Projects in ML and AI – Spring 2026

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Course Overview

This course will expose students to applying their knowledge of ML and AI to real-world problems using real world datasets. The larger focus of the course is on Deep Learning and its applications. Students will learn to implement ML and AI concepts by creating medium to large sized projects throughout the course. Through the final project students will demonstrate in-depth understanding of Deep Learning concepts and an ability to apply these to real-world problems.

Learning Outcomes

1. Demonstrate proficiency in identifying problems that can be solved using ML and/or AI as a tool.
2. Develop techniques and overcome challenges of working with big datasets.
3. Demonstrate an understanding of results both quantitatively and qualitatively.
4. Demonstrate an understanding for existing research and new research directions in the area of AI and ML.
5. Demonstrate proficiency in applying Deep Learning architectures (e.g., CNNs, RNNs, Transformers) to diverse real-world datasets and problem domains.
6. Critically evaluate model performance using advanced metrics and cross-validation techniques and communicate findings through visualizations and written reports.
7. Implement responsible and ethical AI practices, recognizing issues related to bias, fairness, and model interpretability.
8. Collaborate effectively within a team environment, employing version control (e.g., Git) and best practices for reproducible research.
9. Integrate pre-trained models and transfer learning to optimize performance and reduce training time for complex tasks.
10. Demonstrate competency with key ML frameworks and tools, including TensorFlow, PyTorch, and scikit-learn.
11. Design, document, and present end-to-end ML/AI pipelines, from data preprocessing to model deployment.
12. Critically analyze AI research papers to identify contributions, limitations, and potential areas for extension or improvement.
13. Develop an understanding of current and emerging trends in AI (e.g., Generative Models, Reinforcement Learning, Diffusion Models) and their societal implications.

Lecture and Course Organization

- Each week a new ML/AI topic will be introduced (Monday) and some research related to the topic will be presented.
- Students will read research papers (a few will be provided), figure out a real-world problem (may include your own research for a topic).
- Every 2-3 weeks figure out a real-world problem that can be solved by the topics covered in those weeks.
- Find a real-world dataset, perform data cleaning, data visualization, data-preprocessing, and feature engineering.
- Implement the Model, Evaluate and Present your results in a jupyter notebook OR Google Collab (https://colab.research.google.com/)
- There is a weekly discussion forum (on Submitty) where students present their viewpoint on a research topic and engage in discussions.
- Labs are mini-projects that you work on for about 2-4 weeks each. There are 4 labs per semester, and each lab builds on research and topics covered prior to the beginning of the lab. You can work individually or in-groups. At the end of each lab session, you need to explain what you and your team did to get full credit.

Resources

Submitty (https://submitty.cs.rpi.edu/)
Google Colab: Colab Pro Version is Free for Students (Check Registration)

Homework Policy

6 Homeworks – 40 % of the Grade
Participation (Weekly discussions on discussion forum) – 5%
Labs (Every Thursday in Class) – 15%
Final Project/ Paper - 40% of the Grade

Grading Criteria: The grading cut-off is as follows:

A : 95-100
A-: 90-94
B+: 87-89
B : 83-86
B-: 80-82
C+: 77-79
C : 74-76
C-: 70-73
D+: 67-69
D : 64-66
F : 0-63

Additional Information

Minor updates to the schedule may happen depending on the progress we make during the semester.

Final Group Project/Paper Guidelines:

- Must address a real-world problem or use case.
- Utilize a variety of ML and AI techniques covered in the course.
- Emphasize collaboration, code quality, and documentation.

- Present findings, methods, experiments, data collection etc.
- The final report must meet the standards of a conference paper.
- The final project will be developed in multiple stages—proposal, midterm progress report, model demonstration, and final paper/presentation.
- Feedback will be provided at each stage to refine ideas and ensure feasibility.
- ***Optional*** – If the final project work is 'conference ready' that may lead to extra credit.

Academic Integrity

If found responsible for committing academic dishonesty, a student may be subject to one or both types of penalties: an academic (grade) penalty administered by the professor and/or disciplinary action through the Rensselaer judicial process described in the RPI handbook.

Schedule

Week (Date)	Subject	Topics/Assignments
Week 1(Jan-12)	ML Basics	Regression, Logistic Regression, Loss Functions, Gradients and Initialization
Week 2(Jan-19)	Tree-Based Methods, Ensemble Learning	Homework 1 Released Discussion Forum Starts
Week 3(Jan-26)	Deep Neural Networks	Deep Neural Networks Homework 2 Released Lab 1 Released
Week 4(Feb-02)	Training Neural Networks	Improve Training of Neural Networks Overfitting, Regularization Homework 3 Released,
Week 5(Feb-09)	Recurrent Neural Networks	Sequential Data 1 Page Project Proposal Due,
Week 6(Feb-16)	Convolution Neural Networks	Homework 4 Released Lab 2 Released

Week (Date)	Subject	Topics/Assignments
Week 7(Feb-23)	Auto-Encoders Deep Generative Modeling	
Mar-02 SPRING BREAK		
Week 8(Mar-09)	Natural language Processing	Homework 5 Released Lab 3 Released
Week 9(Mar-16)	Transformers Large Language Models (LLMs)	
Week 10(Mar-23)	Reinforcement Learning	Homework 6 Released
Week 11(Mar-30)	Boltzmann Machines Recommender systems	Lab 4 Released
Week 12(Apr-06)	Time Series Analysis	
Week 13(Apr-13)	Diffusion Models, Other advanced topics.	
Week 14 & 15 (Apr-20 & Apr-27)		Project Presentations