

# Syllabus: CS 5043: Advanced Machine Learning: Deep Learning (Spring 2025)

Over the last two decades, **Deep Learning** has revolutionized the data-driven process of constructing mathematical models that solve very complex problems. In this course, we will study a range of Machine Learning problems and the corresponding Deep Learning tools that can be used to solve these problems. We will also study methods for experiment design and model evaluation. In our homework, 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

## Expectations and Teaching Approach

This course spans the space of the mathematics behind Deep Learning, implementation of Deep Neural Network Models, design and evaluation of Machine Learning experiments, and use of high performance computing to address the large data and model scales required to solve complex problems. Students are expected to apply knowledge acquired in the course by working with existing Python code and developing their own. The homework assignments that we will assign are intended to exercise all of these skills, often requiring extrapolation of the base knowledge. This approach is intended to be challenging. However, you are not on your own. The instructor and the teaching assistant are here to answer questions, discuss solutions and offer general guidance. We expect that everyone will be proactive when they are stuck on something.

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## General Information

- Meeting time: Tu/Th 3:00 - 4:15
- Location: Devon Energy Hall 130
- Prerequisites:
  - Linear Algebra (Math 3333),
  - A statistics course from the departmentally approved list, 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/api\\_docs/python/tf](https://www.tensorflow.org/api_docs/python/tf)
    - Keras: <https://keras.io/api/>
    - Supercomputer Systems: [https://www.ou.edu/oscer/getting\\_started/getting\\_started\\_using\\_oscer](https://www.ou.edu/oscer/getting_started/getting_started_using_oscer)
  - Course web page: [https://symbiotic-computing.org/fagg\\_html/classes/aml\\_2025](https://symbiotic-computing.org/fagg_html/classes/aml_2025)
  - 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](https://symbiotic-computing.org/fagg_html)
    - Email: [andrewhfagg@gmail.com](mailto:andrewhfagg@gmail.com)
    - Office hours: see the office hours web page [https://symbiotic-computing.org/fagg\\_html/office.html](https://symbiotic-computing.org/fagg_html/office.html)
  - Teaching Assistant: Andrew Justin
    - Email: [andrewjustin@ou.edu](mailto:andrewjustin@ou.edu)
    - Office hours: see the office hours web page [https://symbiotic-computing.org/fagg\\_html/office.html](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](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 in-class exercises. 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.
  - Tools 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.
- **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.

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## 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 this information 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.

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## University Policies

### Mental Health Support Services

Support is available for any student experiencing mental health issues that are impacting their academic success. Students can either be seen at the University Counseling Center (UCC) located on the second floor of Goddard Health Center or receive 24/7/365 crisis support from a licensed mental health provider through [TELUS Health](#). To schedule an appointment or receive more information about mental health resources at OU please call the UCC at 405-325-2911 or visit the [University Counseling Center](#). The UCC is located at 620 Elm Ave., Room 201, Norman, OK 73019.

### Title IX Resources and Reporting Requirement

The University of Oklahoma faculty are committed to creating a safe learning environment for all members of our community, free from gender and sex-based discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking, in accordance with Title IX. There are resources available to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you have (or someone you know has) experienced any form of sex or gender-based discrimination or violence and wish to speak with someone confidentially, please contact [OU Advocates](#) (available 24/7 at 405-615-0013) or [the University Counseling Center](#) (M-F 8 a.m. to 5 p.m. at 405-325-2911).

Because the University of Oklahoma is committed to the safety of you and other students, and because of our Title IX obligations, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. You may also choose to report directly to the Institutional Equity Office. After a report is filed, the Title IX Coordinator will reach out to provide resources, support, and information and the reported information will remain private. For more information regarding the University's Title IX Grievance procedures, reporting, or support measures, please visit [the Institutional Equity Office](#) at 405-325-3546.

## Reasonable Accommodation Policy

The University of Oklahoma (OU) is committed to the goal of achieving equal educational opportunity and full educational participation for students with disabilities. If you have already established reasonable accommodations with the Accessibility and Disability Resource Center (ADRC), please [submit your semester accommodation request through the ADRC](#) as soon as possible and contact me privately, so that we have adequate time to arrange your approved academic accommodations.

If you have not yet established services through ADRC, but have a documented disability and require accommodations, please complete [the ADRC's pre-registration form](#) to begin the registration process. ADRC facilitates the interactive process that establishes reasonable accommodations for students at OU. For more information on ADRC registration procedures, please review their [Register with the ADRC web page](#). You may also contact them at (405)325-3852 or [adrc@ou.edu](mailto:adrc@ou.edu), or visit [www.ou.edu/adrc](http://www.ou.edu/adrc) for more information.

Note: disabilities may include, but are not limited to, mental health, chronic health, physical, vision, hearing, learning and attention disabilities, pregnancy-related. ADRC can also support students experiencing temporary medical conditions.

## 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. [\[See Faculty Handbook 3.15.2\]](#)

## 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 the Accessibility and Disability Resource Center at 405/325-3852 and/or the Institutional Equity Office at 405/325-3546 as soon as possible. Also, see the Institutional Equity Office [FAQ on Pregnant and Parenting Students' Rights](#) for answers to commonly asked questions.

## Final Exam Preparation Period

Pre-finals week will be 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.

Additional [Weather Safety Information](#) is available through the Department of Campus Safety.

## The University of Oklahoma Active Threat Guidance

The University of Oklahoma embraces a Run, Hide, Fight strategy for active threats on campus. This strategy is well known, widely accepted, and proven to save lives. To receive emergency campus alerts, be sure to update your contact information and preferences in the account settings section at [one.ou.edu](https://one.ou.edu).

**RUN:** Running away from the threat is usually the best option. If it is safe to run, run as far away from the threat as possible. Call 911 when you are in a safe location and let them know from which OU campus you're calling from and location of active threat.

**HIDE:** If running is not practical, the next best option is to hide. Lock and barricade all doors; turn off all lights; turn down your phone's volume; search for improvised weapons; hide behind solid objects and walls; and hide yourself completely and stay quiet. Remain in place until law enforcement arrives. Be patient and remain hidden.

**FIGHT:** If you are unable to run or hide, the last best option is to fight. Have one or more improvised weapons with you and be prepared to attack. Attack them when they are least expecting it and hit them where it hurts most: the face (specifically eyes, nose, and ears), the throat, the diaphragm (solar plexus), and the groin.

Please save OUPD's contact information in your phone:

- **NORMAN campus:** For non-emergencies call (405) 325-1717. For emergencies call (405) 325-1911 or dial 911.
- **TULSA campus:** For non-emergencies call (918) 660-3900. For emergencies call (918) 660-3333 or dial 911.

## 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](#)

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requires the permission of the instructor.

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This page is online at [https://symbiotic-computing.org/fagg\\_html/classes/aml/syllabus.html](https://symbiotic-computing.org/fagg_html/classes/aml/syllabus.html)

[Andrew H. Fagg](#)

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