

Syllabus: CS 5043: Advanced Machine Learning: Deep Learning (Spring 2024)

Machine learning is the data-driven process of constructing mathematical models that can 1) make predictions about future situations, or 2) take actions in a future situation to optimize some outcome. **Neural Networks** (one form of ML method) are unstructured and expressive models that can be used for function approximation and classification. In this course, we will study a range of **Deep Learning** tools that allow for the efficient construction of very complex Neural Network models. We will also study methods for model evaluation. In our homework work, we will make use of several python-based tools, including Tensorflow and Keras.

Topics

Topics include:

- Backpropagation
- Tensorflow and Keras
- Convolutional Neural Networks
- Recurrent Neural Networks
- Timeseries Processing
- Transformer Networks
- Semantic Segmentation
- Generative Models
- Model Interpretation
- ML experiment design and evaluation
- Using a supercomputer for ML experiments

General Information

- Meeting time: Tu/Th 3:00 - 4:15
- Location: Devon Energy Hall 130
- Prerequisites:
 - Linear Algebra (Math 3333), AND
 - Statistics (Math 4743 or Math 4753 or ENGR 3293 or ISE 3293), AND

- Machine Learning (CS 4033/5033) or Neural Networks and Evolution (CS 5073)

OR permission of the instructor.

- Reading Materials:
 - Main Textbook: Simon J.D. Prince (2023) *Understanding Deep Learning*, ISBN-13: 978-0262048644, MIT Press
 - Various papers and other network resources.
 - Other key materials:
 - Class schedule: <http://www.cs.ou.edu/~fagg/classes/aml/schedule.html>
 - Scikit-Learn: <http://scikit-learn.org/stable/>
 - TensorFlow: <https://www.tensorflow.org/>
 - Keras: <https://keras.io/>
 - Supercomputer Systems: https://www.ou.edu/oscer/getting_started/getting_started_using_oscer
 - Course web page: https://symbiotic-computing.org/fagg_html/classes/aml_2024
 - We will also be making heavy use of [Canvas](#)
 - Discussions will be held on Slack (invitation is on the Syllabus section of Canvas)
 - Instructor: Dr. Andrew H. Fagg
 - Office: DEH 243
 - Homepage: https://symbiotic-computing.org/fagg_html
 - Email: andrewhfagg@gmail.com
 - Office hours: see the office hours web page https://symbiotic-computing.org/fagg_html/office.html
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Course Policies

- **Attendance:** This is a very discussion-oriented course. While keeping up with the readings is an important step to take, it is not a substitute for attending class.
- **Class Web Page:** Most of the material that you will need can be found on the class web page located at: https://symbiotic-computing.org/fagg_html/classes/aml
- **Canvas:** This class will also use Canvas, located at: <http://canvas.ou.edu>

Login with your 4+4 (typically the first four letters of your last name followed by the last four digits of your student number), using your standard OU password. If you have difficulty logging in, call 325-HELP. This software provides a number of useful features, including a list of assignments and announcements, and a grade book.

I may update the main web site and the Canvas page several times a week. When I update the site in any significant way, I will post an announcement on Canvas telling you what has been added and where it is located. You are responsible for things posted on the site within 48 hours of the post.

- **Class Communication:**

- The class period will be a mixture of lecture and collaborative project work. Your active participation in both will result in a more salient experience.
- Outside of class, Slack should be the primary method of communication. This allows everyone in the class to benefit from the answers to your questions, and provides students with more timely answers.
- Matters of personal interest should be directed to email instead of to Slack, e.g. informing me of an extended illness.
- Announcements will be posted to the Canvas announcement board. It is your responsibility to have Canvas configured so that you receive these messages in a timely fashion. Note that Canvas can be configured so that it will forward messages, discussion posts and announcements directly to your email address.

- **Proper Academic Conduct:**

- Homework assignments must be your own work. While you may discuss with your peers the generalities of the assignments and solution paths, you may not exchange or look at the code solutions of your peers for the homework problems.
- While the net may be used as a reference, downloading code that solves all or a substantial portion of any assignment from the net is prohibited.
- Services based on Large Language Models (e.g., chatgpt, bing chat, and alpaca) can be good sources of ideas, as well as detailed code examples. However, their output should always be treated skeptically, as these tools rely entirely on identifying common patterns across large text and code bases. You should always take the time to understand the suggestions that are being made and confirm that any code actually accomplishes what is needed. Nonetheless, using these services to solve all or a substantial portion of any assignment is prohibited.

- Programs will be checked by software designed to detect improper copying. This software is extremely effective and has withstood repeated reviews by the campus judicial processes.
- **Incompletes:** The grade of "I" is intended for the rare circumstance when a student who has been successful in a class has an unexpected event occur shortly before the end of the class. I will not consider giving a student a grade of "I" unless the following three conditions have been met:
 - It is within two weeks of the end of the semester.
 - The student has a grade of C or better in the class.
 - The reason that the student cannot complete the class is properly documented and compelling.
- **Accommodation of Disabilities:** The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the professor as early in the semester as possible. Students with disabilities must be registered with the Office of Disability Services prior to receiving accommodations in this course. The [Office of Accessibility and Disability Services](#) is located in Goddard Health Center, Suite 166, phone 405/325-3852 or TDD only 405/325-4173.
- **Classroom Conduct:** Because cell phones and laptops can distract substantially from the classroom experience, students are asked not to use either during class, except in cases in which the laptop is required as part of a classroom exercise.

Disruptions of class will also not be permitted. Examples of disruptive behavior include:

- Allowing a cell phone or pager to repeatedly beep audibly.
- Playing music or computer games during class in such a way that they are visible or audible to other class members.
- Exhibiting erratic or irrational behavior.
- Behavior that distracts the class from the subject matter or discussion.
- Making physical or verbal threats to a faculty member, teaching assistant, or class member.
- Refusal to comply with faculty direction.

In the case of disruptive behavior, I may ask that you leave the classroom and may charge you with a violation of the Student Code of Responsibilities and Conduct.

Grades

Grades will be computed according to the following distribution:

- Homework assignments (total 9): 85%
- In-class exercises: 15%

Homework assignments are due on the date indicated on the [semester schedule](#) at 11:59pm. Assignments handed in late will incur a penalty (0-24 hours: 10%; 24-48 hours: 20%). Submissions will not be accepted after 48 hours.

General Grade Issues

- **Grade questions:** If you have a question about grading (including assessment of points), you may address these during office hours or in email. Note that if you are asking me to reconsider a grade, then I will likely re-examine the entire assignment. You have one week from the point that you receive feedback to address grading questions.
 - **Canvas Grade Summary:** Canvas has a grade book that is used to store the raw data that is used to calculate your course grade. It is the responsibility of each student in this class to check their grades on Canvas after each assignment is graded. If an error is found, please bring it to my attention.
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Course Evaluations

The College of Engineering utilizes student ratings as one of the bases for evaluating the teaching effectiveness of each of its faculty members. The results of these forms are important data used in the process of awarding tenure, making promotions, and giving salary increases. In addition, the faculty use these forms to improve their own teaching effectiveness. The original request for the use of these forms came from students, and it is students who eventually benefit most from their use. Please take this task seriously and respond as honestly and precisely as possible, both to the machine-scored items and to the open-ended questions.

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability.

Please see <https://www.ou.edu/content/dam/eoo/documents/faqs/faqs-pregnant-and-parenting-students.pdf> for commonly asked questions.

Title IX Resources

For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5) or the Sexual Assault Response Team 405-615-0013 (24.7) to learn more or to report an incident.

Religious Observance

It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty. [\[See Faculty Handbook 3.15.2\]](#). Students who will be observing a religious holiday must contact the instructor ahead of time to arrange a plan.

Final Exam Preparation Period

Pre-finals week is defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's [Final Exam Preparation Period Policy](#).

Emergency Protocols

During an emergency, there are official university procedures that will maximize your safety.

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather 1. LOOK for severe weather refuge location maps located inside most OU buildings near the entrances 2. SEEK refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building. 3. GO to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows. 4. GET IN, GET DOWN, COVER UP. 5. WAIT for official notice to resume normal activities.

Links: [Severe Weather Refuge Areas](#), [Severe Weather Preparedness](#)

Fire Alarm/General Emergency: If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates: 1. LEAVE the building. Do not use the elevators. 2. KNOW at least two building exits 3. ASSIST those that may need help 4. PROCEED to the emergency assembly area 5. ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues. 6. WAIT for official notice before attempting to re-enter the building.

Links: [OU Fire Safety on Campus](#)

Armed Subject/Campus Intruder: (it is sad that this must be included in our syllabi) If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots: 1. GET OUT: If you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911. 2. HIDE OUT: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room. 3. TAKE OUT: As a last resort fight to defend yourself.

Links: [Responding to Gunshots](#)