ECE4530J Decision Making in Smart Cities
Summer 2022

Course information
Credits: 4
Meeting times: 8-10AM MW(F)
Prerequisites: VG101, VV216/256/286

Instructor
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Course description
Introduction to key applications in smart cities and relevant decision-making problems. Concepts of connected and autonomous vehicles, intelligent transportation systems, smart grid, smart living, smart environment, smart economy, smart governance. Formulation of decision-making problems embedded in smart city applications, including linear, nonlinear, stochastic, and game-theoretic control/optimization/learning problems. Computer simulation of the above applications and problems. Basic concepts in control/optimization/learning theories. Suitable for junior/senior students interested in preliminary knowledge of smart cities and decision-making theories. Prepares students for more advanced courses on control, optimization, and learning.

Optional references
1. Friedland, B. (2012). Control system design: An introduction to state-space methods. Courier Corporation. Available through SJTU online library.
2. Boyd, S., Boyd, S. P., & Vandenberghe, L. (2004). Convex optimization. Cambridge university press. https://web.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf
3. Hastie, T., Tibshirani, R., and Friedman, J., The Elements of Statistical Learning: Data Mining, Inference and Prediction, Springer, 2nd ed., 2009. https://web.stanford.edu/~hastie/ElemStatLearn/printings/ESLII_print12.pdf

Grading
1. Five homework (HW) sets 25%. Individual work; no collaboration. Late submissions will be docked by 80%.
2. Three mini projects (MP) 15%. Coding and simulation.
3. Two quizzes 40%. 75 min in class. Open-book.
4. One final project 20%. Groups of 3 or 4 (based on session size). Flexible topic. Simulation and exploration of a non-trivial problem in smart cities. Peer-evaluated.

Schedule

No.	Date	Topic	Note
Part 1: Control			

1	5.9	Introduction to smart cities	
2	5.11	Autonomous driving: Speed tracking	
3	5.16	Autonomous driving: Trajectory tracking	
RC1	5.13	Linear algebra review & HW1 guidance	
4	5.18	Autonomous driving: Longitudinal control	HW1 due
5	5.20	Autonomous driving: Vehicle platooning	HW1 solution
6	5.23	Intelligent transportation: Smart intersections	
RC2	5.25	Basics of control; HW1 solution; HW2 & MP1 guidance	
7	5.25	Intelligent transportation: Ramp metering	HW2 due
8	5.30	Intelligent transportation: Dynamic routing	HW2 solution
9	6.1	Smart grids: Governor control	MP1 due
10	6.6	Review on control	
	6.8	Quiz 1	
Part 2: Optimization			
11	6.13	Quiz 1 solution; Optimization in smart cities	
12	6.15	Intelligent transportation: min-cost flow	
13	6.17	Autonomous driving: Path planning	
RC3	6.17	Basics of linear programming; HW3 guidance	
14	6.20	Intelligent transportation: Location optimization	HW3 due
15	6.22	Intelligent transportation: Rebalancing shared bikes	HW3 solution
16	6.27	Smart grid: Balancing	
RC4	6.27	Basics of convex optimization; HW4 guidance	
17	6.29	Autonomous driving: Trajectory planning	HW4 due
18	7.1	Intelligent transportation: Dynamic routing	HW4 solution
19	7.4	Reinforcement learning	MP2 due
20	7.6	Review on optimization	
	7.11	Quiz 2	
	7.13	Quiz 2 solution; Project proposal discussion	Project proposal due
Part 3: Machine Learning			
21	7.15	Smart cities: Learning methods	
22	7.18	Smart grids: Behavior inference & fault detection	
23	7.20	Smart living, environment, economy & governance	HW5 due
24	7.25	Smart cities: Game theory	HW5 solution
	7.27	Project presentation	MP3 due
	7.29	Project presentation	
	8.5		Final report due