

CSCI 1470/2470
Spring 2022

Ritambhara Singh

January 24, 2024
Wednesday

Welcome 😊

Deep Learning



About your instructor!

5th year CS and Data Science faculty and a Center for Computational Molecular Biology (CCMB) member!

Research Interests

Machine Learning, Data Mining, Computational Biology, Health Sciences



B.E
2008-2012



Ph.D.
2012-2018



Postdoc
2018-2019

Office Location

Room 313, Data Science Institute (DSI)
3rd Floor, 164 Angell Street

Office Hours (Starting this week!)

Thursdays, 2:00-4:00 PM or by appointment

Where: Room 375, 3rd Floor, 164 Angell Street ← Not CIT!

Email: cs_deeplearning@brown.edu ← Please email here!

Website: www.ritambharasingh.com



I also teach:

CSCI 2952-G: Deep Learning in Genomics

Introducing...

Your Awesome Course Staff!

Your Graduate TA ☺ Your HTAs!



Michal Golovanevsky
she/her



Raymond Dai
he/him



Erica Song
she/her



Joe Dodson
he/him



Karan Kashyap
he/him



Pranav Mahableshwarkar
he/him



Earth Mokkamakkul
he/him

Your TAs!



Julian Dai
he/him



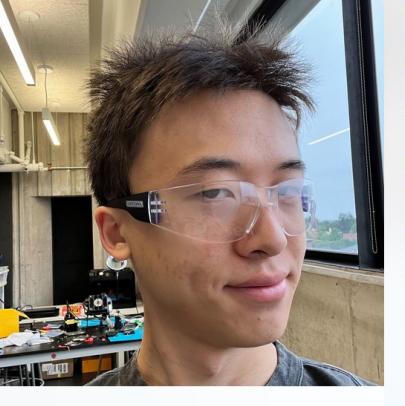
Calvin Eng
he/him



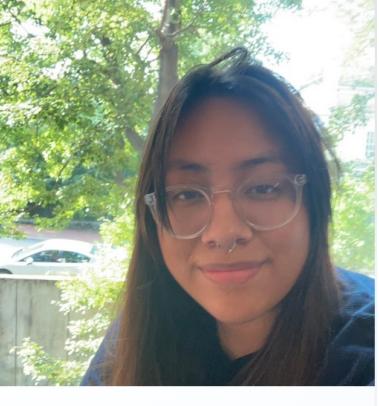
Taj Gillin
he/him



Spandan Goel
he/him



Naicheng (Arnie) He
he/him



Amanda Hernandez Sandate
she/her



Woody Hulse
he/him



Kelvin Jiang
he/him



Bumjin Joo
he/him



Sophia Qiming
she/her



Aayush Setty
he/him



Jason Silva
he/him

Your TAs!



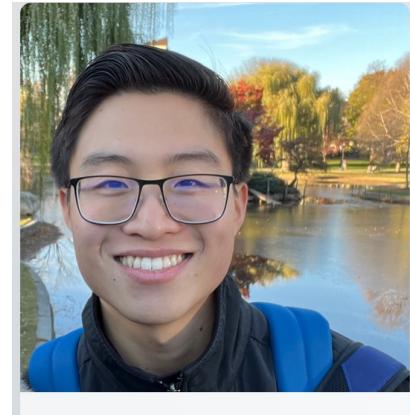
Kyle Lam
he/him



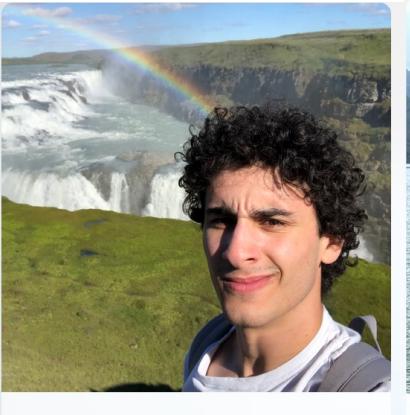
Jennifer Li
she/her



Alyssa Loo
she/her



Michael Lu
he/him



Ben Maizes
he/him



Ken Ngamprasertsith
he/him



Preetish Juneja
he/him



Mohammed Khan
he/him



Philip LaDuka
he/him



Aryan Singh
he/him

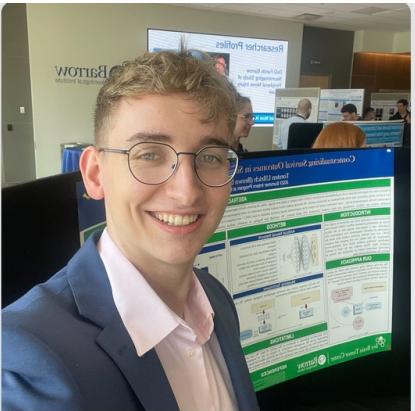


Sameer Sinha
he/him



Quinn Straus
he/him

Your TAs!



Torsten Ullrich

he/him



Mikayla Walsh

he/him



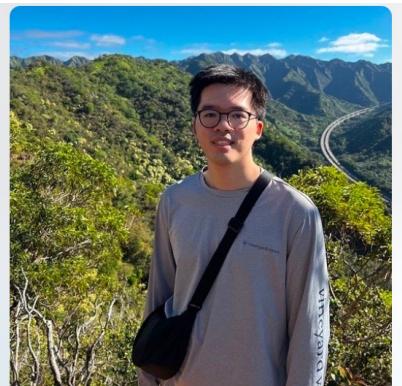
Emily Wang

she/her



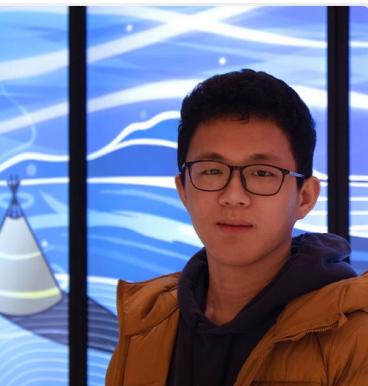
Xilin (Rice) Wang

he/him



Ray Xu

he/him



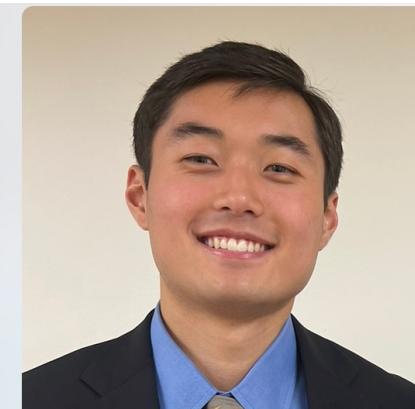
Enyan Zhang

he/him



Alex Zheng

he/him



Alex Zhou

he/him

Your STAs!



Naphat Permpredanun
he/him • STA



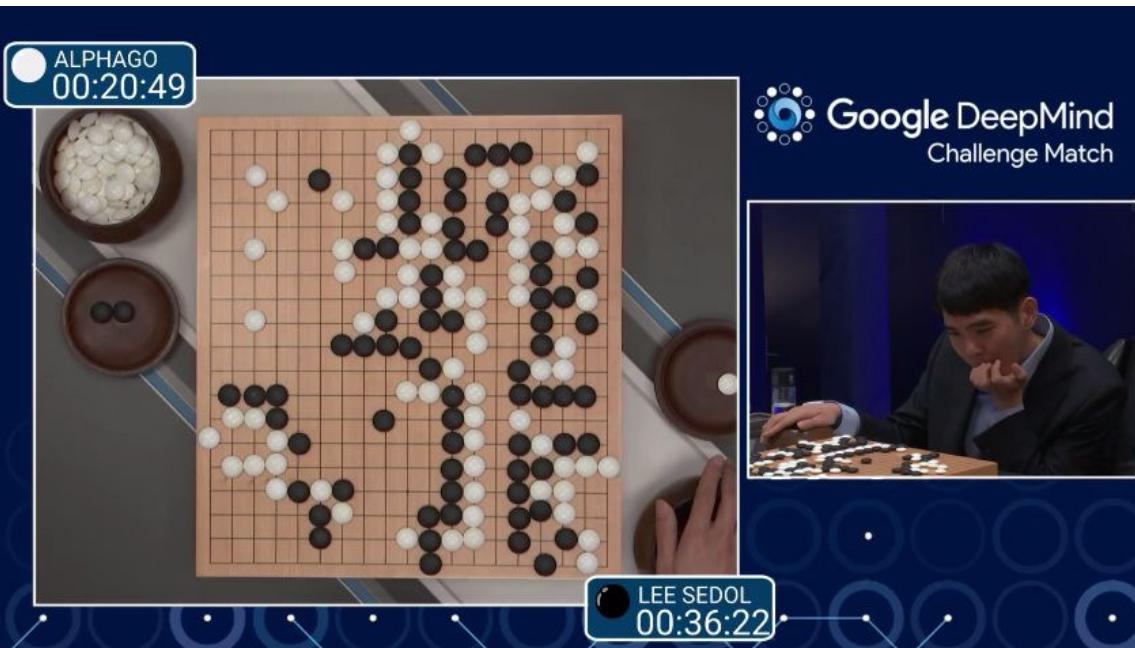
Kyle Yeh
he/him • UTA-STA



Lingze Zhang
he/him • UTA-STA

Why take this course?

You may have heard of “Deep Learning” or “Artificial Intelligence (AI)”



You may have heard of “Deep Learning” or “Artificial Intelligence (AI)”



ChatGPT 4 ▾

 You
a painting of deep underwater with a blue tang fish in the bottom right corner

 ChatGPT



Message ChatGPT...

ChatGPT can make mistakes. Consider checking important information.

You may have heard of “Deep Learning” or “Artificial Intelligence (AI)”





3 reasons to take deep learning class?



1. Enhance career opportunities: Deep learning is a highly sought-after skill in the tech industry, with demand for professionals with deep learning expertise continuing to grow. Taking a deep learning class can help you gain the skills and knowledge needed to pursue a career in this field.
2. Solve complex problems: Deep learning allows you to build models that can automatically learn from large amounts of data, and achieve state-of-the-art performance on a wide range of tasks. The ability to train deep neural networks on vast amounts of data allows for the creation of models that can generalize well to new data, and achieve high accuracy on a wide range of tasks.
3. Be part of cutting-edge technology: Deep learning is a rapidly evolving field, with new breakthroughs and advancements being made regularly. Taking a deep learning class will give you the opportunity to learn about the latest research and techniques, and be part of shaping the future of this technology.

You may have heard of “Deep Learning” or
“Artificial Intelligence (AI)”



Gender Classifier	Darker Male	Darker Female	Lighter Male	Lighter Female	Largest Gap
Microsoft	94.0%	79.2%	100%	98.3%	20.8%
FACE++	99.3%	65.5%	99.2%	94.0%	33.8%
IBM	88.0%	65.3%	99.7%	92.9%	34.4%



You may have heard of “Deep Learning” or “Artificial Intelligence (AI)”



Artificial intelligence / Machine learning

Training a single AI model can emit as much carbon as five cars in their lifetimes

Deep learning has a terrible carbon footprint.

by Karen Hao

June 6, 2019

In review of fatal Arizona crash, U.S. agency says Uber software had flaws

By David Shepardson

4 MIN READ



WASHINGTON (Reuters) - An Uber self-driving test vehicle that struck and killed an Arizona woman in 2018 had software flaws, the National Transportation Safety Board said Tuesday as it disclosed the company's autonomous test vehicles were involved in 37 crashes over the prior 18 months.

You may have heard of “Deep Learning” or “Artificial Intelligence (AI)”



Bloomberg

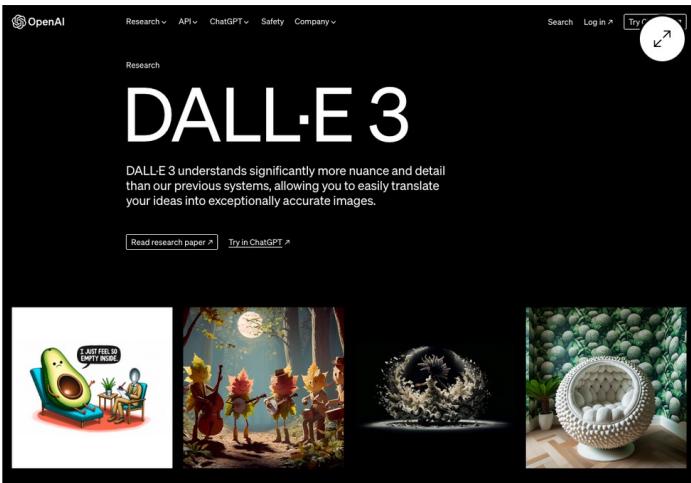
• Live Now Markets Economics Industries Tech AI Politics Wealth Pursuits Opinion Businessweek Equality Green

US Edition ▾

Technology
AI

Dall-E 3 Is So Good It's Stoking an Artist Revolt Against AI Scraping

Artists are worried AI will take their jobs — so they're getting creative.



The Dall-E 3 website.

SANDER VAN DER LINDEN IDEAS JAN 22, 2024 7:00 AM

AI-Generated Fake News Is Coming to an Election Near You

Targeted, AI-generated political misinformation is already out there—and humans are falling for it.



PHOTO-ILLUSTRATION: LAUREN JOSEPH, GETTY IMAGES

Our goal is to answers some important questions

- What is deep learning?
- What are the the **different types of deep learning models?**
- How to **implement** a deep learning models?
- What models are **appropriate for different applications?**
- Will our approach **improve our understanding** of the data or the problem?
- What are the **ethical considerations** when using deep learning models?



Next time when you come across “Deep Learning” you will know:

What is Deep Learning?

(1) What is Machine Learning?

(2) How does it connect to Deep Learning?

(3) What is NOT Deep Learning?

What is Machine Learning?

Input: X



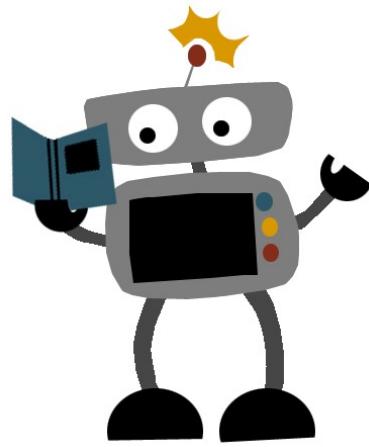
Function: f



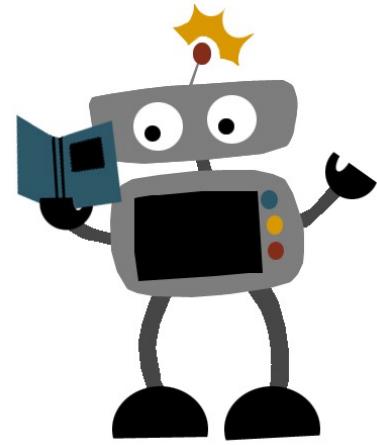
$$f(X) \rightarrow Y$$

Output: Y

"Cooking?"



What is Machine Learning?



Supervised
Learning

Input: X



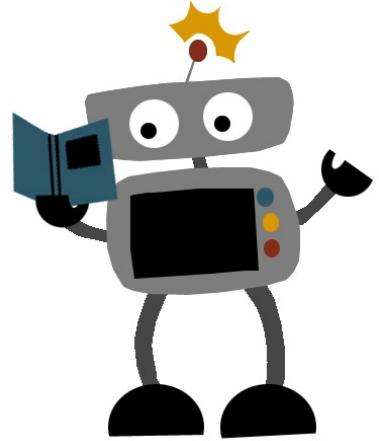
Learned
function: f

Output: Y
"Cooking?"



$$f(X) \rightarrow Y$$

What is Machine Learning?



Input: X

I do not want sour
cream in my
burrito



Learned
function: f



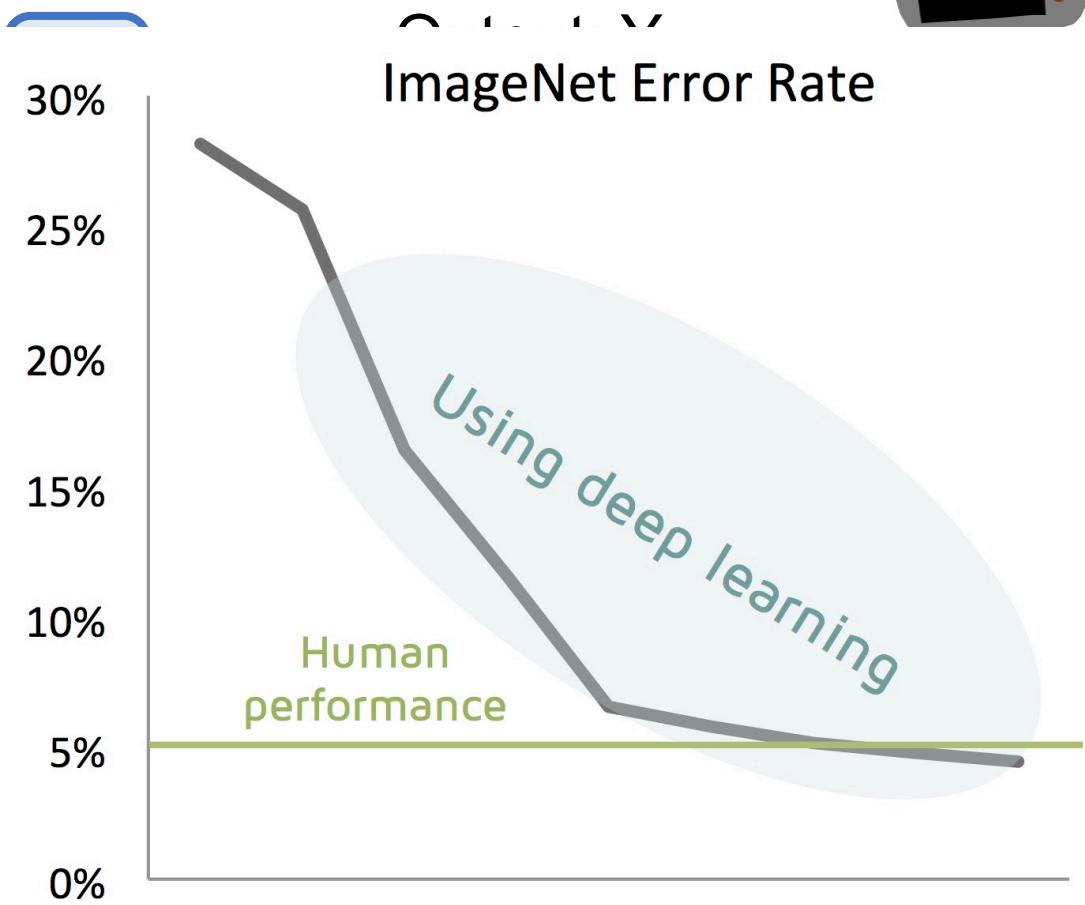
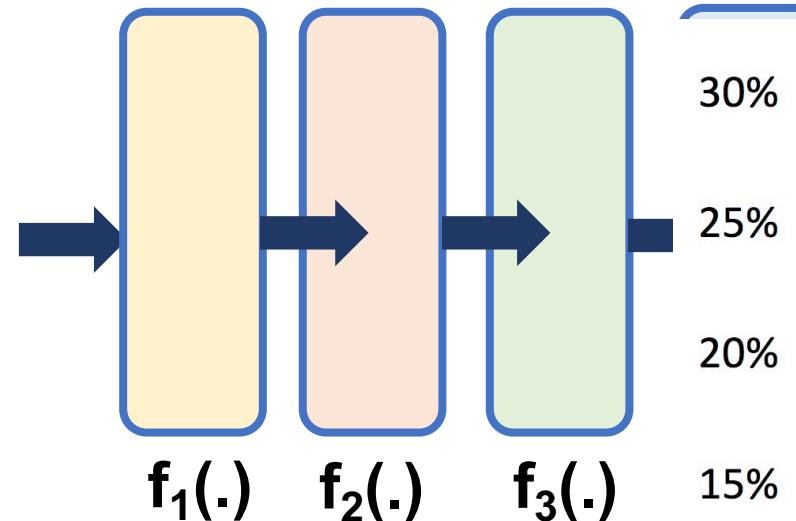
Output: Y

No quiero crema
agreya en mi
burrito

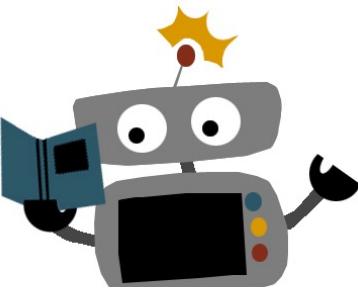
$$f(X) \rightarrow Y$$

What is Deep Learning?

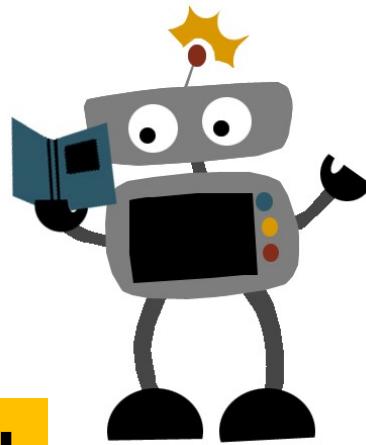
Input: X



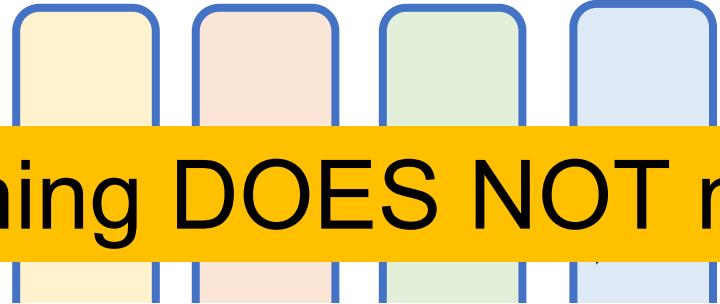
$f_4 \left(f_3 \left(f_2 \left(f_1 \left(X \right) \right) \right) \right), \dots$



What is Deep Learning?



Input: X



Output: Y

"Cooking?"

Deep Learning DOES NOT mimic the brain!



TURN ANY PHOTO INTO AN ARTWORK – FOR FREE!

We use an algorithm inspired by the human brain. It uses the stylistic elements of one image to draw the content of another. Get your own artwork in just three steps.

[<https://deepart.io>]

WHAT IS DEEP LEARNING?

A newly re-invigorated form of machine learning, which is itself a subset of artificial intelligence, deep learning employs powerful computers, massive data sets, “supervised” (trained) neural networks and an algorithm called back-propagation (backprop for short) to recognize objects and translate speech in real time **by mimicking the layers of neurons in a human brain’s neocortex.**

[<https://builtin.com/artificial-intelligence/deep-learning>]

"Cooking?"

What is NOT Deep Learning?

Deep Learning is NOT AI



[<https://www.healthcareitnews.com/ai-powered-healthcare>]



HOME > AI-POWERED SOLUTIONS

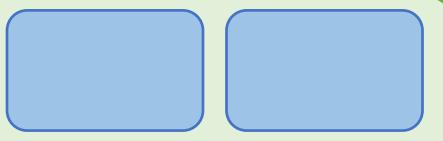
AI-Powered Solutions

[<https://www.arubanetworks.com/solutions/ai-powered-solutions>]

Artificial Intelligence (AI)

arning

ing



Recap

Input: X



Machine Learning

$$f(X) \rightarrow Y$$

Output: Y

"Cooking?"



Deep Learning is NOT AI

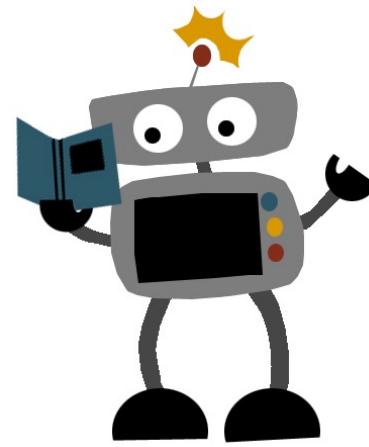


Deep Learning DOES NOT mimic the brain!

Deep Learning



$$f_4(f_3(f_2(f_1(X)))) \rightarrow Y$$



Questions?



Ice-breaker (a.k.a “please-don’t-make-me-do-this” activity)

- Turn to the person sitting next to you and introduce yourself!
- **What do you hope to learn/be able to do by the end of this course?**

Join at menti.com | use code 35 33 01 2



Course Logistics

The Course Website

<http://cs.brown.edu/courses/csci1470>



- Your one-stop-shop for:
 - Syllabus
 - Lecture, lab, & assignment schedules
 - Links to important forms, etc.
 - ...

The Canvas Website

<https://canvas.brown.edu/courses/1094502>

2024 Spring

Home

Syllabus

Media Library

Quizzes

Announcements

Ed Discussion

GradeScope

Assignments

CSCI1470/2470 Spring24 Deep Learning

[Jump to Today](#)



Welcome to CSCI 1470/2470! Over the past few years, Deep Learning has become a popular area, with deep neural network methods obtaining state-of-the-art results on applications in computer vision (Self-Driving Cars), natural language processing (Google Translate), and reinforcement learning (AlphaGo). These technologies are having transformative effects on our society, including some undesirable ones (e.g. deep fakes).

This course intends to give students a practical understanding of how Deep Learning works, how to implement deep neural networks, and how to apply them ethically. We introduce students to the core concepts of deep neural networks, including the backpropagation algorithm for training neural networks, as well as specific operations such as convolution (in the context of computer vision) and word embeddings, and recurrent neural networks (in the context of natural language processing).

- Your access to:
 - Ed Discussion
 - GradeScope
 - Lectures
 - Weekly quizzes
 - Weekly course announcements from instructor

Which Version of the Course Should I Take?

CS 1470

- Undergrads + grads
- Lectures
- Labs
- Assignments (Code + Written)
- Group final project
 - Implement existing research paper
 - Poster presentation

CS 2470

- Grad students only
- Same Lectures
- Same Labs
- Same Assignments, plus:
 - Additional required features
 - Additional written questions
- Group final project
 - Try something new
 - Oral presentation

Which Version of the Course Should I Take?

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Six Awesome Assignments

The slide features a central large image of the TensorFlow 2.0 logo. Above it are three smaller diagrams: a coordinate system with four green 'x' marks, two stylized human figures connected by a network of black lines, and a grid of nine small images with their corresponding captions below them. Below the central logo are three examples of assignments: 'Language modeling' (a slice of cake), 'Image Captioning' (a slice of cake), and 'Variational Autoencoders' (a colorful abstract image).

6: frog 9: truck 9: truck 4: deer 1: automobile
1: automobile 2: bird 7: horse 8: ship 3: cat

TensorFlow 2.0

Language modeling

a cake with a slice cut out of it

Image Captioning

Variational Autoencoders

Brown Deep Learning Day!

- Course final project
- In-person mini conference!
- Poster sessions and presentations
 - Grouped by theme: e.g. vision, language, robotics, ...
- **Tentative Date: May 6-7, 2024**
- Details forthcoming!



Deep Learning Day (Spring 2022)

Lectures and class participation

- In-person Lectures

- Lecture recordings available
- Recordings posted to Canvas (Media Library)

- Weekly quiz on Canvas

- Released on Wednesday (starts next week!)
- Due on Thursday
- Minimum time/effort if you attend class or watch lectures regularly
- No deadline extensions!

Lectures

Monday, Wednesday, and Friday at 12:00-12:50pm in Salomon Center DECI

Course offered in-person with recordings made available for reviewing. This schedule is subject to change.

Week 1-4 Deep Learning Basics

1/24	Welcome to Deep Learning	 Recording	 Slides
1/26	Supervised Learning - Classification/Regression, Training/Validation/Testing		
1/29	Perceptron and MNIST		
1/31	Perceptron (continued) and Loss Functions		
2/2	Optimization and Backpropagation		
2/5	Backpropagation (continued)		
2/7	Autodiff		
2/9	Matrix representation of NNs + GPUs + Intro to Tensorflow		
2/12	Multi-layer NNs and Activation Functions		
2/14	The Lifecycle of a Machine Learning Project		

Labs and office hours

- In-person lab and office hours
 - Will take a week or so to finalize
 - **Team work highly encouraged for lab hours!**
 - Might have remote options (in the works!)
 - **NEW FORMAT** for office hours
 - Conceptual hours (group-based help/discussion on concepts)
 - Collab hours (group-based help/discussion on code)
 - **TAs will only look at your code in the first week of assignment release (including 1-1 debugging) during collab hours**

cs1470 (Deep Learning) External Calendar						
Today		Jan 28 – Feb 3, 2024		Print Week Month Agenda		
Sun 1/28	Mon 1/29	Tue 1/30	Wed 1/31	Thu 2/1	Fri 2/2	Sat 2/3
	HW 0C - Math Review (due 6pm EST) HW 0P - Setup (due 6pm EST)			HW 1P - Beras Part 1 (due 6pm EST) HW 1C - Beras Part 1 (due 6pm EST)		
10am		10 – 12p Collab Hours CIT 201				
11am			11 – 1p Collab Ho Lab 6 CIT 201	11 – 1p CIT 477 (Lubrano)		
12pm	12p – 1p Lecture Salomon Center 001		12p – 1p Lecture Salomon Center 001		12p – 1p Lecture Salomon Center 001	12p – 2p Collab Ho Lab 11 CIT 201
1pm						12p – 2p CIT 165
2pm	2p – 4p Collab Hours CIT 201	2p – 4p Conceptual Hours CIT 201		2p – 4p Instructor's office hours Room 375, 3p – 5p Floor, 164 A Conceptu Providence	2p – 4p Collab Ho Lab 9 CIT 201	2p – 4p Collab Ho Lab 12 CIT 201
3pm			3p – 5p Collab Hours CIT 201	3p – 5p Conceptual Hours CIT 201	3p – 5p Floor, 164 A Conceptu Providence	2p – 4p CIT 165
4pm	4p – 6p Collab Hours CIT 201	4p – 6p Collab Hours CIT 201			4p – 6p Collab Hours CIT 201	4p – 6p Conceptual Hours CIT 201
5pm		5:30p – 7:30p Lab 1 CIT 165	5p – 7p Lab 3 CIT 165		5p – 7p Lab 7 CIT 165	5p – 7p Lab 10 CIT 241
6pm		6p – 8p Collab Ho CIT 201			6p – 8p Conceptual Hours CIT 201	
7pm		7:30p – 9:30p Lab 2 CIT 165	7p – 9p Collab Ho Lab 4 CIT 201	7p – 9p Collab Ho Lab 8 CIT 201	7p – 9p CIT 165	
8pm		8p – 10p Collab Ho CIT 201	8p – 10p Collab Ho Lab 5 CIT 201	8p – 10p Collab Ho Lab 5 CIT 201	8p – 10p CIT 165	
9pm						

Assignment logistics

- Assignments
 - Get stencils via Github Classroom
 - Submission via Gradescope



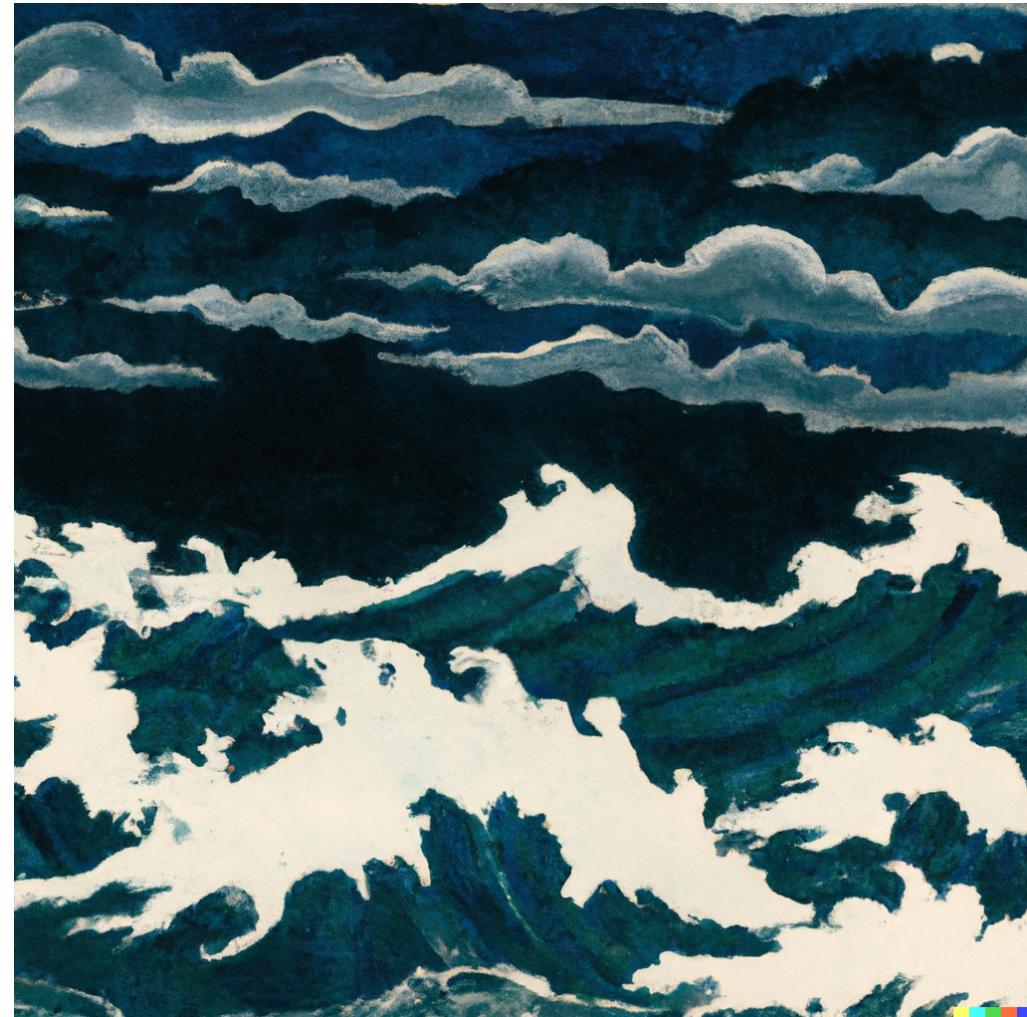
Somewhat new!

Homework and Lab 0 + SRC discussions

- Homework 0 (will be released today!)
 - Review of relevant math and probability concepts
 - Setting up programming environment
 - Points for completion only (**deadline Feb 02**)
- Lab 0 (will be released today!)
 - Review of python and numpy
 - Complete on your own (**preferably by Jan 29**)
- SRC discussion sessions
 - **Sign up to attend 2 sessions for this semester**
 - STAs will provide prompts related to that week's homework

The only thing set in stone is our excitement to learn!

- Will try things for class engagement
- Due dates might move around
- We might have make-up classes/labs
- The schedule will remain flexible till the end
- Suggestions are welcome!



DALL-E 2 prompt "japanese painting of a stormy ocean"

This course is also offered in the Fall!



Professor Chen Sun
(taught in Fall 2022)

Acknowledgements



Original course material developed by
Professor Daniel Ritchie
and previous FABULOUS TA staff

Immediate Action Items

- **Read the [course missive](#); sign the [collaboration policy form](#)**
- Make sure you can access the course [Ed Discussion](#) page via [Canvas](#) (all announcements will happen there)
- Create a [GitHub](#) account (if you don't have one already)
- Make sure you can access the course [GradeScope](#) via Canvas (all assignments will be submitted there)
- **Start working on HW0 – Submission deadline Feb 02 (Friday 6PM EST)**
- **Do Lab 0 (Especially if you've never used Python and/or numpy before!) – Finish before lab 1!**
- If you want to do work on CS department machines over SSH, you'll need a CS login
 - All enrolled students automatically have one (it's the same as your Brown ID)
 - If you are not yet enrolled, you'll need to email problem@cs.brown.edu
 - More information about CS accounts can be found [here](#).
 - *Note that a CS login is **not required** for this course, as we are not using handin or any other department infrastructure to manage files or submissions*

Questions?

