Worcester Polytechnic Institute

Machine Learning for Robotics, Fall 2025

Instructor: Navid Dadkhah Tehrani, PhD
Contact Information: TBD
Office Hours: TBD
Required Textbook:

A. Zhang, Z. Lipton, M. Li, A. J. Smola, Dive into Deep Learning, Cambridge University Press, 2023.

Course Description:

This course offers a comprehensive introduction to the realm of Deep Neural Networks (DNN) and their diverse applications in robotics. Students will delve into fundamental deep learning architectures, including fully connected, convolutional, recurrent, and transformer. Exploring widely-used backbone architectures in robotics, the course spans applications such as vision-based depth estimation, semantic segmentation, classification, object detection, and the learning of robot dynamics models. Through a dynamic blend of engaging lectures and hands-on coding assignments, students will acquire proficiency in the core concepts and techniques of DNN, with a focus on their practical implementation in robotic systems. The culmination of the course is a team project at the end of the term, providing students with the opportunity to apply their newfound mastery to real-world robotics applications.

Prerequisite Courses:
Python programming language. Basic knowledge of linear algebra and probability.

Learning Outcomes:
By the end of this course, students should be able to:

1. Grasp the key components of a deep learning robotics system, including MLP, CNN, RNN, and Transformers, along with their associated hyperparameters.
2. Utilize DNN effectively to address classification, segmentation, prediction, object detection, and depth estimation tasks in the field of robotics.
3. Understand various optimization techniques and tricks crucial for the successful training of deep neural networks.
4. Delve deeply into modern transformer architectures and their applications in the context of robotics.
5. Apply DNN skills to solve real robotics problems using PyTorch, culminating in a tangible and practical application of the learned concepts.

Communication:
We will be using “Discussion Board” under the Canvas course site. All the course-related questions such as question about course material, assignments, clarifications, expectations, etc, should be asked in the Q/A Discussion Board in Canvas (and NOT via Email). This will prevent students from asking the same questions through emails repeatedly. You can expect a response

from the instructor within 24 hours. Feel free to answer others' questions, discuss topics with your peers in Canvas.
Office Hours: via Zoom (TBD).

Course Approach:

- There will be one asynchronous lecture per week, which will be available on each Wednesdays at 11:59 PM.
- Week begins on Monday at 7 AM and closes Sunday at 11:59 PM.
- All times are Worcester, MA times (EST).
- All material can be found on the WPI Canvas learning management system.

Tentative Schedule of Weekly Classes:

Week#	General Topic	Assignment
1	**Introduction to Deep Learning in robotics**	
2	**Multi-layer Perceptron neural networks**	
3	**regression**	
4	**Classification**	
5	**Regularization methods**	**HW1**
6	**CNNs (VGG, Resnet)**	
7	**Recurrent Neural Networks (RNNs), LSTM, GRU**	**HW2**
8	**Encoder-decoder architectures**	
9	**Attention and Transformers**	**HW3**
10	**Vision Transformers**	
11	**MLP-mixer, FPB, Bi-FPN**	**HW4**
12	**Semantic Segmentation networks**	
13	**Object detection networks**	
14	**Depth Estimation Networks**	

Course Requirements:

1. **Grade Determination Breakdown**
   Evaluation in this course will be based on homework projects:

Homework	**60%**
Final project + presentation	**40%**

2. **Assignments**
   1- Homework (HW):
   There will be 3-4 computer programming homework assignments. Each HW solution needs to be uploaded to Canvas.
   2- The final project: The final project and a 10 minutes presentation about the results has to be submitted before the end of the semester.

3. **Late Work Policy**
   Assignments are due 11:59 PM on the given due date.
   Submission link will be closed at the deadline and no late work will be accepted unless an extension has been discussed with the instructor in advance of the deadline.

Technical Requirements:
All material is accessible by Canvas through a web browser.
If you experience technical difficulties with Canvas, you can use "help" button to access 24*7 help resources.
If you required further assistance, you can contact the Help Desk at helpdesk@wpi.edu or 508.831.5888.

Library Access:
As a student at WPI, you have access to a variety of resources through the library. Use the link here to access databases, e-journals, and/or e-books. You will be required to log in with your WPI username and password to access materials.

POLICIES

Academic Integrity:
You are expected to be familiar with the *Student Guide to Academic Integrity at WPI* that is downloadable from here. Consequences for violating the Academic Honest Policy range from earning a zero on the assignment, failing the course, or being suspended or expelled from WPI. Common examples of violations include:

- Copying and pasting text directly from a source without providing appropriately cited credit
- Paraphrasing, summarizing, or rephrasing from a source without providing appropriate citations
- Collaborating on individual assignments
- Turning in work where a good portion of the work is someone else's, even if properly cited

Academic Accommodations:
Courses should be compliant with the **American Disability Act**. Provide the following statement or a similar variation. If you, as the instructor, have questions about making content accessible to all learners, reach out to the Office of Accessibility Services.
We at WPI strive to create an inclusive environment where all students are valued members of the class community.

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If you need course adaptations or accommodations because of a disability, or if you have medical information to share with us that may impact your performance or participation in this course, please make an appointment with us as soon as possible.
Students with approved academic accommodations should plan to submit their accommodation letters through the Office of Accessibility Services Student Portal. Should you have any questions about how accommodations can be implemented in this particular course, please contact me as soon as possible.
Students who are not currently registered with the Office of Accessibility Services (OAS) but who would like to find out more information regarding requesting accommodations and what that entails should plan to contact them via:
Email: AccessibilityServices@wpi.edu and/or
Phone: (508) 831-4908.
On Campus – Daniels Hall, First Floor 124

Grading Policy:
Final course grades are based on a student's performance as follows:

Letter Grade	Percentage
A	90 - 100
B	80 - 89
C	70 - 79
D	60 - 69
F	< 60

Course incompletes may be granted if the major part of the course is completed; however, no additional credit can be given for missed class discussions or teamwork beyond the end of the course. In addition, in the case of an incomplete, the student is responsible for handing in the final work within the WPI required timeframe of one (1) year. After this time, an incomplete grade changes to a failing (F) grade.