UMBC
CMSC 475/675 Neural Networks

Syllabus

Spring 2026, 3 credits

Contents

1 Course Information

1.1 Meetings and Instructors

Lectures	Monday, Wednesday 4:00 PM – 5:15 PM
Location	Sondheim 105
Course Website:	https://courses.cs.umbc.edu/graduate/675/

	Name	Email @umbc.edu	Office Hours
Prof.	Tejas Gokhale	gokhale	ITE 342-B Wed 1430 – 1530
TA	TBD	TBD	TBD TBD

1.2 Description

This class will offer a comprehensive overview of neural networks and deep learning algorithms. Deep Learning has been a highly successful research field over the last 20 years across a range of domains (vision, language, audio, robotics; "AI" in general). Deep learning has lead to significant commercial success and exciting new directions that may previously have seemed out of reach. The class will focus on the core principles of extracting meaningful representations from high-dimensional data, a fundamental aspect for several applications in autonomous decision making. Class lectures will cover fundamental topics such as network design, training and optimization, and evaluation. Homeworks will give students the opportunity to implement algorithms learnt in class for applications in visual recognition, language understanding and other domains. In the term project, students will construct a research hypothesis, propose new techniques and solutions, interpret results, and communicate key findings.

1.3 Prerequisites

We will assume that you have a basic (but solid) foundation in linear algebra, geometry, probability, and Python programming. Recommended classes at UMBC are: MATH 221 (Linear Algebra), STAT 355 or CMPE 320 (Probability and Statistics), MATH 151 (Calculus and Analytical Geometry). If you are unfamiliar with linear algebra or calculus, you should consider taking both: without these tools, you are likely to struggle with the course. Although we will provide brief math refreshers of these necessary topics, CMSC 475/675 should not be your first introduction to these topics. We understand that some students may have had some prior exposure to signal/image/audio processing, computer graphics, machine learning, etc. However, none of these are pre-requisites – the class is designed to be self-contained.

1.4 Reading Material

The class does not have a mandatory textbook and I don't expect you to buy one. However, the following books are excellent references for the course content and are available for free online at links provided by the authors. Other readings will come from papers from conferences such as NeurIPS, ICLR, ICML, etc.

- Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press
  https://www.deeplearningbook.org/

- Deep Learning: Foundations and Concepts, Chris Bishop and Hugh Bishop, Springer https://www.bishopbook.com/
- Pattern Recognition and Machine Learning, Chris Bishop, Springer https://www.microsoft.com/en-us/research/uploads/prod/2006/01/Bishop-Pattern-Recognition-and-Machine-Learning-2006.pdf
- Applied Machine Learning, David Forsyth, Springer https://link.springer.com/book/10.1007/978-3-030-18114-7

1.5 List of Topics

A preliminary list of topics is given below. The list may evolve during the semester.

- Machine Learning
- Single- and Multi-Layer Perceptrons
- Convolutional Neural Networks
- Neural Network Training
- Representation Learning
- Generative Modeling
- Self-supervised Learning
- Neural Language Models
- Transformers
- Diffusion Models
- Robustness, Reliability, and Evaluation
- Other advanced topics

1.6 Course Academic Objectives

By taking this class, students will be able to:

- learn fundamentals of neural network architectures, training protocols, evaluation strategies;
- implement and experiment with traditional as well as modern neural network based based solutions for computer vision and natural language understanding tasks;
- write code to develop algorithms that use neural networks for classification and regression tasks and write code to compare and evaluate performance of different techniques;
- read and analyze research papers and practice scientific communication skills;
- formulate innovative problem statements for a group project, propose new techniques and solutions, interpret results, and communicate key findings

1.7 Class Participation and Communication

I expect all students to participate in classroom discussions by asking questions, answering questions, identifying and communicating challenges, and engaging n discussion. Such discussions can also take place on the online discussion forum for the class. The online discussion forum can be used for discussions with peers, the TA, and the instructor, for instance you can ask questions or clarifications about assignments but should not discuss solutions. I also welcome your feedback throughout the semester about how the course is going. In addition to regular office hours, you can schedule an appointment with me if you think one-on-one time would help.

Email. Questions should be sent via email to **both** the TA and the instructor using your UMBC email only. Please use the following prefix in the subject line: `[NN: <your subject>]`. For ex-

ample, a question about Homework 2 can have the subject: `[NN: HW2]`, or a question about the project proposal can have the subject: `[NN: Project Proposal]`. You may not receive a response if you fail to follow these instructions, or for last minute messages. Please plan ahead. Questions must follow the academic integrity guidelines outlined below.

1.8 Undergraduate vs Graduate Section?

This class is offered as both an undergraduate (475) and graduate (675) class. There is no difference in lectures and class materials. The main difference is in the homework and evaluation of projects. For the 675 section, homework assignments will additionally require a literature review on a given topic or other advanced exercises – 475 students may opt to attempt these sections for extra credit. Projects will have higher expectations for the 675 section, in terms of the scope and goals of the project and research maturity in the written report and presentation. Students in the undergraduate section can implement existing algorithms and develop tools and demos with innovating applications or use-cases. Students in the 675 Section are expected to propose novel research ideas with the intention of publishing in academic workshops or conferences – this entails a unique and novel hypothesis, extensive literature review, and evidence to support or reject the hypothesis backed by exhaustive experiments and analysis.

2 Evaluation

2.1 Evaluation Components

Homework	3 assignments (combination of conceptual questions, exercises, and programming).	30%
Project	Course project in groups of 4 (smaller or individual groups only for PhD students with the professor's consent). • 5% for project proposal • 5% for status update video • 2% for individual reflection • 10% for final presentation • 8% for final report	30%
Quizzes	short pop-up quizzes during class	15%
Scribing	Take notes and typeset them for one lecture in the semester	5%
Midterm Exam	Date will be announced in class	20%

Extra Credit. Neural networks is a research area that celebrates creativity. Some homework assignments may have an optional section where students may use the material learned in class to answer open-ended questions or to complete tasks that require creativity. Lectures may also have pop quizzes about concepts learned in previous lectures for extra credit. Extra credit is capped at 10%. For example, if you get 6 extra points and 91 in the rest of your class, your final grade will be $91 + 6 = 97$ points; however if you get 18 extra points and 91 in the rest of the class, your final grade will be $91 + 10 = 101$ points. Attempting extra credit assignments is optional, but a valuable opportunity to make up for points lost in other assignments/exams.

Grading Scale. Please see the table below for the grading scale used on the normalized and rounded (floored) final percentages. These are minimum grades – your final grade could be higher.

If you get at least	your minimum grade will be
90	A
80	B
70	C
65	D

2.2 Deadlines and Late Submission

Due dates will be announced on Blackboard, with a deadline of 11:59 PM (UMBC time) of the specified day, unless stated otherwise. Submission instructions will be provided for each assignment.

Every student will be granted 10 late days to use as needed throughout the course. Each late day extends the deadline by 24 hours and does not influence the grade. Late days are not fractional – any extensions between 1 minute or 23 hours 59 minutes are all counted as 1 late day. The late days can be used for homework and project-related deadlines only. Late submissions turned in after all 10 late days have been exhausted will not be evaluated and will receive 0 points. Late days should be used as a contingency plan so that you have peace of mind during health issues, personal reasons, or emergencies.

If you run out of late days and do not turn an assignment in on time, please still turn in your work. I reserve the right to issue class-wide extensions.

3 Academic Integrity

I take academic honesty seriously. Do not cheat, deceive, plagiarize, improperly share, access or use code, or otherwise engage in academically dishonest behaviors.

- Doing so may result in lost credit, course failure, suspension, or dismissal from UMBC.
- Instances of suspected dishonesty will be handled through proper administrative procedures.
- Every member of a group is responsible for the group's submission. If one member is academically dishonest, all members may be sanctioned, regardless of individual actions.

Please watch this brief video on integrity, from Dr. Cynthia Matuszek. This course follows the academic honesty policy from the Office of Undergraduate Education, available from `https://academicconduct.umbc.edu/`. The following is a concise summary of the policies adopted:

> *By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal.*
>
> **If you have any questions about what is or is not acceptable, ask first.**

We are here to help. If you are struggling with the class content in any way it is your responsibility to communicate it to the instructor and TA so that we can assist you.

3.1 Types of Academic Dishonesty

- Plagiarism: Using a source (for code, text, images, etc.) without appropriate citations and recognition.
- Fabrication: Fabricating sources or any other information in your assignments.
- Aiding and abetting: Providing another student with answers, or helping them to cheat, is an equally serious violation of the principles of academic honesty. A student who commits such an offense is subject to the same penalties.
- Copying: Using another student's work (including students from previous offerings of this or similar classes at UMBC or elsewhere) for an assignment, exam, or project without acknowledgment.

This is not a complete list. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the Faculty Handbook, and the UMBC Policies section of the UMBC Directory (or for graduate courses, the Graduate School website).

3.2 Getting Help and Using Sources

Especially for computer science classes, there are generally questions about what is and is not allowed. You are encouraged to discuss the subject matter with others. The discussion board provides a great forum for this. However, you may not write or complete assignments for another student; allow another student to write or complete your assignments; pair program; copy someone else's work; or allow your work to be copied. (This list is not inclusive.) You are free to use online references like Stack Overflow only for issues that are not the primary aspect of the course and are not directly related to the assignments. For example, you may consult online forums for understanding how to use `numpy` `opencv` etc. or if you're getting a weird compilation error. Don't get stuck fighting your tools. Be sure to properly acknowledge whatever external help—be it from students, third party libraries, or other readings.

3.3 "Study" Sites

There are a number of sites that are primarily designed to help people get through classes without learning the material or doing the supporting work. Despite the self-branding as "study sites," these are cheating sites, and using them will reduce your ability to learn the course material. In addition, the material on these sites is typically stolen, that is, used without permission of the authors. Uploading any course materials to any external site is is a violation of this class's academic integrity policy, because (1) it risks aiding and abetting, and (2) it is a copyright violation. It goes without saying that getting answers to homeworks, quizzes, etc. from such sites is plagiarism, and is academically dishonest. These violations will be handled like any other.

3.4 Use of AI Assistants

This is a class that teaches you how to design AI systems. Using AI systems to do class work is therefore an obvious form of cheating. The use of AI systems or AI assistants (including but not limited to language models such as ChatGPT) for completing *any* part of assignments in this class is considered cheating. There are no exceptions to this rule.

3.5 Group Work

Some work may be group work, which will be submitted by a group of two or more students. When submitting such an assignment, the same rules apply, except that the submitted work must be the work of the students as a group. By submitting a group assignment, each student is representing that the assignment is the work of the entire group, and each student takes full responsibility for the assignment's originality and content. This means that every member of a group is responsible for the group's submission. If one member is academically dishonest, all members may be sanctioned, regardless of individual actions. There may be additional penalties for failing to contribute to the group as expected or involving your group members in academic misconduct, which may go beyond a zero on the assignment. Note that this means that if a student in a group makes no contribution to the assignment, the rest of the group must not include their name. If someone does not contribute to a project, claiming that they did is aiding and abetting.

3.6 Good Practices

If the integrity of your work in this course is challenged, you are responsible for demonstrating proof that the work submitted is your own. Enabling versioning/tracking in Google Docs, MS Word, LaTeX, or other software so that your writing activities/progress during the semester can be logged, and keeping copies of notes, scribbles, and related material is encouraged.

3.7 Viva or Oral Defense of Flagged Submissions

To ensure academic and professional integrity, I reserve the right to hold a one-on-one oral viva (defense) of papers deemed questionable to determine your knowledge and mastery of the topic/resources versus the material submitted. Failing that viva will result in an 'F' on the assignment and an Academic Integrity violation report filed with the Graduate School.

3.8 Penalties

Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. The **absolute minimum penalty** for a first offense of academic dishonesty in this course is a grade of zero on the assignment and a one-letter-grade reduction in the final class grade. However, depending on the nature of the offense, the penalty may be more severe, including but not limited to an `F` for the course, suspension, or expulsion. The minimum penalty for a second offense of academic dishonesty is an `F` for the course without possibility of dropping, but may be more severe.

4 Other Useful Resources

UMBC's Office of Equity and Civil Rights maintains a webpage that states the official and up-to-date university policies and resources on the following:

- Accessibility and Disability Accommodations, Guidance and Resources
- Sexual Assault, Sexual Harassment, Gender Based Violence and Discrimination
- Pregnant and Parenting Students
- Religious Observances and Accommodations
- Hate, Bias, Discrimination and Harassment

This webpage can be accessed here: `https://ecr.umbc.edu/sample-title-ix-responsible-employee-syllabus-language/`. Please review this important information.