Syllabus of CIVL 4100R - Practical Machine Learning for Smart Infrastructure Systems

Syllabus

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Course description

This course covers fundamental machine learning concepts and hands-on experience about smart infrastructure system applications. Lectures will cover the “full stack” of machine learning, including data cleaning and pre-processing, machine learning, and reinforcement learning. The covered topics include: collecting and processing real-world project data, detecting abnormal data, and imputing missing data; analyzing the data with a variety of machine learning methods

including linear & logistic regression, decision tree, SVM, unsupervised learning (clustering, PCA), and advanced machine learning methods (ensemble learning and deep learning). Last, we will introduce reinforcement learning to build autonomous infrastructure systems that learn to make good decisions.

One key feature of this course is its application-driven nature. All applications of this course are about smart infrastructure systems. Through those applications, students will know how ML can be applied in their future career and research.

Calendar

Week	Lecture Topic		Project
1	Course introduction	Pandas I	
2	Pandas II	Time series data	
3	Data visualization I	Data visualization II	
4	Supervised learning: linear & logistic regression	Supervised learning: decision tree, SVM	P1: Thermal preference prediction
5	Unsupervised learning: clustering, PCA	Ensemble learning: bagging, boosting, random forests	P1 due
6	Neural networks	Introduction to computer vision problems	
7	Deep convolutional neural networks I	Deep convolutional neural networks II	P2: Structural defects detection
8	Practical strategies: regularization, optimizers	Hyper-parameter tuning	P2 due
9	Introduction to time series problem	Recurrent neural networks	P3: Structural response prediction
10	Rethink time series problems	RL: problem statement and introduction	P3 due
11	Markovian Decision Process	Imitation Learning & model-based RL	

12	Reinforcement learning algorithms I	Reinforcement learning algorithms II	P4: Building energy system control
13	Course review		P4 due

Grading

- Project: 20%*4 = 80%
- In-class quiz: 5%*4 = 20%

Projects

A total of four projects let you practice and apply the concepts learned in lecture and section. The project will be due at 23:59 PM Friday the next week since the project is released.

Project late policy

All assignments must be turned in on time (deadline is 23:59 pm on the due date). We will allow a total of five late days (weekends and holidays counted) cumulatively. We will not make any additional allowances for late assignments: the late days are intended to provide for exceptional circumstances, and students should avoid using them unless absolutely necessary. Any assignments that are submitted late (with insufficient late days remaining) will not be graded.

Integrity

Cheating is strictly not allowed for either assignments or exams.

All projects should be done individually. You are allowed to discuss the project with other students, but not allowed to copy solutions/codes or share your solutions/codes with other students who haven't completed the project already. Cheating on projects or in-class quiz results in 0 points, so you really do not want to cheat.

Please, do your own work. Thank you!

Citizenship

A diversified, inclusive and equitable environment would benefit everyone of our community. For exceptionally rude or disrespectful behavior toward the course staff or other students, your final grade will be lowered by up to a full letter grade (e.g., from an A- to a B-) at the discretion of the course instructors. You don't need to be concerned about this policy if you treat other human beings with even a bare minimum of respect and consideration and do not engage in behavior that is actively harmful to others.

Office hour

- Time: 4-5 pm every Wed.
- Venue: Room 3564 for Walter Zhe Wang and Room 3565 for Jize Zhang