THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

DATS 6203 Machine Learning II: Data Analysis
CRN 54363
Monday 6:10 PM 8:40 PM

INSTRUCTOR:

Name: Amir Jafari, PhD
Term: Fall 2020
Campus address: Online (Webex and BlackBoard Ultra)
Webex: https://gwu.webex.com/meet/ajafari
Github: https://github.com/amir-jafari
E-mail: ajafari@gwu.edu
Phone: (202)-994-1239
Office hours: Tuesdays 4:00 pm -6:00 pm (Remote & Webex)

COURSE DESCRIPTION:

The main focus of this course will be the implementation of **deep learning techniques** on **GPUs**. Three key deep learning architectures will be covered. **Multilayer Perceptrons, Convolution Networks and Long Short Term Memory** are the main four deep network architecture. Some time will be spent on the background of each network, but the primary focus will be on implementation. In addition to discussing the three network architectures, the course will concentrate on three of the most popular deep learning frameworks: **Keras, Tensorflow and Pytorch**. The strategy will be to present a deep network architecture, and then describe how that network can be trained and analyzed within a particular framework. Each network will be trained in a different framework.

LEARNING OUTCOMES:

Students will be able to:

1. implement the machine learning algorithms on CPU and GPU.
2. use four deep learning architectures (Multilayer Perceptrons, Convolution Networks and Long Short Term Memory).
3. train and test four deep learning network architectures (MLP, CNN, LTSM).
4. use the three popular software in the deep learning area Keras, Tensorflow ans Pytorch.
5. train and analyse within a particular framework.

RESOURCES:

A- Neural Network Design (2nd Ed) - Author: Hagan, Demuth,Beale, De Jesus- Free Ebook Web Link.
B- Neural Network Design Demos - Author: Amir Jafari, Martin Hagan, Pedro Uria- PyPi Web Link
C- Deep Learning - Author: Ian Goodfellow, Yoshua Bengio, Aaron Courville, Ebook Web Link.
D- Python Machine Learning - Author: Sebastian Raschka
E- Machine Learning Course at Stanford and Oxford- Stanford Web Link, Oxford Web Link

SOFTWARE:

Amazon Web Services (AWS) and Google Cloud Platform(GCP) virtual machines will be used heavily the course. Basic Linux knowledge such as working with terminal is needed. Python are used for homework assignments, Labs, class exercises, final project and demos.

TENTATIVE COURSE OUTLINE (SUBJECT TO CHANGE):

Week	Topic	Comments
August 31, 2020	Software Setup	
September 7, 2020	Labor Day (no classes))	
September 14, 2020	Linear Algebra 1	
September 21, 2020	Linear Algebra 2	Quiz1
September 28, 2020	Multilayer Networks	Quiz2
October 5, 2020	Training, Performance, Optimization	Quiz3
October 12, 2020	Keras	
October 19, 2020	General Neural Nets	**Exam 1**
October 26, 2020	Training Convolution Nets	Quiz4
November 2, 2020	Pytorch	
November 9, 2020	LSTM	Quiz5
November 16, 2020	Training Recurrent Nets	**Exam 2**
November 23, 2020	TensorFlow (2.0)	Quiz 6
November 30, 2020	Deep Learning Applications	
December 7, 2020	**Final Project Presentation** and Submission	

PREREQUISITES:

DATS 6203 or equivalent - Machine Learning I
MATH 2233 equivalent- Time Series Modeling & Analysis
Linear Algebra and Stochastic System.

ASSIGNMENT DESCRIPTION:

The labs and homework will be associated with each module; there will be lab exercises for each module that covers a framework; and there may be one project for each deep network type. The exam will cover all the LAB exercises and homework and quizzes. George Washington University has a Amazon Web Services (AWS) cloud account with NVIDIA compatible GPUs and I will give 50 dollar credit for Google Cloud Platform (GCP). The mini and final projects should be done on these systems.

ACADEMIC INTEGRITY:

The code of academic integrity applies to all courses in the George Washington School (”Academic dishonesty is defined as cheating of any kind, including misrepresenting one’s own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information.”). In the spirit of the code, a student’s word is a declaration of good faith acceptable as truth in all academic matters. Cheating and attempted cheating, plagiarism, lying, and stealing of academic work

and related materials constitute Honor Code violations. These will not be tolerated. Please become familiar with the code. All students are expected to maintain the highest level of academic integrity throughout the course of the semester. Please note that acts of academic dishonesty during the course will be prosecuted and harsh penalties may be sought for such acts. Students are responsible for knowing what acts constitute academic dishonesty. The code may be found at HERE. The Universitys Guide of Academic Integrity in Online Learning Environments is available at HERE for your review.

GRADING AND EXAMINATION POLICY:

- 2 Exam - 25 pts each
- Homework/Labs - 25 pts
- Quizzes - 25 pts
- 1 Final project - 25 pts

The top three scores of quizzes, total homeworks/labs and 2 exams will be added to the final project score to obtain the total grade for the course (out of a total of 100 pts). All exams and quizzes may be in class or take home. I may collect homeworks or give a quiz (most probably there is a quiz after every 2 weeks). No make-up exams unless previous arrangements have been made. Students will be expected to attend class and prepare assignments. Habitual failure to do so will result in a reduced grade. An incomplete grade will only be given when a student misses a portion of the semester because of illness or accident. Cheating on examinations, plagiarism and other forms of academic dishonesty are serious offenses and may subject the student to penalties ranging from failing grades to dismissal.

SECURITY:

In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location.

DISABILITY SUPPORT SERVICES (DSS):

Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Marvin Center, Suite 242, to establish eligibility and to coordinate reasonable accommodations. See HERE
The University Counseling Center (UCC Phone: 202-994-5300) offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems Web Link. Services for students include:

- crisis and emergency mental health consultations
- confidential assessment, counseling services (individual and small group), and referrals

UNIVERSITY POLICIES:

Students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. Faculty should extend to these students the courtesy of absence without penalty on such occasions, including permission to make up examinations. Faculty who intend to observe a religious holiday should arrange at the beginning of the semester to reschedule missed classes or to make other provisions for their course-related activities. For details and policy, see Religious Holidays in HERE.

EMAIL ETIQUETTE:

In the age of technology, when most forms of communication are electronic, it is important to adopt a proper etiquette to communicate with one another. It is asked that students use salutation when sending emails to their instructors and also make sure to SIGN their name and include their class/section at the end of the email. The instructor reserves the right NOT to reply to emails that are not properly addressed or do not have a signature. Students should also use their GWU email for any correspondence with the instructors. Students are required to check their emails daily and especially the morning before class.

COURSE CONTENT (SUBJECT TO CHANGE):

Week	Module	Topics
August 31, 2020	Software Setup	Google Could Platform (GCP) Amazon Web Services (AWS) Pycharm Editor
September 7, 2020		Labor Day (no classes)
September 14, 2020	Linear Algebra 1	Vector Calculus Gradient Hessian
September 21, 2020	Linear Algebra 2	Linear Algebra Vector Spaces Eigen Values Eigen Vectors
September 28, 2020	Multilayer Networks	Neurons Layers Multiple layers Multiple Layer Perceptron
October 5, 2020	Training,optimization	Perf. optimization Perf. Functions Optimization Gradient Calculations Chain rule
October 12, 2020	Keras	Dense Sequential Compile
October 19, 2020	General Neural Nets	Layer Feed Forward Net General Layer Feed Forward Network Weight Function
October 26, 2020	Training CNN	Gradient calculation Convolution Pooling
November 2, 2020	Pytorch	Computational Graph Module Stacking Multiple LSTMs

Week	Module	Topics
November 9, 2020	LSTM	Recurrent Networks Issues in Training Recurrent Networks Long Short Term Memory Network
November 16, 2020	Training RNN	Dynamic backpropagation Creating an LSTM
November 23, 2020	TensorFlow (2.0)	Computational Graph Conv 2D Convolution Network Training
November 30, 2020	Deep Learning Applications	NLP Word2Vec GAN Transformers(BERT, XLNET, ROBERTA,...)
December 7, 2020	Final Project Presentation and Submission	

AVERAGE AMOUNT TIME LEARNING PER WEEK:

Students are expected to spend a minimum of 100 minutes of out-of-class work for every 50 minutes of direct instruction, for a minimum total of 2.5 hours a week. A 3-credit course should include 2.5 hours of direct instruction and a minimum of 5 hours of independent learning or 7.5 hours per week.

ONLINE RESOURCES:

For technical requirements and support, student services, obtaining a GWorld card, and state contact information please check HERE

Virtual ACADEMIC SUPPORT:

A full range of academic support is offered virtually in fall 2020.See HERE for updates. Tutoring and course reviewsessions are offered through Academic Commons in an online format. See HERE. Writing and research consultationsare available online. See HERE. Coaching, offered through theOffice of Student Success, is available in a virtual format. See HERE. Academic Commons offers several short videos addressing differentvirtual learning strategiesfor the unique circumstances of the fall 2020 semester. See HERE. They also offer a variety oflive virtual workshopsto equip students with the tools they need to succeed in a virtual environment. See HERE

SAFETY and SECURITY:

In an emergency: call GWPD 202-994-6111 or 911. For situation-specific actions: review the Emergency Response Handbook in HERE.In an active violence situation: Get Out, Hide Out, or Take Out. See HERE. Stay informed: safety.gwu.edu/stay-informed