DATS 6303 – Deep Learning
CRN 46374
Mondays 3:30 PM – 6:10 PM

INSTRUCTOR:

Name: Amir Jafari, PhD
Term: Spring 2026
Campus address: MON 353
Zoom: https://gwu-edu.zoom.us/j/9991766531
Github: https://github.com/amir-jafari
E-mail: ajafari@gwu.edu
Phone: (202)-994-1239
Office hours: By Appointments
Office location: Samson Hall Room 315

COURSE DESCRIPTION:

The main focus of this course will be the implementation of **deep learning techniques** on **GPUs**. The course covers fundamental and advanced deep learning architectures, including **Multilayer Perceptrons (MLPs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM), Transformers and Attention Mechanisms, Generative Adversarial Networks (GANs), Computer Vision Architectures, and Specialized Architectures**. Additional topics include **linear and non-linear sequence modeling** techniques.

While some time will be spent on the theoretical background of each architecture, the primary focus will be on **practical implementation**. The course will concentrate on two of the most popular deep learning frameworks: **TensorFlow and PyTorch**. The strategy will be to present each deep network architecture and then demonstrate how that network can be trained, optimized, and analyzed within these frameworks. Students will gain hands-on experience implementing various architectures across different frameworks.

LEARNING OUTCOMES:

Students will be able to:

1. implement the deep learning algorithms on GPU.
2. explore multiple deep learning architectures (Multilayer Perceptrons, Convolution Networks, Long Short Term Memory, Transformers).
3. train, test and analyze deep learning network architectures.
4. work on the most practical and popular deep learning frameworks.
5. Apply deep learning models to solve practical artificial intelligence problems across diverse domains, including computer vision and audio processing.
6. Develop end-to-end AI systems by integrating trained models into production environments and real-world applications.

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: Martin Hagan, Amir Hossein Jafari, Ebook Web Link.
D- Course Software Setup Tools and Basic Topics 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	Quiz & Exams
January 12, 2026	Software Environment Setup	
January 19, 2026	Martin Luther King Day (no classes)	
January 26, 2026	Linear Algebra & Vector Space and Matrix Linear Transformation	
February 2, 2026	Perceptron Network (One Layer Network)	Quiz1
February 9, 2026	Performance Index and Optimization	Quiz2
February 16, 2026	Presidents' Day (no classes)	
February 23, 2026	MultiLayer Network and Back Propagation	Quiz3
March 2, 2026	Training Deep Network (Batch Norm, ADAM)	Quiz4
March 9, 2026	Spring Break (no classes)	
March 16, 2026	Tensorflow and Dataloaders	Quiz5
March 23, 2026	General Layer Digital Dynamic Network	Exam 1
March 30, 2026	Training Convolution Networks	Quiz6
April 6, 2026	Pytorch and Custom Dataloaders &Streamlit	Quiz7
April 13, 2026	Linear and Non Linear Sequence (RNN, LSTM/GRU)	Exam 2
April 20, 2026	Seq2seq with Attention & Transformers Vision Transformers	Quiz8
April 27, 2026	Special Architectures(GAN and Resnet)	
April 29, 2026	**Final Project Presentation and Submission**	

PREREQUISITES:
DATS 6101

RECOMMENDED BACKGROUND:
MATH 2233 equivalent- Time Series Modeling & Analysis
Machine Learning
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 University's "Guide of Academic Integrity in Online Learning Environments" is available at HERE for your review.

GRADING AND EXAMINATION POLICY:

- 2 Exam - 25 pts each
- Quizzes - 25 pts
- 1 Final project - 25 pts

The top 5 quiz scores (25 pts each quiz 10 pts), exam1(25 pts) and exam2(25 pts) scores will be added to the final project score(25 pts) 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.

COURSE CONTENT (SUBJECT TO CHANGE):

Week	Module	Topics
January 12, 2026	Software Setup	Google Could Platform (GCP) Amazon Web Services (AWS) Pycharm Editor
January 19, 2026	Martin Luther King Day (no classes)	
January 26, 2026	Linear Algebra & Vector Space and Matrix Linear Transformation	Vector Calculus Vector Space Vector Properties Linear Algebra Eigen Values Eigen Vectors
February 2, 2026	Perceptron Network (One Layer Network)	Neurons Layers Multiple layers Multiple Layer Perceptron
February 9, 2026	Performance Index and Optimization Perf. Functions Optimization Taylor Series	
February 16, 2026	Presidents' Day (no classes)	
February 23, 2026	Multi Layer Network and Back Propagation	Perf. Functions Optimization Taylor Series
March 2, 2026	Training Deep Network (Batch Norm, ADAM)	Gradient Calculations Chain rule Newtons Method
March 9, 2026	Spring Break (no classes)	
March 16, 2026	Tensorflow and Dataloaders	Dense Sequential Compile
March 23, 2026	General Layer Digital Dynamic Network	Layer Feed Forward Net General Layer Feed Forward Network Weight Function

Week	Module	Topics
March 30, 2026	Training Convolution Networks	Gradient calculation Convolution Pooling
April 6, 2026	Pytorch and Custom Dataloaders	Computational Graph Module Stacking Multiple LSTMs
April 13, 2026	Linear and Non Linear Sequence (RNN, LSTM and GRU) & Streamlit	FIR IIR Delays Tap Delay Line Memory Recurrent Networks Issues in Training Long Short Term Memory Network Dynamic backpropagation Creating an LSTM
April 20, 2026	Seq2seq with Attention Transformers Vision Transformers	BPTT RTRL Rolling and Unrolling patching
April 27, 2026	Special Architectures (GAN and Resnet)	GAN Resenet
April 29, 2026	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

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.

CLASSROOM RECORDING:

The particular class recordings will be available to students who are registered on an individual basis,

upon request. Please let me know in advance if you have an medical issues or any emergencies that you will not be able to join the class.

GENERATIVE AI USAGE POLICY:

This course recognizes the growing role of Generative AI tools (such as ChatGPT, Claude, GitHub Copilot, and similar technologies) in modern data science and AI development. The following policy governs their use:

Permitted Use:

- Students **may use** Generative AI tools for take-home quizzes, homework assignments, and take-home exams to assist with learning, debugging code, generating ideas, and understanding complex concepts.
- Generative AI can be used as a learning aid for exploring different approaches to problems and improving code quality.

Prohibited Use:

- Students **may not use** Generative AI tools during in-class quizzes and in-class examinations. These assessments are designed to evaluate individual understanding and must be completed independently.

Required Citation and Attribution:

- **All use of Generative AI must be properly cited and documented.** When submitting work that has been created or assisted by AI tools, students must clearly indicate:
  - Which AI tool was used (e.g., "ChatGPT was used to help debug the code in lines 45-60")
  - What specific assistance the AI provided
  - How the AI-generated content was incorporated or modified

Academic Integrity:

- **Failure to cite AI assistance constitutes plagiarism** and will be treated as an academic integrity violation under the University's Academic Integrity Code.
- Submitting AI-generated work as entirely your own without acknowledgment is considered academic dishonesty.
- Students are expected to understand and be able to explain any code or content they submit, regardless of whether AI tools were used.
- The misuse of AI tools—such as submitting AI-generated work without understanding it, using AI during prohibited assessments, or failing to provide proper attribution—violates academic integrity standards and will result in penalties as outlined in the university's academic dishonesty policy.

Guiding Principle: Generative AI should be used as a tool to enhance learning and productivity, not as a replacement for developing your own understanding and skills. Students remain responsible for the accuracy, quality, and integrity of all submitted work.

Virtual ACADEMIC SUPPORT:

A full range of academic support is offered virtually in fall 2020. See HERE for updates. Tutoring and course review sessions are offered through Academic Commons in an online format. See HERE. Writing and research consultations are available online. See HERE. Coaching, offered through the Office of Student Success, is available in a virtual format. See HERE. Academic Commons offers several short videos addressing different virtual learning strategies for the unique circumstances of the fall 2020 semester. See HERE. They also offer a variety of live virtual workshops to 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

Attendance Policy:

Attendance is a crucial component of this course, as active participation and engagement significantly contribute to the learning process. Students are expected to attend all scheduled classes in person and virtual or online presence does not count as in person and counts as absence.

- Each student is allowed a maximum of three (2) absences during the course without penalty.
- Beginning with the fourth (3th) absence, a penalty of 10 points per week will be deducted from the student's total grade.

For example:

- A student who misses two (2) classes will have their grade calculated from the full 100 points.
- A student who misses four (4) classes will have their grade calculated from a maximum of 80 points.

This policy ensures fairness and emphasizes the importance of consistent class attendance. Students are encouraged to communicate any unavoidable absences in advance to discuss potential accommodations.