CSCI 246 – Discrete Structures

Mike Wojnowicz

Fall 2025

Montana State University

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Delayed start

We will start at 4:15 today due to the last-minute room change.

Feel free to

- Check out the syllabus ahead of time on Canvas
- Meet a neighbor
- Meditate
- Brag to your friends about how much you're going to learn about discrete structures!

...

Course overview

What is Discrete Math?

dis·crete / dis'krēt.

Adjective: Individually separate and distinct.

Synonyms: separate - detached - distinct - abstract.

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Syllabus Review

See Canvas for syllabus.

Why Active Learning?

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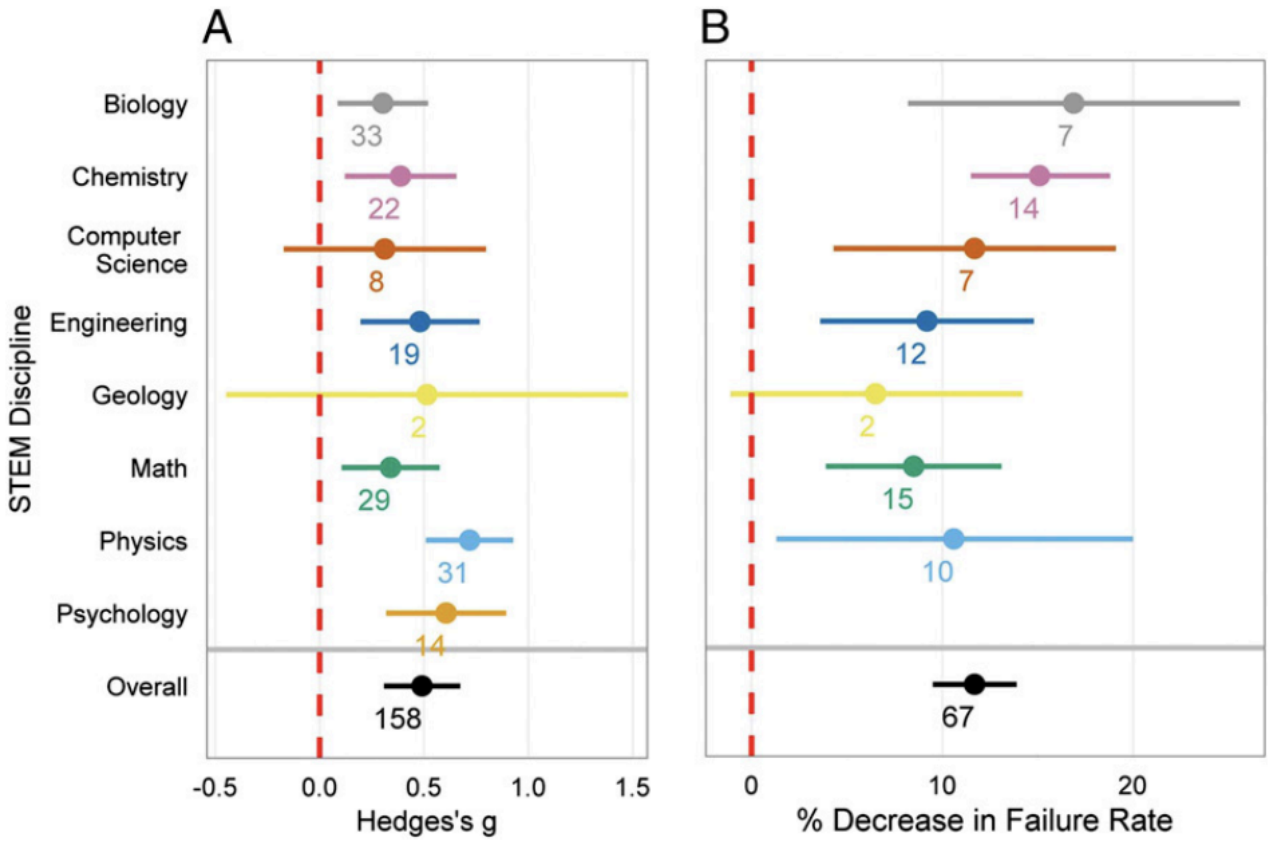

Freeman et al. (2014). *Proceedings of the National Academy of Sciences*.

Tips for Reading Math Textbooks

Work through examples.

- Don't just skim (or worse, skip!) the examples. Instead, devote more of your focus to the examples. Working through them and verbalizing the main ideas behind them is a great way to test to make sure you're understanding what you're reading.
- Read with a pencil and paper in your hand and when you get to an example, work it out! Try not to look at the solution until you are done.
- When checking your work, make sure you understand each step and why.
- Practice the examples BEFORE you attempt homework problems and then try to do your homework without referring back to the example

Source: https://learningcenter.unc.edu/tips-and-tools/readingmathtexts/.

Virtues of discrete math – a brief example

About Me

Michael Wojnowicz
Assistant Professor, GSOC @ MSU
Research Associate, Biostats @ Harvard
Postdoc, CS @ Tufts
Distinguished Data Scientist @ Cylance
(cybersecurity start-up, sold for $1.4b)

Research interests

- Probabilistic machine learning
- Scalable inference
- Modeling spatiotemporal data

Motivation

Continuous authentication:
continuously verify a user's identity
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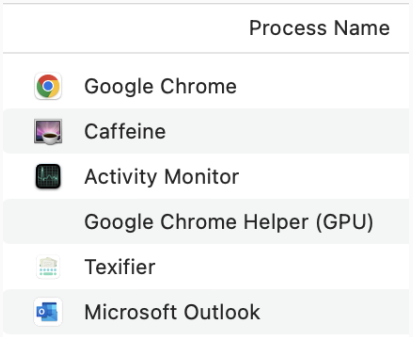

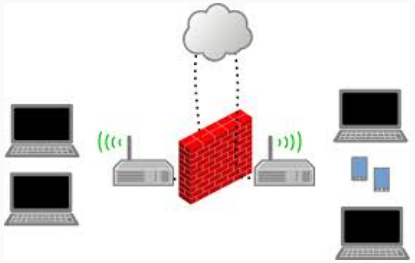

Data sources: Keystrokes, mouse movements, process starts, network traffic, etc.

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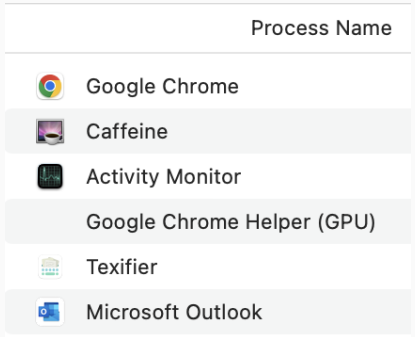

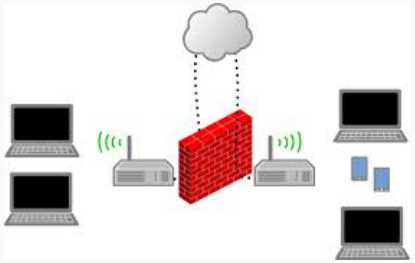

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Modeling Desiderata: fast, lightweight, reliable training; interpretable probabilistic (but expressive) models

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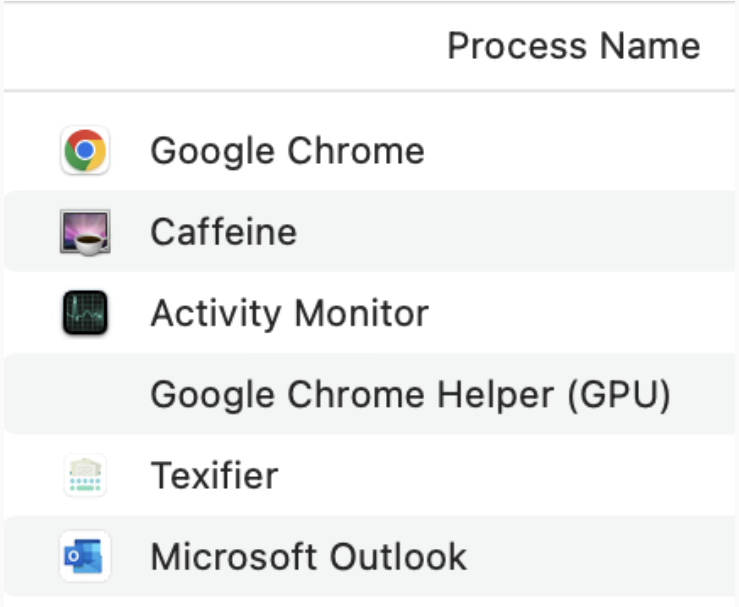

Subgoal: Learn computer process start sequences which characterize the typical behavior of a user.

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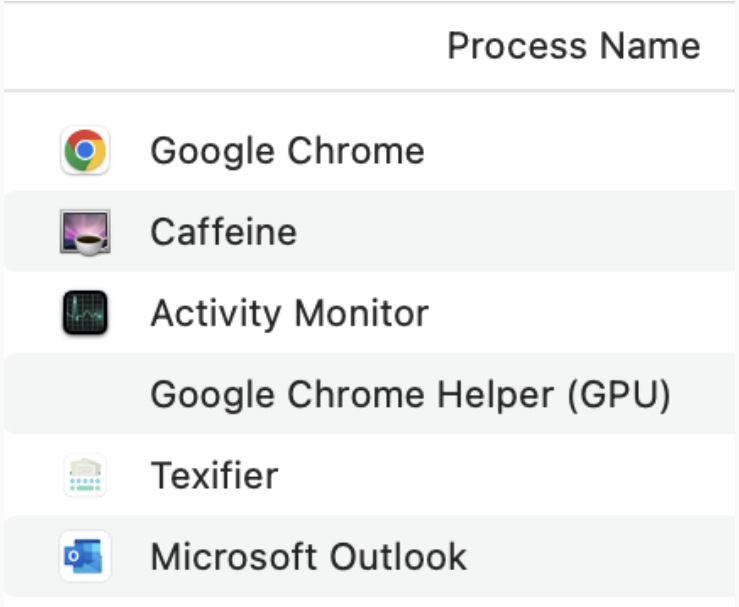

Subgoal: Learn computer process start sequences which characterize the typical behavior of a user.

Difficulty: Many 1000s of computer processes, sparsely observed.

Solution: Scalable Bayesian Categorical Modeling

Wojnowicz, Miller, Aeron, Hughes, '22, *International Conference of Machine Learning (ICML)*.

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Figure 2: A new model for a computer user's process starts (with 1,553 categories, 1,553 covariates, and 17,724 examples), to aid in **intruder detection**.

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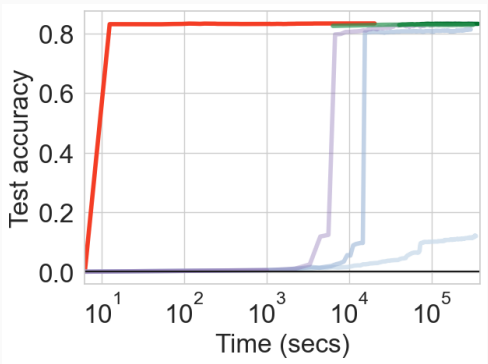
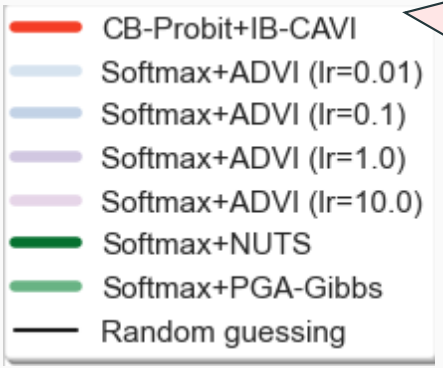
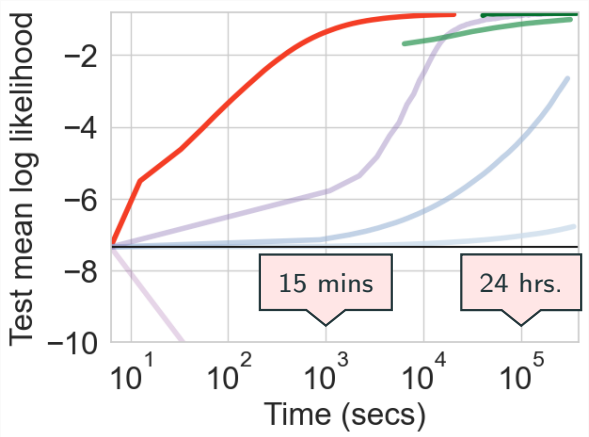
Indistinguishable accuracy.





A new model

Little-to-no cost in probabilities.



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The solution to this problem used almost every content area we're covering in this course

- Discrete probability
- Counting
- Complexity (Big-O notation)
- Recursions
- Graph theory
- Proof techniques

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