Syllabus, Slides and Discussion

piazza.com/cmu/spring2020/16831/home

Slides usually available day of the lecture

Assignments/Grades - **Gradescope**

Waitlist

Contact me via Piazza (private post) if you need this class to graduate or if you need this for research.

If you plan to drop this class, please do it ASAP so that we can determine scribe assignments

Integrity

- All **encouraged** to work together BUT you must do your own work (code and write up)

- If you work with someone, **please** include their name in your write up and inside any code that has been discussed

- If we find highly identical write-ups or code without proper accreditation of collaborators, we will take action according to university policies.

- You can use online resources for scribe notes but please do not straight copy and paste.

Take care of yourself. *Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.*

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at http://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

Grading

(1) **Assignments 70%** (4 total)

(2) **Quizzes 10%** (about 5)

(3) **Scribe notes 20%** (once in groups of 1 or 2).

Grades determined on an **absolute scale**. Typically 90% and above is A, 80% - 89% is B, 70 - 79 is C, 60% - 69% D, 59% or below is R.
There will be extra credit opportunities.

Scribe Notes

- **Motivation:** Opportunity to review lectures and gain a deeper understanding of topics. Provide a supplemental source of material for students to review topics.

20% of your grade

Scribe Notes Details

- Use the Overleaf project and template distributed by the teaching staff to compile your scribe notes
- Each group will be assigned to a lecture as a note taker.
- It is recommended that you download the PDF of the lecture slides prior to class and take notes directly on the slides. Ask the instructor to upload the PDF prior to class if you do not see the files.
- Please see Piazza for the latest scribe assignments.
- If you need to change days to be the scribe, please negotiate directly with other students and report changes to the TA.

Scribe Notes Grading

- Submit scribe notes within 7 days of the lecture **(1 pt)**
- Add a review section briefly summarizing last lecture. 1 to 2 pages. **(4 pts)**
- Summary content of lecture plus citations. 5 to 7 pages **(15 pts)**
- Add an appendix that provides outside information, derivations, properties, inequalities, papers, books, online resources that would aid another student reading the scribe notes. **(Extra Credit: 1 pts per page, up to 5 pages)**

Date	Topic	Date	Topic
01-13	Learning Problems	01-15	PWEA (Greed, Majority)
01-20	No Class (MLK Day)	01-22	PWEA (Rand. Greedy, WMA)
01-27	PWEA (RWMA) / OLC (Perceptron)	01-29	Online Linear Classification (Winnow)
02-03	Online Convex Optimization (Convexity, FTL)	02-05	OCO (FTRL, Online Mirror Descent)
02-10	OCO (OMD, Duality)	02-12	Supervised Learning (SVM, AdaBoost)
02-17	Bandits (Stochastic, Hoeffding)	02-19	Bandits (Explore-Exploit, UCB)
02-24	Bandits (EXP3)	02-26	Bandits (EXP4, Thompson Sampling)
03-02	Filtering (Bayes, HMM, KF)	03-04	Filtering (EKF, EKF-SLAM)
03-09	Spring Break	03-11	Spring Break
03-16	RL (Markov Decision Process, GPI, VI)	03-18	RL (Monte Carlo, TD-λ, Q-learning)*
03-23	RL (Policy Gradient, Actor-Critic)*	03-25	RL (Actor-Critic)*
03-30	IRL (Intro, Linear Program)	04-01	IRL (Linear Program, Matrix Game)
04-06	IRL (Quadratic Program)	04-08	Buffer
04-13	IRL (Max Margin Planning)	04-15	IRL (Conditional Choice Prob.)*
04-20	IRL (Maximum Entropy)	04-22	IRL (Maximum Entropy)
04-27	Exploratory Topic	04-29	Exploratory Topic

Assignments

HW	Topic	Release Date	Submission Date	Editor
1	Weighted Majority Algorithm	01-22	02-05	-
2	Online Supervised Learning	02-12	02-26	-
3	Multi-Armed Bandit	02-26	03-18	-
4	Inverse Reinforcement Learning	04-01	04-15	-

70% of your grade

Late day policy

- **5** late days total for the semester.
- You can use up to **2** late days on a single assignments.
- Submissions beyond the allowed late days will be penalized by a deduction in points by **1/3** per day

Class Overview

16-831 Statistical Techniques in Robotics

Carnegie Mellon University (Kris Kitani)

Prediction with Experts

Online Linear Classification

Online Convex Optimization

Online Methods for Supervised Learning

Multi-Armed Bandits

State Estimation

Reinforcement Learning

Apprenticeship Learning

- Consistent Algorithm
- Halving Algorithm
- Randomized Greedy Algorithm
- Weighted Majority Algorithm
- Randomized Weighted Majority Algorithm

- Winnow Algorithm
- Online Perceptron Algorithm

- Convex Optimization and Gradient Descent
- Follow the Leader
- Follow the Regularized Leader
- Online Gradient Descent

- Multi-Layer Perceptron
- SVM and AdaBoost

- UCB, Thompson Sampling
- Adversarial Bandits (EXP3)
- Contextual Bandits (EXP4)

- Bayesian inference
- Kalman Filter

- Markov Decision Process
- Value Functions
- Policy Iteration
- Policy Gradient Methods

- IRL as Linear Programming
- IRL as Matrix Game
- IRL as Quadratic Programming
- IRL as Entropy Maximization