

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Fall 2025

Instructor:	Pan Du	Time:	MW 2:00 – 3:15 PM
Email:	pdu@nd.edu	Place:	DeBartolo Hall 120

Office Location & Hours: 2027B McCourtney Hall. After class (M/W 3:30–5:00 PM) or by appointment.

Course Description: This course offers a hands-on, interdisciplinary introduction to modern Machine Learning (ML) and Deep Learning (DL) techniques for STEM students. Topics range from foundational models like linear classifiers and shallow neural networks to advanced methods such as convolutional neural networks, generative modeling, graph neural networks, reinforcement learning, and natural language processing. Emphasis is placed on real-world applications across aerospace and mechanical systems, bio-engineering, chemical processes, electrical systems, and materials science. Through inspirational, hands-on projects, students will bridge theory and practice by applying ML/DL to topics aligned with their interests.

Main References:

- Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.

Objectives:

- Understand key ML/DL concepts and algorithms
- Implement neural networks using PyTorch
- Apply AI to problems in engineering disciplines
- Interpret model performance and troubleshoot issues

Prerequisites: A basic foundation in mathematics (e.g., MATH 20580 or 10094) and an engineering background (e.g., AME 20251 or 30251) are recommended. Familiarity with linear algebra and a basic understanding of probability are sufficient. Basic Python skills are also expected—if you can write simple loops and functions, you're all set.

Grading Policy:

- Weekly/Bi-weekly assignments 30%
- Midterm Exams 30%
- Final Project Report & Presentation 15% & 15%
- Participation 10%

Class Policy:

- Late work is allowed but may be subject to a modest grade deduction unless a reasonable explanation is provided in advance.
- Regular attendance is expected and essential. Please provide reasonable notice in case of absence.
- Academic honesty is required at all times. All submitted work must be your own.

Tentative Course Outline:

Week	Topic
1	Introduction to AI and Course Overview
2	Python Refresher and ML Foundations
3	Linear Models and Logistic Regression
4	Neural Networks and Backpropagation
5	Deep Learning with PyTorch
6	Convolutional Neural Networks (CNNs)
7	Recurrent Neural Networks (RNNs)
8	Midterm Exam
9	<i>Fall Break – No Class</i>
10	Graph Neural Networks (GNNs)
11	Unsupervised and Self-Supervised Learning
12	AI for Engineering Applications
13	Project Work and Model Deployment
14	Natural Language Processing (NLP) and Reinforcement Learning (RL)
15	Final Project Presentations
