

CSCI 1470/2470  
Spring 2022

Ritambhara Singh

January 24, 2024  
Wednesday

Welcome 😊

# Deep Learning



# About your instructor!

5<sup>th</sup> 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  
208-2012



Ph.D.  
2012-2018



Postdoc  
2018-2019



## Office Location

Room 313, Data Science Institute (DSI)  
3<sup>rd</sup> Floor, 164 Angell Street

## Office Hours (Starting this week!)

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

Where: Room 375, 3<sup>rd</sup> Floor, 164 Angell Street ← Not CIT!

Email: [cs\\_deeplearning@brown.edu](mailto:cs_deeplearning@brown.edu) ← Please email here!

Website: [www.ritambharasingh.com](http://www.ritambharasingh.com)

I also teach:  
CSCI 2952-G: Deep Learning in Genomics

Introducing...

Your Awesome Course Staff!

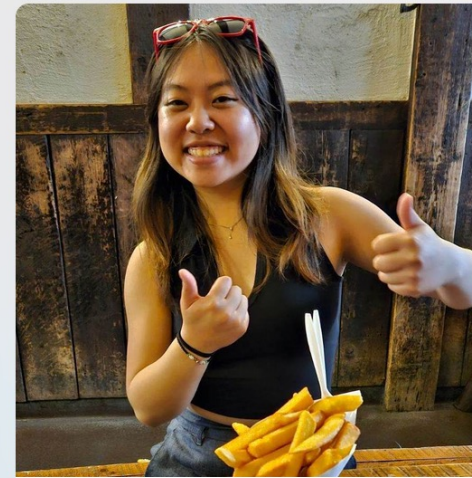
# Your Graduate TA 😊 Your HTAs!



**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 Mokkaakul**  
he/him

# Your TAs!



**Julian Dai**  
he/him



**Calvin Eng**  
he/him



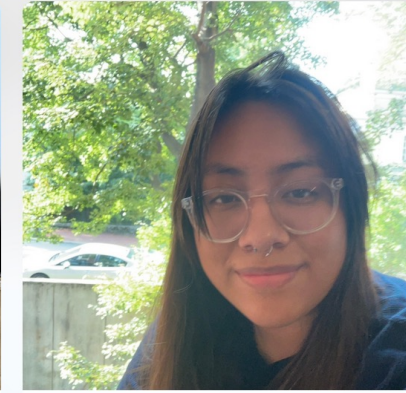
**Taj Gillin**  
he/him



**Spandan Goel**  
he/him



**Naicheng (Arnie) He**  
he/him



**Amanda Hernandez Sandate**  
she/her



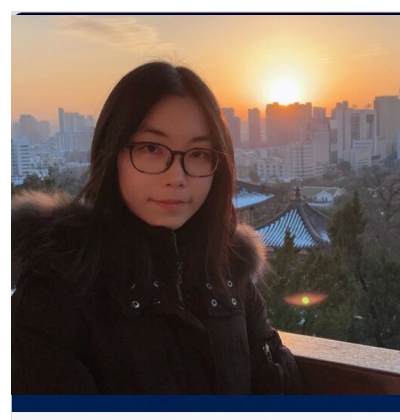
**Woody Hulse**  
he/him



**Kelvin Jiang**  
he/him



**Bumjin Joo**  
he/him



**Sophia Qiming**  
she/her



**Aayush Setty**  
he/him



**Jason Silva**  
he/him

# Your TAs!



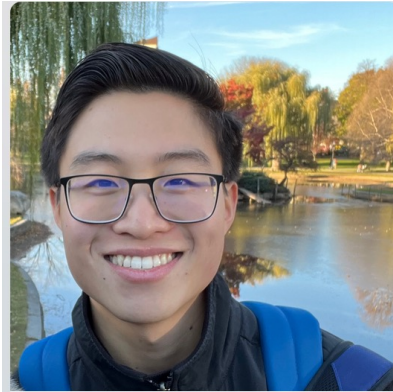
**Kyle Lam**  
he/him



**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



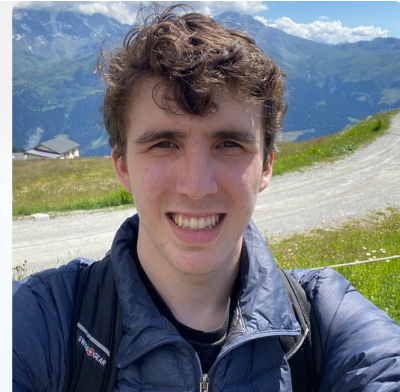
**Philip LaDuca**  
he/him



**Aryan Singh**  
he/him



**Sameer Sinha**  
he/him



**Quinn Straus**  
he/him

# Your TAs!



**Torsten Ullrich**  
he/him



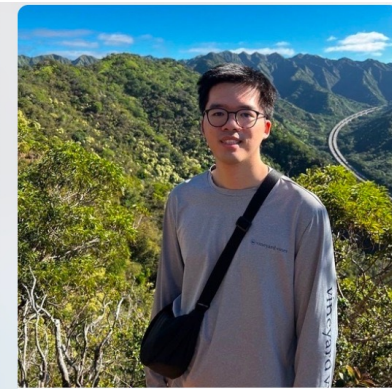
**Mikayla Walsh**  
he/him



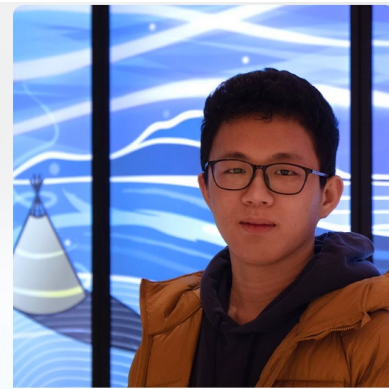
**Emily Wang**  
she/her



**Xilin (Rice) Wang**  
he/him



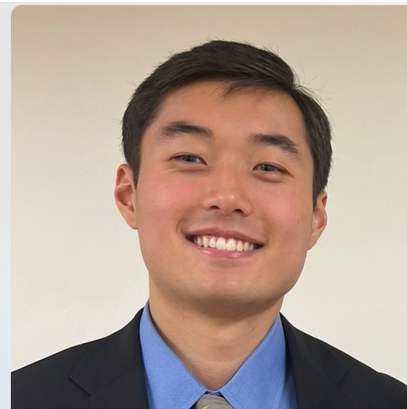
**Ray Xu**  
he/him



**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

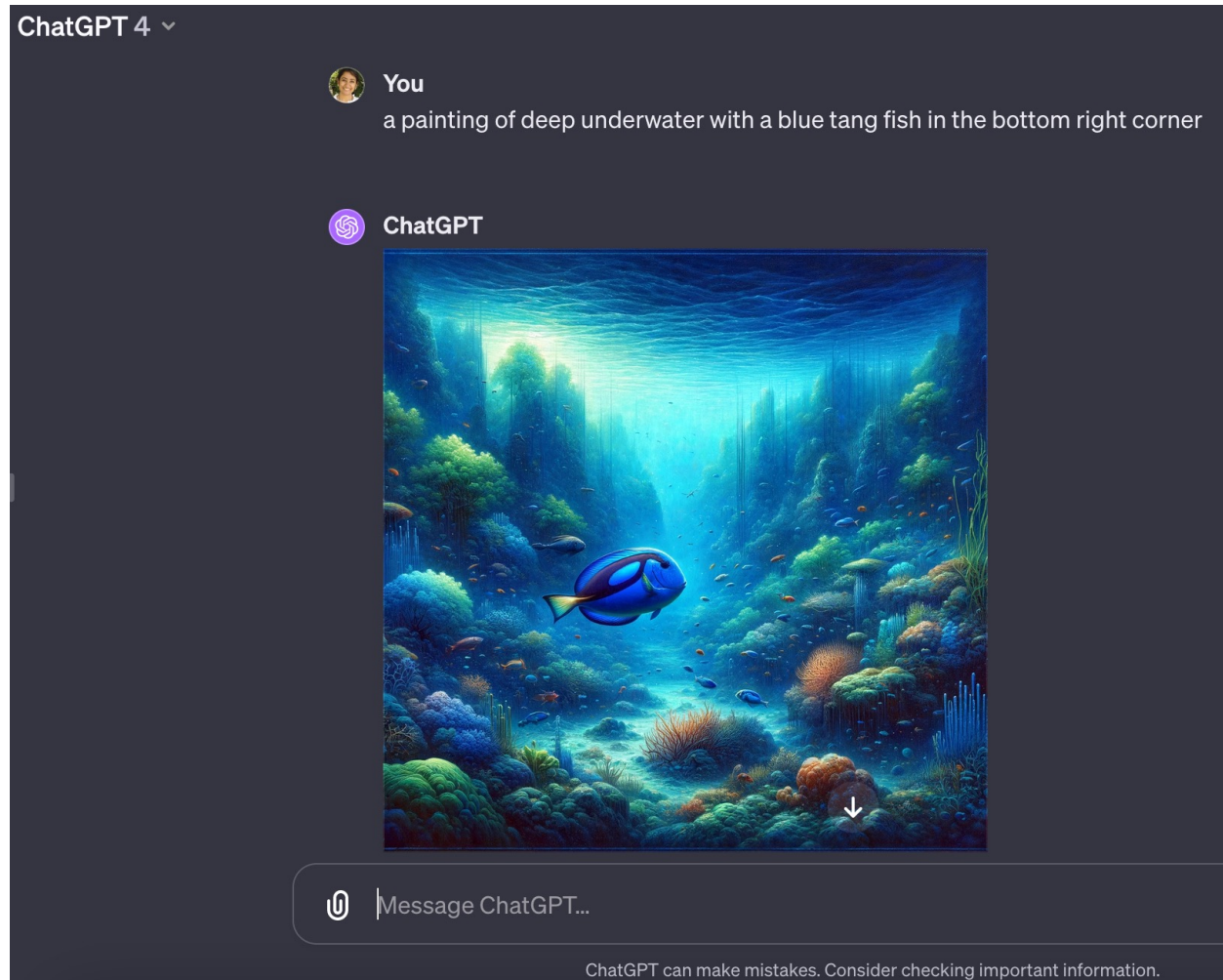


Why take this course?

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



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



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





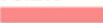





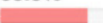

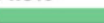







## 3 reasons to take deep learning class?

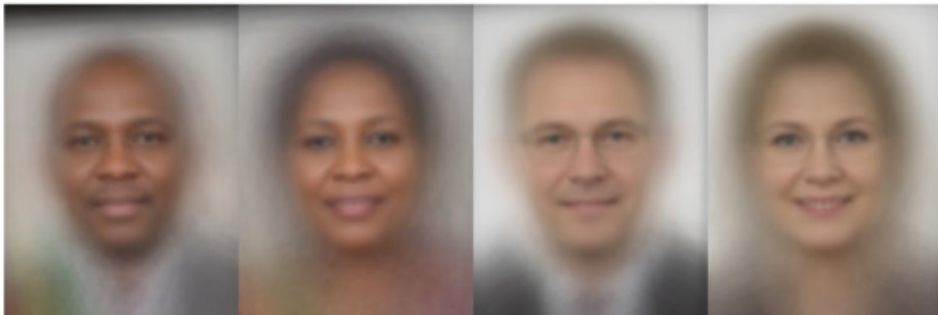


1. Enhance career opportunities: Deep learning is a highly sought-after skill in the tech industry, with demand for professionals with deep learning expertise continuing to grow. Taking a deep learning class can help you gain the skills and knowledge needed to pursue a career in this field.
2. Solve 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

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## 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

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## 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

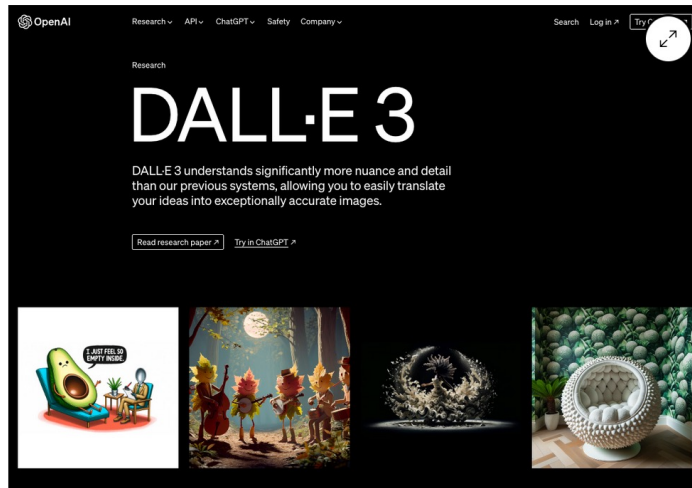
US Edition

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

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.

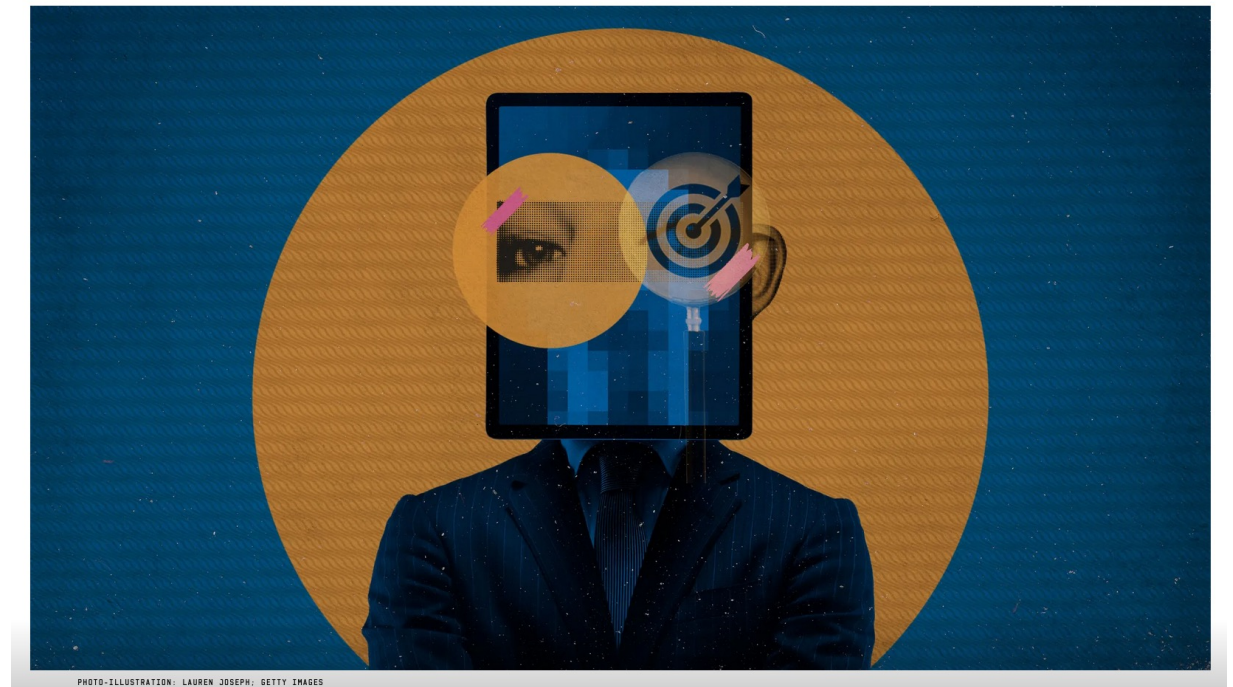


PHOTO-ILLUSTRATION: LAUREN JOSEPH; GETTY IMAGES

# 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



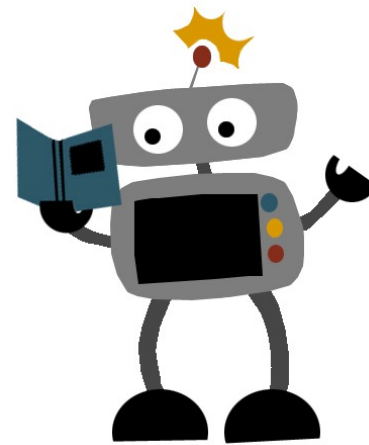
Function: f



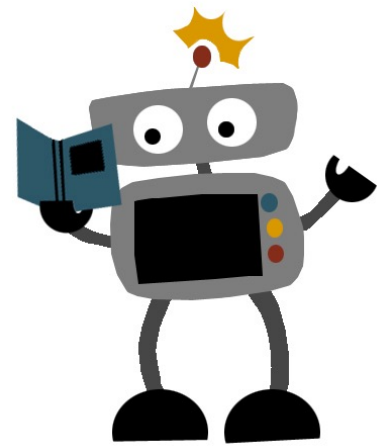
$f(X) \rightarrow Y$

Output: Y

"Cooking?"



# What is Machine Learning?



## Supervised Learning

Input: X



Learned  
function:  $f$

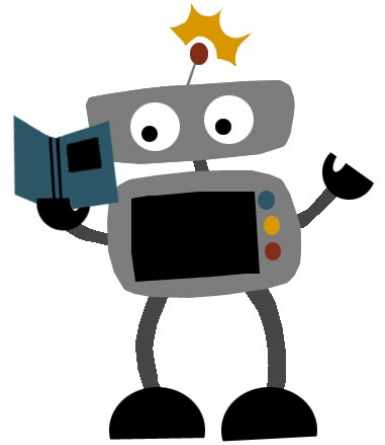


Output: Y  
"Cooking?"



$$f(X) \rightarrow Y$$

# What is Machine Learning?



Input: X

I do not want sour  
cream in my  
burrito



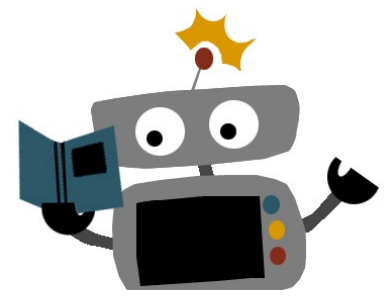
Learned  
function: f



Output: Y

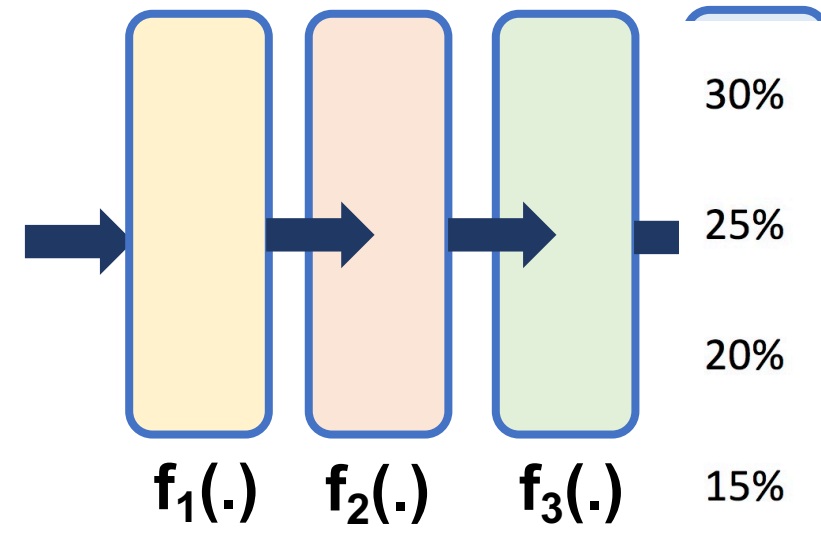
No quiero crema  
agrea en mi  
burrito

$f(X) \rightarrow Y$

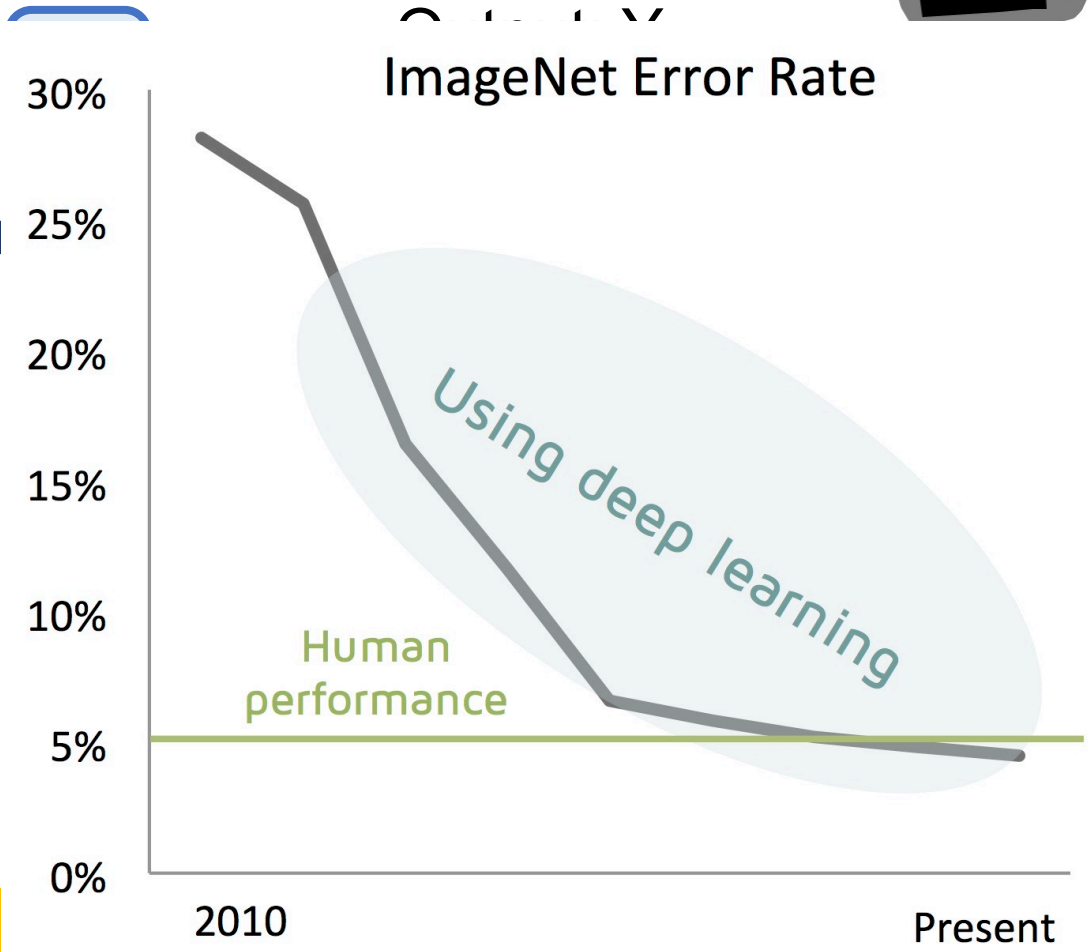


# What is Deep Learning?

Input: X

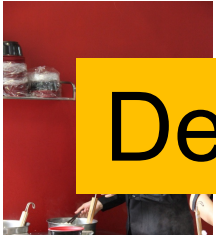


$$f_4 (f_3 (f_2 (f_1 (X))))$$

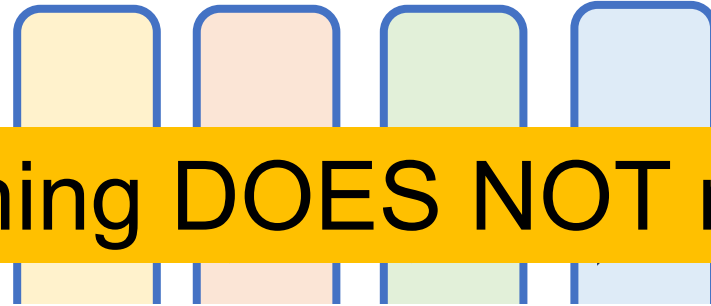


# What is Deep Learning?

Input: X

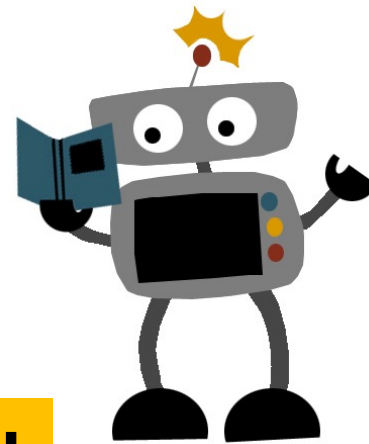


Deep Learning DOES NOT mimic the brain!



Output: Y

"Cooking?"



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

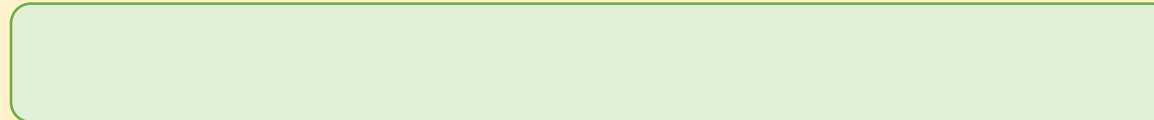
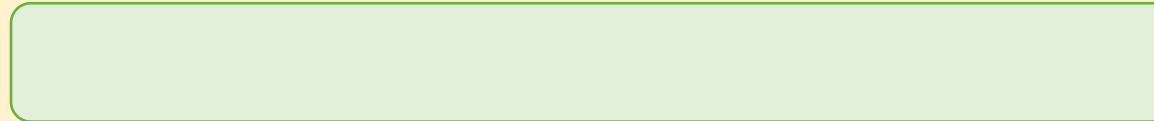
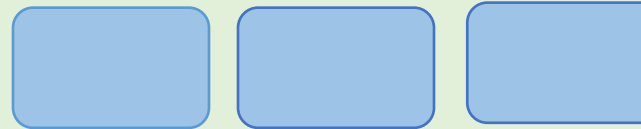
AI-Powered Solutions

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

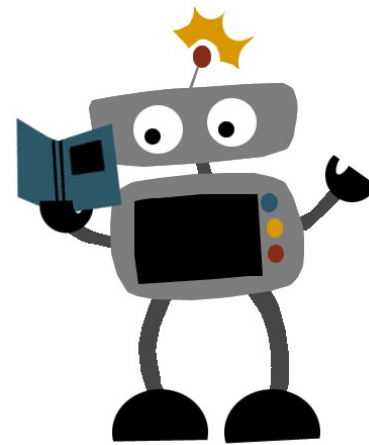
Artificial Intelligence (AI)

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](https://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](#)

 Edit

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?

## CS 1470

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## CS 2470

- Grad students only
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- Same Labs
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  - Additional written questions
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# Six Awesome Assignments



The image features the TensorFlow 2.0 logo prominently in the center. To the left of the logo is a small icon of a coordinate system with a red line and green 'x' marks. To the right is a neural network diagram with green and blue nodes. Further right is a grid of ten small images, each with a number and a label: 6. frog, 9. truck, 9. truck, 4. deer, 1. automobile, 1. automobile, 2. bird, 7. horse, 8. ship, 3. cat. Below the TensorFlow logo, the text 'Language modeling' is positioned on the left, 'Image Captioning' is centered below a small image of a cake with the caption 'a cake with a slice cut out of it', and 'Variational Autoencoders' is on the right.

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 477 (Lubrano)	11 – 1p Lecture Salomon Center 001	
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 Collab Ho Lab 11 CIT 165
2pm	2p – 4p Collab Hours CIT 201	2p – 4p Conceptual Hours CIT 201			2p – 4p Instructor's office hours Room 375, Floor, 164 A 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 Conceptual Hours CIT 201		
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			5p – 7p Lab 3 CIT 165		5p – 7p Lab 7 CIT 165		
6pm		5:30p – 7:30p Lab 1 CIT 165				5p – 7p Lab 10 CIT 241	
7pm		6p – 8p Collab Ho CIT 201				6p – 8p Conceptual Hours CIT 201	
8pm		7:30p – 9:30p Lab 2 CIT 165					
8pm		8p – 10p Collab Ho CIT 201	7p – 9p Collab Ho Lab 4 CIT 201	7p – 9p Collab Ho Lab 5 CIT 165	8p – 10p Collab Ho Lab 5 CIT 201	7p – 9p Collab Ho Lab 8 CIT 201	
9pm							

# Assignment logistics

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

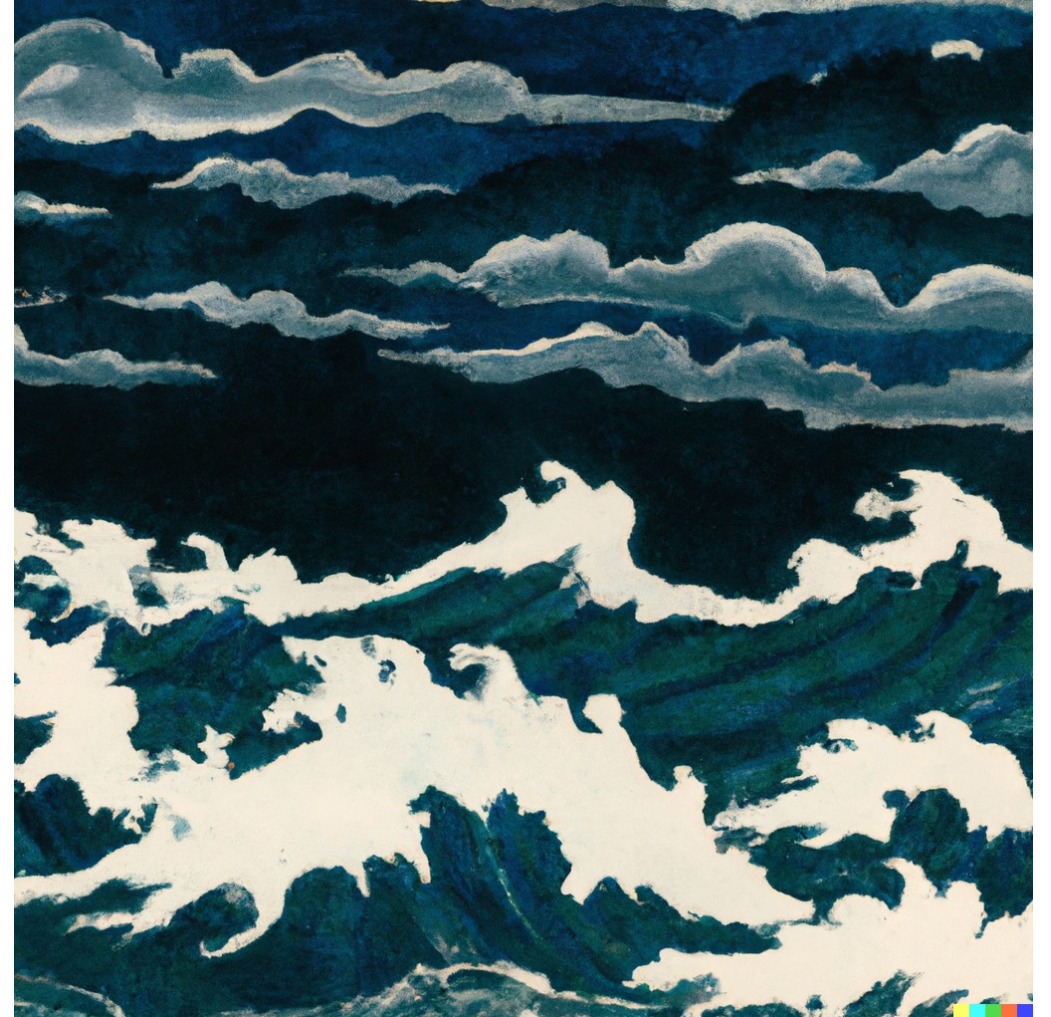


# Homework and Lab 0 + SRC discussions

- 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!**



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](mailto: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?

