CSC 578: Neural Networks and Deep Learning, Winter 2025

Instructor Info

- **Instructor:** Tianxiang (Adam) Gao (Assistant Professor, School of Computing, DePaul University)
- **Office:** CDM 712
- **Email:** t.gao@depaul.edu
- **Office Hours:** Tue 9:00 AM - 11:00 PM by Zoom or Advising Appointments via BlueStar.

Course Info

- **Instructor:** Adam (Assistant Professor, School of Computing, DePaul University)
- **Dates:** Jan 4, 2025 – Mar 28, 2025
- **Time:** Thur 5:45 PM – 9:00 PM
- **Classroom:** CDM 224
- **Sections:** 801 (Loop; in-person), 841 (Online; Flex)
- **Course website:** D2L

Course Description:

This course covers the foundations of deep learning, including fundamental neural network architectures (e.g., multilayer perceptrons) and training methodologies, including advanced optimization techniques (e.g., momentum, RMSprop, Adam). It also addresses generalization and regularization strategies (e.g., overparameterization, the double descent phenomenon, and weight decay). We will explore cutting-edge neural network architectures, including convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformers (e.g., GPT and BERT) with attention mechanisms. Students will gain hands-on experience by implementing these models and applying them to real-world problems in computer vision (CV), natural language processing (NLP), and computational biology. *Prerequisites: CSC 412 and (DSC 478 or CSC 480).*

Required Materials

Textbooks (Recommended)

- Neural Networks and Deep Learning, by Michael Nielsen.
- Deep Learning Book, by Goodfellow, Bengio, and Courville.

Software:

- Python with PyTorch or TensorFlow;
- Jupyter Notebooks for hands-on assignments

Hardware: Students are recommended to use a platform or environment where a hardware accelerator (e.g., GPU) is available that facilitates faster execution speed.

- Cloud platforms with free accounts: Google CoLab, Kaggle, Amazon Web Services
- Local Machines that has no worries about access time-outs

Learning Outcomes

By the end of this course, students will be able to:

- Understand the fundamentals of deep neural networks.
- Explore advanced topics such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformer architectures.
- Gain practical experience through assignments and projects implementing deep learning models in Python using popular frameworks (e.g., PyTorch or TensorFlow).
- Learn how to apply deep learning techniques to real-world problems such as computer vision, and natural language processing.

Attendance & Participation

Students are encouraged to attend in person or join via a live link but attendance won't count toward their grade.

Late Work

Late programming assignments are accepted for up to **3 days**, with a 10% penalty for each day late. However, late quizzes and final projects will **not** be accepted.

Courseworks

- **Quizzes:** 25% – Weekly quizzes will assess students' understanding of lecture concepts. The best **5** out of 10 will be counted toward the final grade.
- **Programming Assignments:** 35% – Weekly assignments implementing and analyzing DNNs related techiniques. The best **5** out of 10 will count toward the final grade.
- **Midterm:** 20% – The **take-home** midterm will test core concepts covered in the first half of the course.
- **Final Project:** 20% – The final project will be split into three phases:
  - *Proposal:* 8% – Submit a project proposal outlining the problem, objectives, and planned approach.
  - *Final Report:* 12% – Submit a detailed final report covering the solution, results, and project analysis.

Programming Assignment Policy

Students must download the provided Jupyter Notebook (.ipynb) from D2L and complete the assignment by filling in only the designated code sections. The notebook must be submitted in its original format without altering any other parts of the file. Any violation of these instructions—such as modifying other sections or submitting in a different format—will result in **zero** points for the assignments.

Grading Scale

Final grades will be assigned according to the following scale:

A	93 – 100	C+	77 – 79
A–	90 – 92	C	73 – 76
B+	87 – 89	C–	70 – 72
B	83 – 86	D	60 – 69
B–	80 – 82	F	0 – 59

Course Schedule

Table 1: Class Schedule for 10-Week Quarter

Week	Lecture Topics
1	Intro to Neural Networks
2	Training Neural Networks
3	Advanced Optimizers
4	Generalization and Regularization
5	Convolutional Neural Networks (CNNs)
6	Learning with CNNs
7	Recurrent Neural Networks (RNNs)
8	Sequence-to-Sequence Models (Seq2Seq)
9	Large Language Models (LLM)
10	Graph Neural Networks (GNNs)

Important Dates

- 01/04, Saturday – Begin WQ2025
- 01/09, Thursday – First Class Meeting
- 01/15, Wednesday – 11:59 PM Deadline to add classes to WQ 2025 schedule
- 01/10, Friday – Last day to drop WQ 2025 classes with no penalty (100% refund of tuition if applicable and no grade on transcript)
- 02/4, Tuesday – The midterm begins at 5 PM. You must complete it in a single 2-hour slot within this period.
- 02/5, Wednesday – Midterm due by 5 PM
- 02/21 (Friday) – Last day to withdraw from WQ2025 classes
- 03/21 (Friday) – END WINTER QUARTER 2025

University Policies & Resources

We've included these policies and resources to start, but please edit as needed for your own teaching context. There are more examples of policies on the Teaching Commons.

Academic Integrity

DePaul University is a learning community that fosters the pursuit of knowledge and the transmission of ideas within a context that emphasizes a sense of responsibility for oneself, for others and for society at large. Violations of academic integrity, in any of their forms, are, therefore, detrimental to the values of DePaul, to the students' own development as responsible members of society, and to the pursuit of knowledge and the transmission of ideas. Violations include but are not limited to the following categories: cheating; plagiarism; fabrication; falsification or sabotage of research data; destruction or misuse of the university's academic resources; alteration or falsification of academic records; and academic misconduct. Conduct that is punishable under the Academic Integrity Policy could result in additional disciplinary actions by other university officials and possible civil or criminal prosecution. Please refer to your Student Handbook or visit Academic Integrity at DePaul University (http://academicintegrity.depaul.edu) for further details.

Library Resources

The DePaul University Library (https://library.depaul.edu) provides access to authoritative information sources, such as scholarly articles, journals, and books, primary sources, and research databases. Research help is available daily in-person and via chat, email, phone, or text. You may also make an appointment (in-person, phone, or Zoom) with a librarian to discuss your research projects.

Center for Students with Disabilities

Students seeking disability-related accommodations are required to register with DePaul's Center for Students with Disabilities (CSD) enabling you to access accommodations and support services to assist your success. There are two office locations:

- Loop Campus - Lewis Center #1420 - (312) 362-8002
- Lincoln Park Campus - Student Center #370 - (773) 325-1677

Students can also email the office at csd@depaul.edu. Students who are registered with the Center for Students with Disabilities are also invited to contact me privately to discuss how I may assist in facilitating the accommodations you will use in this course. This is best done early in the term. Our conversation will remain confidential to the extent possible.

University Counseling & Psychological Services

University Counseling & Psychological Services (UCAPS) helps remove barriers to learning and support academic success by providing free, goal-focused, collaborative, short-term, confidential, individual, and group counseling services for DePaul's students. UCAPS has a diverse multi-disciplinary staff that includes licensed mental health professionals in psychology, counseling, and social work.

Students can talk to a therapist or schedule a brief screening and consultation appointment in the following ways:

- To speak directly to a therapist 24 hours a day, 7 days a week, students should call 773-325-CARE (2273) and Press "1" when prompted.
- To schedule a brief screening and consultation (BSC) appointment, students should call 773-325-CARE (2273) during regular business hours and Press "2" when prompted.

The Writing Center

I strongly recommend you make use of the Writing Center throughout your time at DePaul. The Writing Center provides free peer writing tutoring for DePaul students, faculty, staff, and alumni. Writing Center tutors work with writers at all stages of the writing process, from invention to revision, and they are trained to identify recurring issues in your writing as well as address any specific questions or areas that you want to talk about. Visit www.depaul.edu/writing for more information.

Name & Pronouns

I will gladly address you by the name and pronouns that you indicate. Please advise me of your name and/or your pronouns early in the quarter so that I may make appropriate notes in my records. Please also note that students may choose to identify within the University community with a first name that differs from their legal name, and they may also update their gender and gender pronouns. If a new name is identified, it will display as a "preferred name" in University-related systems and documents except where the use of the legal name is necessitated or required by University business or legal necessity. For more information and instructions on how to make these updates, please see the LGBTQIA Resource Center's Personal Information Change resources and the Student Preferred Name and Gender Policy at policies.depaul.edu.

Dean of Students

The Dean of Students Office (DOS) promotes student learning and ethical decision-making in an inclusive and validating environment. Utilizing a comprehensive approach to student advocacy that is informed by DePaul's Catholic, Vincentian, and urban mission, the office collaborates with students, staff, faculty, parents, and community partners to support students in reaching their academic and personal success.

You can contact the Dean of Students Office by calling (773) 325-7290 or emailing deanofstudents@depaul.edu. In cases of emergency, please call the Department of Public Safety at (773) 325-7777.

Sexual & Relationship Violence

As a DePaul community, we share a commitment to take care of one another. Classroom relationships are based on trust and communication. Sometimes, material raised in class may bring up issues for students related to sexual and relationship violence. In other instances, students may reach out to faculty as a source of help and support. It is important for students to know that faculty are required to report information reported to them about experiences with sexual or relationship violence to DePaul's Title IX Coordinator. Students should also know that disclosing experiences with sexual or relationship violence in course assignments or discussion does not constitute a formal report to the University and may not begin the process of DePaul providing a response. Students seeking to report an incident of sexual or relationship violence to DePaul should contact Public Safety (Lincoln Park: 773-325-7777; Loop: 312-362-8400) and/or the Title IX Coordinator (Lincoln Park: 312-362-8970 or titleixcoordinator@depaul.edu). Students seeking to speak confidentially about issues related to sexual and relationship violence should contact a Survivor Support Advocate in the Office of Health Promotion & Wellness for information and resources (773-325-7129 or hpw@depaul.edu). More information is available at http://studentaffairs.depaul.edu/hpw/shvp.html.

Basic Needs

Access to nutritious food and reliable housing are factors that influence many students' ability to succeed in the classroom and beyond. However, students facing food or housing insecurities may be hesitant to call attention to their ongoing struggles. DePaul University is committed to and cares about all students. To help you manage personal challenges and basic needs security, the university offers several resources. Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live, is urged to contact the Dean of Students Office for support: by calling (773) 325-7290 or emailing deanofstudents@depaul.edu. You can also contact the Elizabeth Ann Seton Food Pantry and Sandwich Kitchen and the Dax Program (Chicago - Depaul; email: emily.edwards@depaulusa.org; phone: (312) 362-7931) for support. The Center for Access and Attainment has also created a guide for Food and Housing Resources that you can review.

If you are comfortable doing so, please also let me know about these challenges, so that I can help you access resources.