Adaptive Computation and Machine Learning Series) by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, ISBN-10: 0262035618
- Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher M. Bishop, ISBN-10: 0387310738

None of the textbooks will be required. However, having one or two of them may complement and expand the materials discussed in lectures. Lectures will come with slide files and tutorial/review papers for students to study after lectures.

Attendance Policy:

Students are required to attend classes regularly.

Grading Policy:

- Class attendance: 10%
- Paper review: 30%
- Paper presentation: 10%
- Term Project (instructor provided or self-identified): 50%, graded per team, each team consisting of no more than three members.

Drop Policy:

As per University guidelines. See the University Calendar for drop dates.

Disabilities:

Old Dominion University is committed to ensuring equal access to all qualified students with disabilities in accordance with the Americans with Disabilities Act. The Office of Educational Accessibility (OEA) is the campus office that works with students who have disabilities to provide and/or arrange reasonable accommodations.

- If you experience a disability which will impact your ability to access any aspect of my class, please present me with an accommodation letter from OEA so that we can work together to ensure that appropriate accommodations are available to you.
- If you feel that you will experience barriers to your ability to learn and/or testing in my class but do not have an accommodation letter, please consider scheduling an appointment with OEA to determine if academic accommodations are necessary.

The Office of Educational Accessibility is located at 1021 Student Success Center and their phone number is (757)683-4655. Additional information is available at the OEA website: http://www.odu.edu/educationalaccessibility/

Honor Code:

Students are expected to follow the ODU Honor Code for all assignments. Any violations will be dealt with strictly according to university policy. Despite that this course requires a lot of interaction, and thus discussions of ideas are encouraged, **the work that you turn in must be your own**.

Academic Dishonesty:

Old Dominion University is committed to students' personal and academic success. In order to achieve this vision, students, faculty, and staff work together to create an environment that provides the best opportunity for academic inquiry and learning. All students must be honest and forthright in their academic studies. Your work in this course and classroom behavior must align with the expectations outlined in the Code of Student Conduct, which can be found at www.odu.edu/oscai. The following behaviors along with classroom disruptions violate this policy, corrupt the educational process, and will not be tolerated.

Cheating: Using unauthorized assistance, materials, study aids, or other information in any academic exercise.

Plagiarism: Using someone else's language, ideas, or other original material without acknowledging its source in any academic exercise.

Fabrication: Inventing, altering or falsifying any data, citation or information in any academic exercise.

Facilitation: Helping another student commit, or attempt to commit, any Academic Integrity violation, or failure to report suspected Academic Integrity violations to a faculty member.

Academic dishonesty will be reported to the Office of Student Conduct & Academic Integrity and may result in sanctions up to and including expulsion from the University.