GGS 788 – Deep Learning for Geoinformation
Spring 2026 – Monday – 4:30 to 7:10
Classroom – Exploratory Hall - 2310

Instructors: Mike Wolf, PhD; Adjunct Professor
Email: mwolf7@masonlive.gmu.edu (best way to reach me)
Office: Exploratory Hall
Office Hours: By appointment

Course Materials (reference text):

- Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems second edition by Aurélien Géron
- Various online deep learning instructional videos
- Various peer reviewed journal articles

Course Description:
This course presents the theory and practice of Deep Learning as it applies to Geoinformation. Deep learning is a class of machine learning algorithms which enables computers to learn from known examples. Deep learning techniques have been used successfully for a variety of applications, including automatic speech recognition, image recognition, natural language processing, drug discovery, and recommendation systems. Our focus will be on the application of deep learning to problems involving geoinformation. Peer-reviewed literature in deep learning is explored. The computer labs will be used to enhance the subject materials using the Python programming language and other tools. Having prior experience working with Python is required and a very good statistical background is essential to maximize your learning. We will build from the basics in class but move quickly in order to be able to apply basic deep learning techniques. Class attendance is required in that we will be doing multiple in-class exercises which you will leverage for your class project.

Course Objectives:
This is a graduate course and so it is expected that one has advanced research abilities along with refined writing and programming skills. By attending class lectures, performing background topic research and independent study, students will be able to:

- Understand the fundamentals of deep learning and its application to geoinformation
- Develop the ability to effectively and authoritatively research and present executive summaries of deep learning problems.
- Ability to formulate and solve basic problems using various deep learning methods
- Most importantly, learn how to learn from each other in a collaborative environment.

Planned Schedule:

Date	Topic	Lecture Scope
1/26/2026	Introduction	Introduction, Syllabus Review and What is Deep Learning?
2/2/2026	What is Deep Learning? Survey of deep learning	In-class examples Class peer review journal discussion Peer review journal presentation #1
2/9/2026	Mathematics of Deep Learning Part 1	In-class examples Project Scope Due
2/16/2026	Mathematics of Deep Learning Part 2	In-class examples and hands-on exercise Regression Assignment Due and presentation
2/23/2026	Neural Networks: FFN Build a neural network: feed forward	In-class examples and hands-on exercise
3/2/2026	PyTorch Part 1	In-class examples and hands-on exercise
3/16/2026	PyTorch Part 2	In-class examples and hands-on exercise
3/23/2026	PyTorch Part 3	In-class examples and hands-on exercise
3/30/2026	TensorFlow & CNN Part 1 & Image Augmentation	In-class examples and hands-on exercise
4/6/2026	TensorFlow & CNN Part 2 & Hyperparameter Tuning	In-class demonstration
4/13/2026	Temporal Learning - LSTM	In-class examples and hands-on exercise Interim Project Due & Presentations
4/20/2026	Transformer Models & Adversarial Learning	In-class examples and hands-on exercise
4/27/2026	Complete Example – Unet on Satellite images	In-class examples and hands-on exercise
5/4/2026	Presentations Wrap-up	Deep Learning Presentation Final Project Due

Grading Policy:

***In-class Exercises and Article Presentations* (25%):**
Students are expected to participate in all in-class exercise and discuss their results. These in-class exercises will be extended as homework for the following class. The student will be asked to find peer review journal articles based on their interests. A summary of these articles will be presented in class with each presentation being no more than 10 minutes.

***Research Project* (50%)**
The research project will count for 50% of the student's grade. The research project will be due on the last day of class along with the associated presentation. All students must attend the presentation lecture in order to receive a passing grade for this course.

***Class Participation* (25%):**
Students are expected to attend the class periods of the courses for which they register. In-class participation is important not only to the individual student, but also to the class as a whole. Instructors may use absence, tardiness, or early departure as de facto evidence of non-participation.

Expectations for Participation:

- Students prepare for and actively engage in class discussion (e.g., demonstrate active listening, not distracted by electronics or peers)
- Students thoughtfully engage in in-class assignments and activities
- Students constructively participate in-group activities
- Students participate in class discussion by:
    - raising informed discussion points;
    - connecting discussion to reading material, news, and relevant experiences;
    - asking questions;
    - listening to other perspectives;
    - sharing the floor with others.

Grading

Grade	Points
A	>=90
B	>=80 to <=90
C	>=70 to <=80
F	<70

GMU Email Accounts & Canvas:
You must use and regularly check your GMU email account and Canvas to receive information for this class. Please do not send emails from non-GMU accounts, they will be ignored. I will normally respond within 24 hours.

Honor Code:
You are expected to follow the George Mason University rules of student conduct as noted in the catalog.

Office of Disability Services:
If you require academic accommodation due to a permanent or temporary disability, please contact the Office of Disability Services (ODS) at (703)993-2474, http://ods.gmu.edu. ODS will then contact me to arrange appropriate accommodation.

Classroom Expectations and other Miscellaneous:
Students are expected to be on time for class.

1. Should circumstances arise that make you late, do not disrupt the class as you enter.
2. In the event of any class cancellation, including inclement weather (e.g. snow), the class will resume where we left off, adjustments, if necessary, will be made later.
3. Please turn cell phone sounds off and do not text or talk during class.
4. Please be respectful of your peers and your instructor and do not engage in activities that are unrelated to the class. Such disruptions show a lack of professionalism and may affect your participation grade.
5. Lecture slides will be provided within 24 hours after the lecture. If you feel note taking is necessary, research has shown that pen and paper is the most effective.

Use of Generative-AI
Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. Three fundamental principles to follow at all times are that: (1) all work submitted be your own, as defined by the assignment; (2) when you use the work, the words, or the ideas of others, including fellow students or online sites, you give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment or exam, ask for clarification. No grade is important enough to justify academic misconduct. Use of Generative-AI tools should be used following the fundamental principles of the Honor Code. This includes being honest about the use of these tools for submitted work and including citations when using the work of others, whether individual people or Generative-AI tools.

All work submitted in this course must be your own original work; use of AI writing tools, such as ChatGPT, are prohibited in this course and will be considered a violation of academic integrity. All academic integrity violations will be reported to the office of Academic Integrity.

More Details

One item to note: This is an upper-level graduate science class so the programming and mathematics skills that should have been learned is expected.

The following python environment has been tested and has no conflicts between packages. This assumes that the student has installed the most recent version of Anaconda python. The “conda” and “pip” commands can be cut & paste into the base “Anaconda Prompt (anaconda3).

****
Build Python environment on Anaconda named - TensorFlow
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```
conda create --name TensorFlow python=3.9.12 anaconda
conda activate TensorFlow

pip install opencv-python
pip install opencv_contrib_python
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pip install imutils
pip install tensorflow # includes gpu support, my version 2.10.1
pip install tensorflow_datasets
pip install git+https://github.com/tensorflow/docs

****
Build Python environment on Anaconda named - PyTorch
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conda create --name PyTorch python=3.9.12 anaconda
conda activate PyTorch

https://pytorch.org/get-started/locally/

conda install pytorch torchvision torchaudio cudatoolkit=11.3 -c pytorch # NOTE: for my PC configuration, my PyTorch version is 1.12.1
