Machine Learning for Science & Society

- Spring 2021
- Tuesdays 5:30-8:15
- Professor Sarah Brown
- CSC 592: Topics in Computer Science

In this class, we will address the challenges in applying machine learning to scientific research and in high stakes social contexts. On the science side, we will examine the role of ML in research, in particular how it works within knowledge production and how to evaluate ML in line with domain norms. On the social side, we will consider how to ensure ML-based algorithmic decision making systems uphold social values, with a focus on fairness. While these two applications are distinct, many of the challenges translate into common technical problems. Some of the common challenges include:

- missing data
- noisy or missing labels
- multiple objectives

We will look at a range of strategies for identifying and mitigating these problems including:

- robust evaluation
- model inspection
- explanations
- interpretable models

Format

This will be a synchronous course offered via Zoom. To successfully participate in this course students will need:

- consistent internet access during class time
- to use URI SSO credentials to access readings and materials
- a microphone to participate in conversations in class, at least most sessions

The course will involve:

- reading and evaluating ML research papers
- facilitating and participating in class discussions of the papers
- producing a replication, demo, or illustration of one concept covered for a broader audience
- completing a project using ML in a scientific or social domain
- writing a CS conference style (short & concise) final paper on their project

graduate students are encouraged to do a project related to their research

Prerequisites

To be successful in this class students should have:

- past experience with machine (CSC461 or equivalent)
- basic programming skills
- familiarity with concepts in probability, linear algebra, and calculus that appear in ML

varying skill in these topics is ok, but a general understanding of the basic ideas is important. If you're interested and not sure if you have the background, complete the form below

Basic Facts

Meetings

This class will meet on Monday and Wednesday 3-4:15pm. via Zoom (link provided to registered students via BrightSpace)

> **Tip**
>
> You can subscribe to the Brightspace Calendar to access it in your favorite calendaring tool.

Instructor

Professor Sarah M Brown is an Assistant Professor in Computer Science. Her current research aims to answer the question, “How can machine learning produce AI systems that make fair decisions?”

Office Hours

By appointment, link on Brightspace.

Schedule

We will meet synchronously via Zoom: Tu 5:30-8:15

This course will proceed in three main parts: overview, deep dives, and wrap up.

Structure

Overview

In the first part of the course we will review ML basics, set norms for interaction and complete a survey of the topics that we will cover for the rest of the semester.

In this part of the class, Professor Brown will lead synchronous sessions. Students will be responsible for reading overviews, refreshing background material, and choosing an area for their course project. Students will start with an introductory demo or replication as a mini project.

Deep Dives

During the middle of the course we will spend one week on each topic. There will be 1-3 papers to read each week.

Students will be responsible for presenting papers in class on a rotating basis.

During this time students will have milestones where they need to complete interim steps for their course project. The first milestone will be a proposal that includes the specific products for the remainder of the milestones based on a template.

Conclusion

In the end of the course, we will focus on integrating ideas across multiple topics.

We will also workshop students’ projects, giving substantive feedback prior to the final submissions.

Final projects will be evaluated through a presentation and paper

Weekly topics

- Paper discussion led by Daniel
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    - 2021-02-10
    - Missing data with graphical models and causal reasoning
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    - Graphical Models for Inference with Missing Data
    - Missing Data as a Causal and Probabilistic Problem

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  - Paper discussion led by Julian
* - 2021-02-15
  - Current Challenges in Missing data
  - [ from Artemiss workshop](https://artemiss-workshop.github.io/#program
)
  - Paper overview
* - 2021-02-17
  - Current Challenges in Missing data
  - [ from Artemiss workshop](https://artemiss-workshop.github.io/#program
)
  - '''- Replication and testing discussion
  -preview of lasso and admm constraint to multiobjecitve reformulation '''
* - 2021-02-22
  - Fairness
  - ```- fairml classification chapter
  - friedler empricial comparison paper  ```
  - Empirical setup
* - 2021-02-24
  - Fairness
  - Reading
  - Activities
* - 2021-03-01
  - Multi-objective & constrained opt
  - Reading
  - Activities
* - 2021-03-03
  - Multi-objective & constrained opt
  - Reading
  - Activities
* - 2021-03-08
  - Multi-objective & constrained opt
  - Reading
  - Activities
* - 2021-03-10
  - Multi-objective & constrained opt
  - Reading
  - Activities
* - 2021-03-15
  - Noisy & Missing labels
  - Reading
  - Activities
* - 2021-03-17
  - Noisy & Missing labels
  - Reading
  - Activities
* - 2021-03-22
  - Interpretable & Explanation
  - survey
  - Activities
* - 2021-03-24
  - Interpretable
  - '''Rudin examples, CORELS'''
  - Activities
* - 2021-03-29
  - Interpretability
  - Science of - Kim & Doshi
  - Activities
* - 2021-03-31
  - Interpretability
  - Falsifiable, survey
  - Activities
* - 2021-04-05
  - Explanation - perturbation based
  - Reading
  - Activities
* - 2021-04-07
  - Explanation
  - TCAV
  - Activities
* - 2021-04-12
  - Meta- issues
  - '''ml & phil sci'''
  - Activities
* - 2021-04-13
  - Meta- issues
  - '''Roles for computing in social change'''
  - Activities
* - 2021-04-19
  - Project Presentations
  - projects
  - peer feedback
* - 2021-04-21
  - Project Presentations
  - projects
  - peer feedback
* - 2021-04-26
  - Project Presentations
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- Reading
- revision plans
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By Sarah M Brown