

CSCI 1470

Eric Ewing

Wednesday,
1/23/24

Deep Learning

Day 1: Introduction to Deep Learning

About Your Instructor



2012-2016 B.A. in
Computer Science
+ Classics



USC

2018-2022
Began Ph.D.



2022-2024
Finished Ph.D.



Office: Arnold Lab 305

Office Hours:

- Wednesdays 3-5pm
- Tuesdays 3-5pm

Enter from Waterman St., near Metcalf!

Research Interests:

- Multi-Robot Systems
- Deep Learning for Optimization
- Interface between classical AI systems and Deep Learning

Your HTAs!



Dave Lubawski



Yuyang Luo



Sissy Han



Winston Li

Your UTAs!



Adam Lalani
he/him



Johnny Elias
he/him



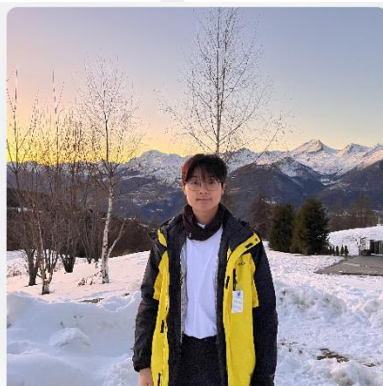
Navay Sahay
she/her



Marcel Mateos Salles
he/him



Nathan DePiero
he/him



Yujin Chung
he/him



Armaan Patankar
he/him



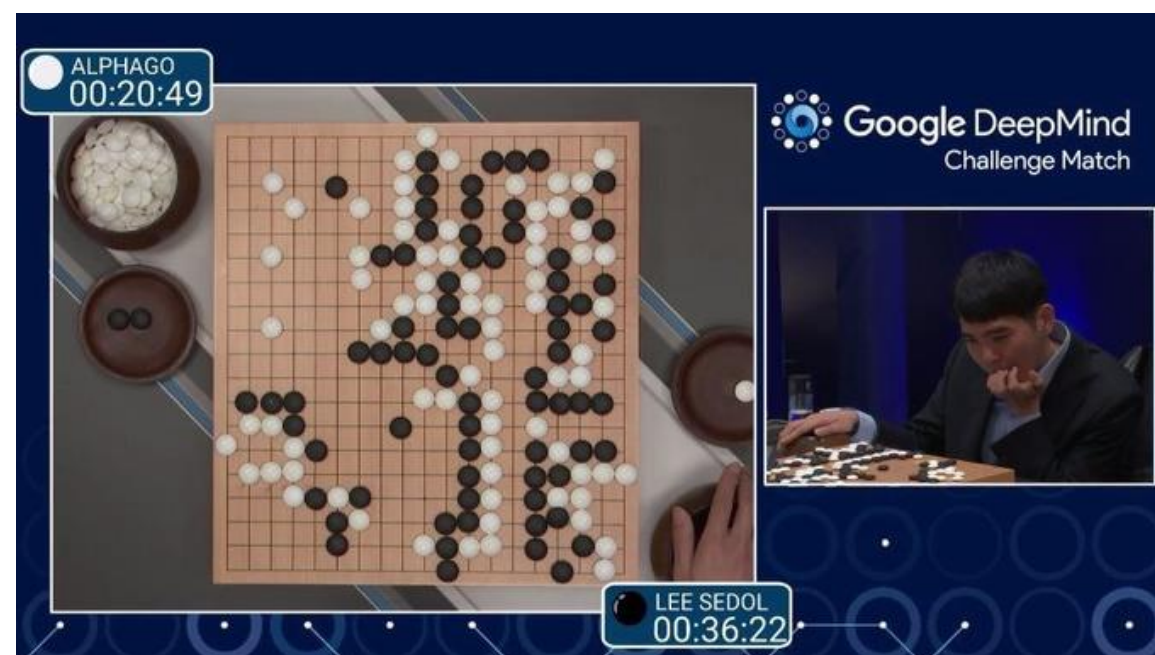
Bentzi Gitig
he/him



Dhruv Raghavan
he/him

Why take this course?

You may have heard of “Deep Learning”



You may have heard of “Deep Learning”

EE Why should students take a course in deep learning?

There are several compelling reasons for students to take a deep learning course:

Deep learning has become a fundamental technology that powers many of the tools and services we use daily - from recommendation systems and virtual assistants to medical imaging and autonomous vehicles. Understanding how these systems work gives students insight into the technology shaping our world.

The field teaches valuable technical and analytical skills that extend beyond AI. Students learn to think systematically about complex problems, work with large datasets, implement and debug sophisticated algorithms, and evaluate results critically. These skills are valuable across many technical and quantitative fields.

Deep learning also provides an excellent framework for understanding modern software development practices. Students gain hands-on experience with popular tools and frameworks like PyTorch or TensorFlow, version control, cloud computing, and optimization techniques.

From a career perspective, the skills learned in deep learning courses are highly sought after across industries. Companies increasingly need people who can develop and deploy AI systems, or who simply understand their capabilities and limitations well enough to integrate them effectively into products and workflows.

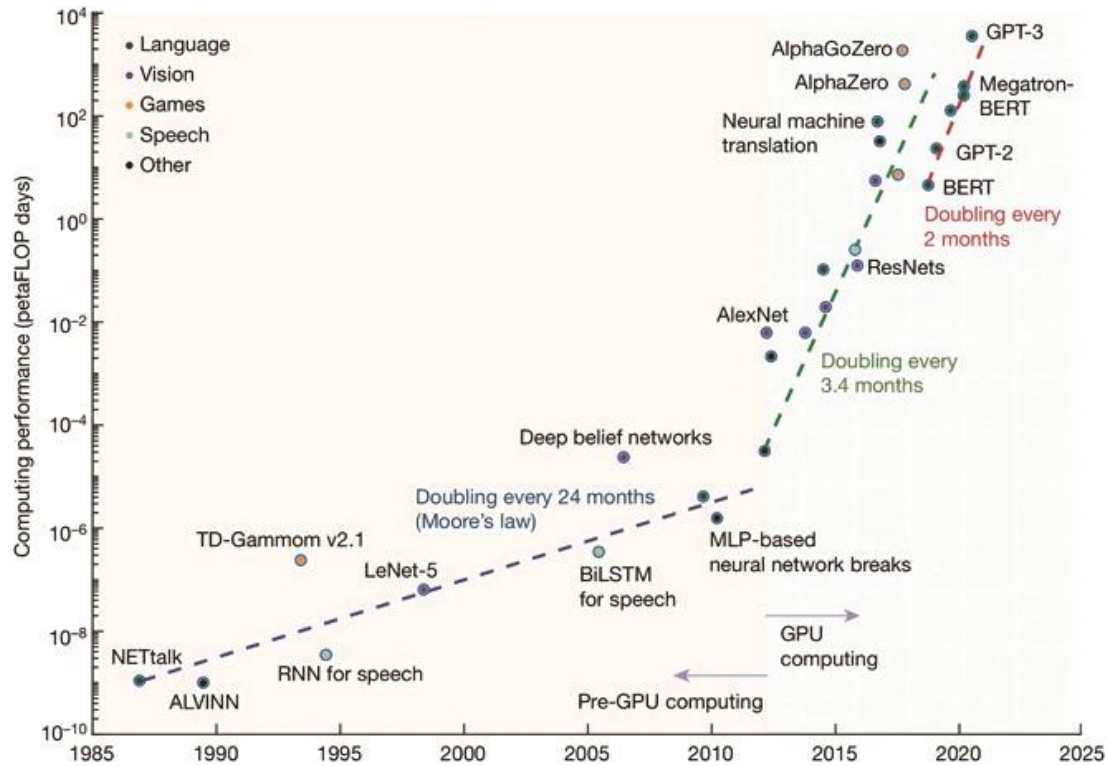
Perhaps most importantly, deep learning offers an exciting way to explore fundamental questions about intelligence, learning, and pattern recognition. Students get to build systems that can recognize speech, generate images, or solve complex games - providing concrete insights into how machines can learn to perform tasks that once seemed uniquely human.

What aspects of deep learning interest you most? Are you considering taking a course in it?

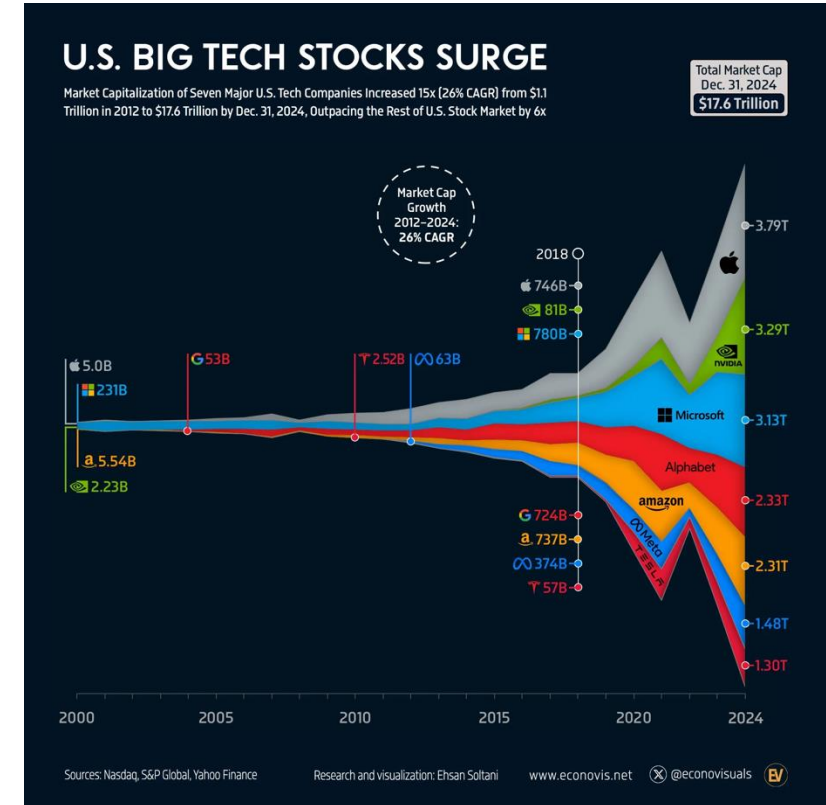
Copy Retry Share

1. You use DL-based tools daily
2. The skills you learn in this class extend beyond applications in deep learning
3. Skills in DL and working with DL tools are sought after
4. Explore questions about intelligence and learning

You may have heard of “Deep Learning”



The amount of compute required for powering generative AI doubles every 100 days



41% of companies worldwide plan to reduce workforces by 2030 due to AI

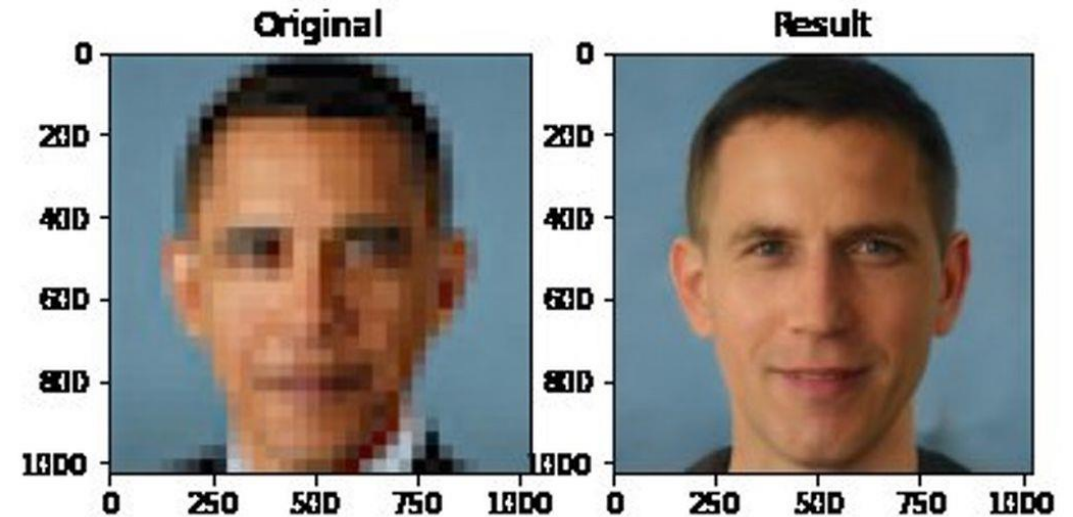
By Olesya Dmitracova, CNN

2 minute read · Published 7:57 AM EST, Wed January 8, 2025

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% <div><div></div></div>	79.2% <div><div></div></div>	100% <div><div></div></div>	98.3% <div><div></div></div>	20.8% <div><div></div></div>
 FACE++	99.3% <div><div></div></div>	65.5% <div><div></div></div>	99.2% <div><div></div></div>	94.0% <div><div></div></div>	33.8% <div><div></div></div>
 IBM	88.0% <div><div></div></div>	65.3% <div><div></div></div>	99.7% <div><div></div></div>	92.9% <div><div></div></div>	34.4% <div><div></div></div>



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

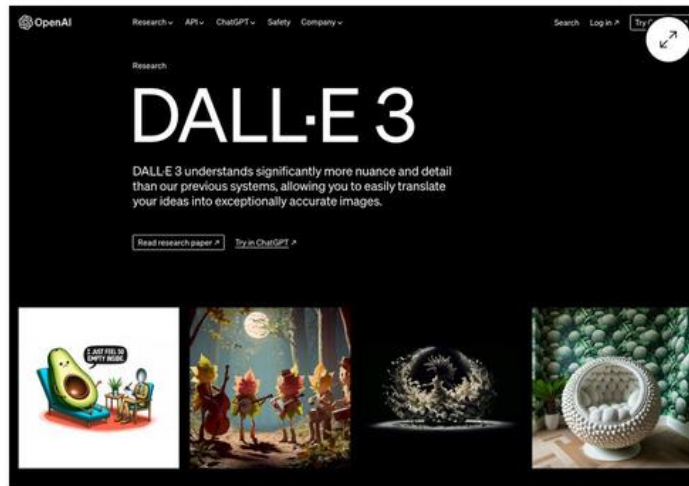
US Edition ▾

• 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 different deep learning architectures and **when are they appropriate to use?**
 - How are deep learning systems **implemented?**
- What are the **ethical considerations** when using deep learning models?
- What **causes improvements** in DL models?
- Where is **human decision making** needed in DL systems?
- **Why Now?**



Today's Goals:

What is Deep Learning?

- (1) What is Machine Learning?
- (2) How Does Deep Learning fit in?
- (3) What is NOT Deep Learning?

What is Machine Learning?

Input: X

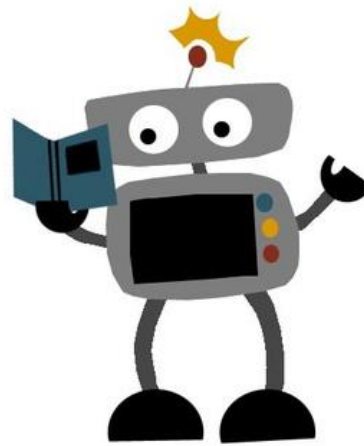


Function: f



Output: Y

"Cooking?"



What is Machine Learning?

Input: X



Function: f

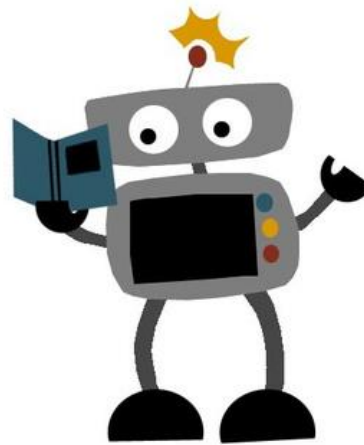


Output: Y

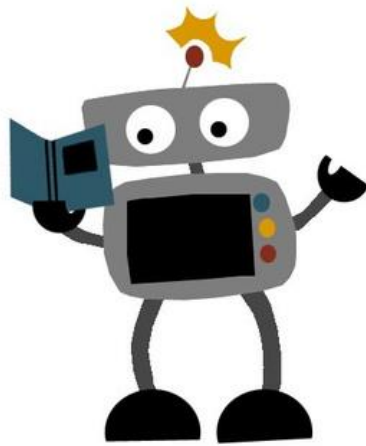
"Cooking?"



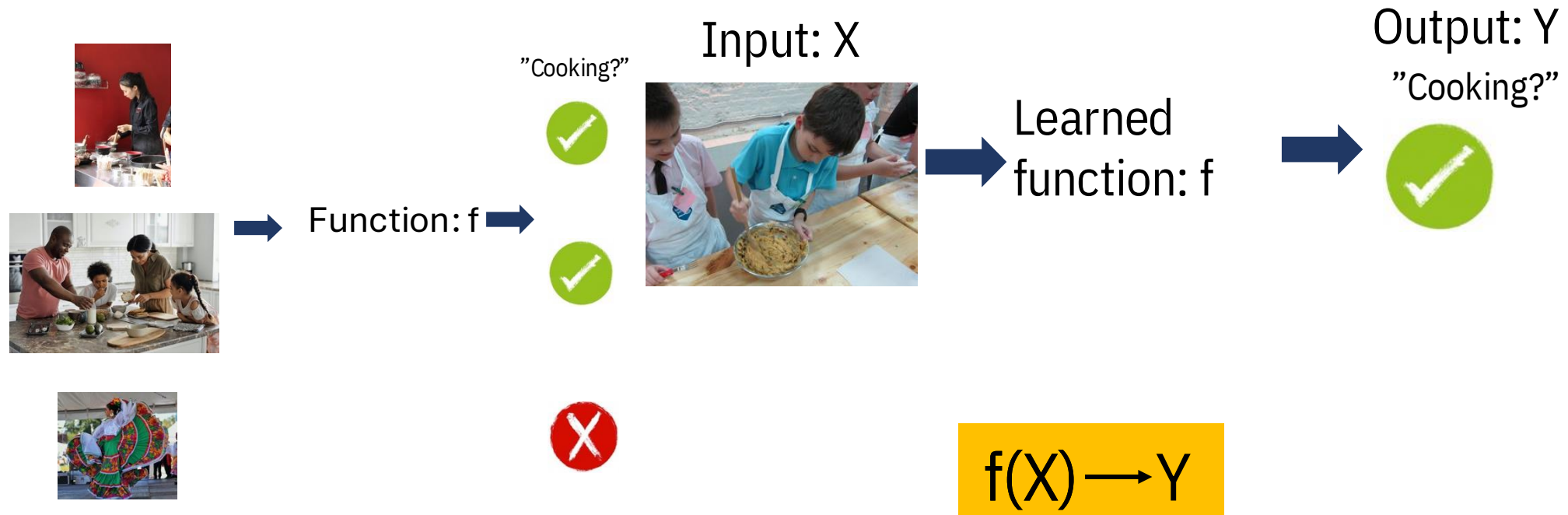
$f(X) \rightarrow Y$



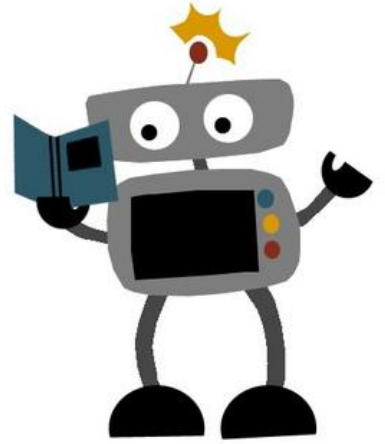
What is Machine Learning?



Supervised Learning



What is Machine Learning?



Input: X

I do not want
sour cream in my
burrito



Learned
function: f



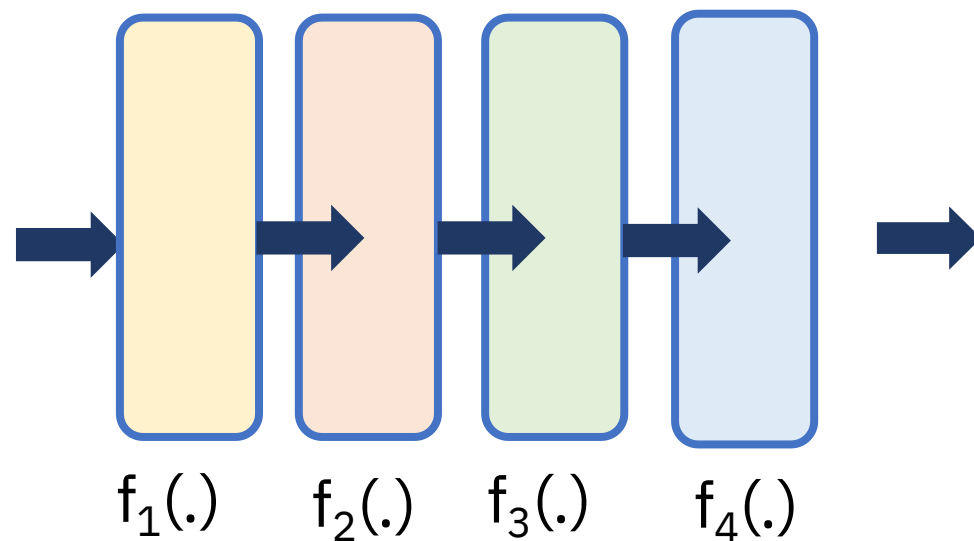
Output: Y

No quiero crema
agrea en mi
burrito

$f(X) \rightarrow Y$

What is Deep Learning?

Input: X



Output: Y

"Cooking?"

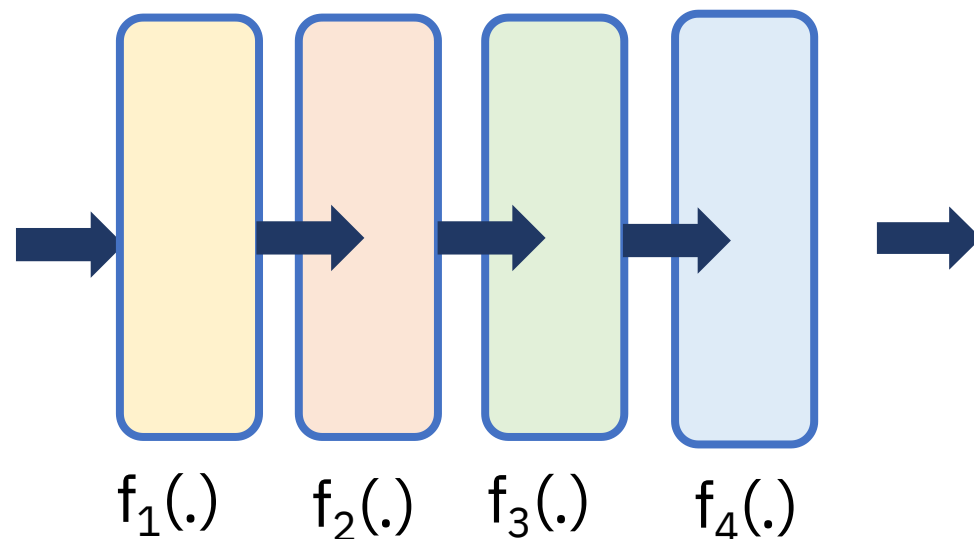


$$f_4(f_3(f_2(f_1(X)))) \rightarrow Y$$



What is Deep Learning?

Input: X



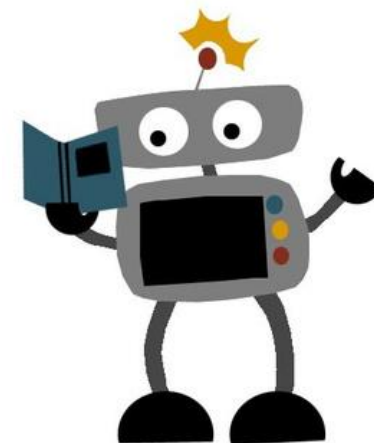
Neural Network

Output: Y

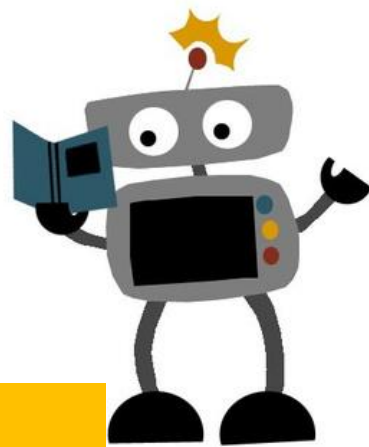
"Cooking?"



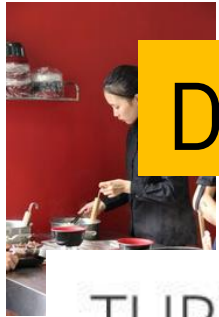
$$f_4 (f_3 (f_2 (f_1 (X)))) \rightarrow Y$$



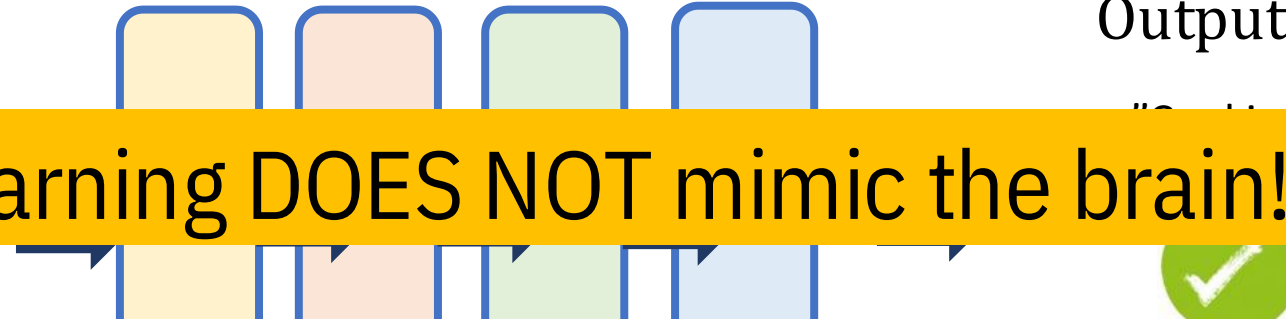
What is Deep Learning?



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?

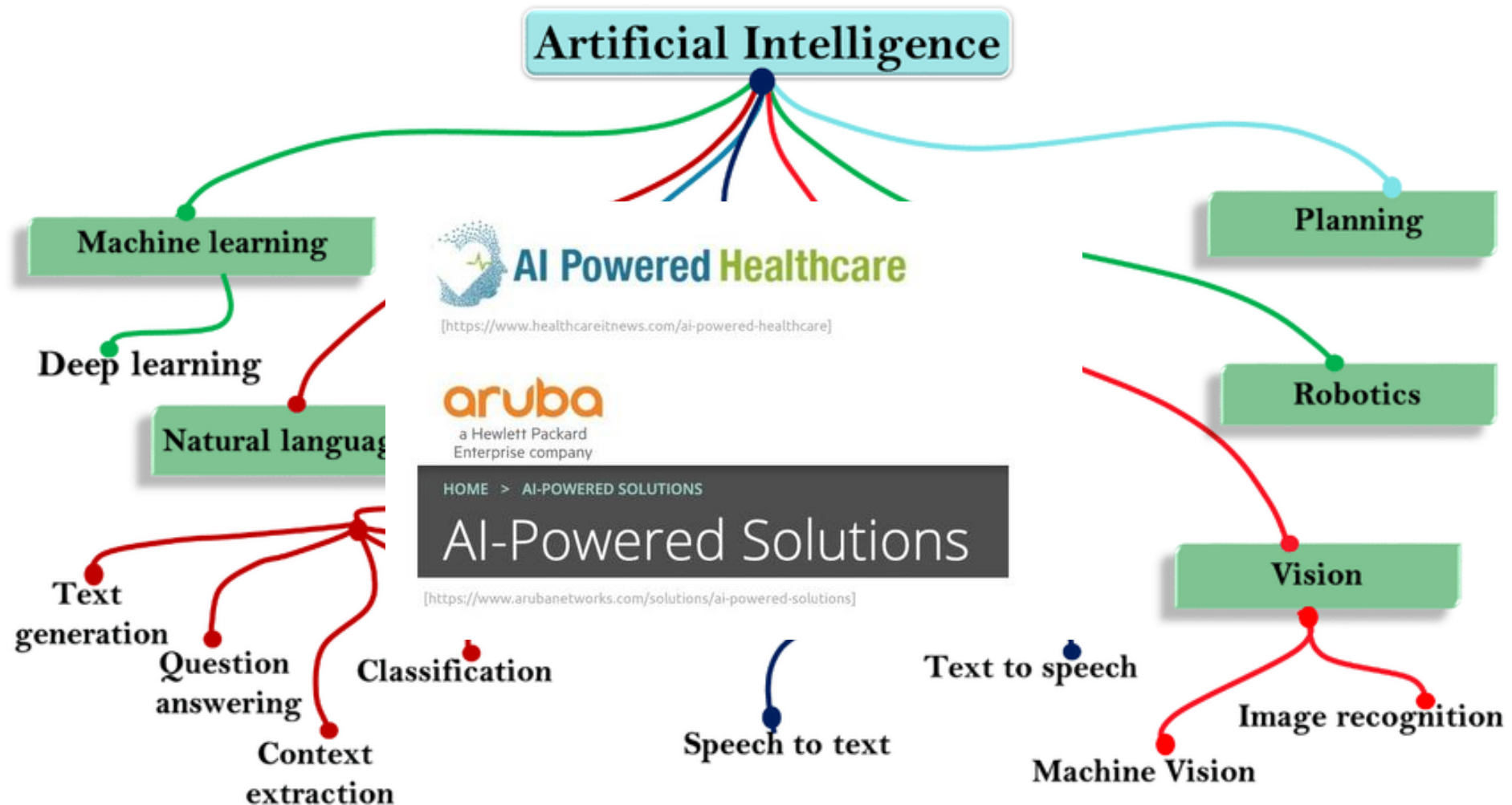


A newly re-invigorated form of machine learning, which is itself a subset of artificial intelligence, deep learning employs powerful computers, massive data sets, “supervised” (trained) neural networks and an algorithm called back-propagation (backprop for short) to recognize objects and translate speech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

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

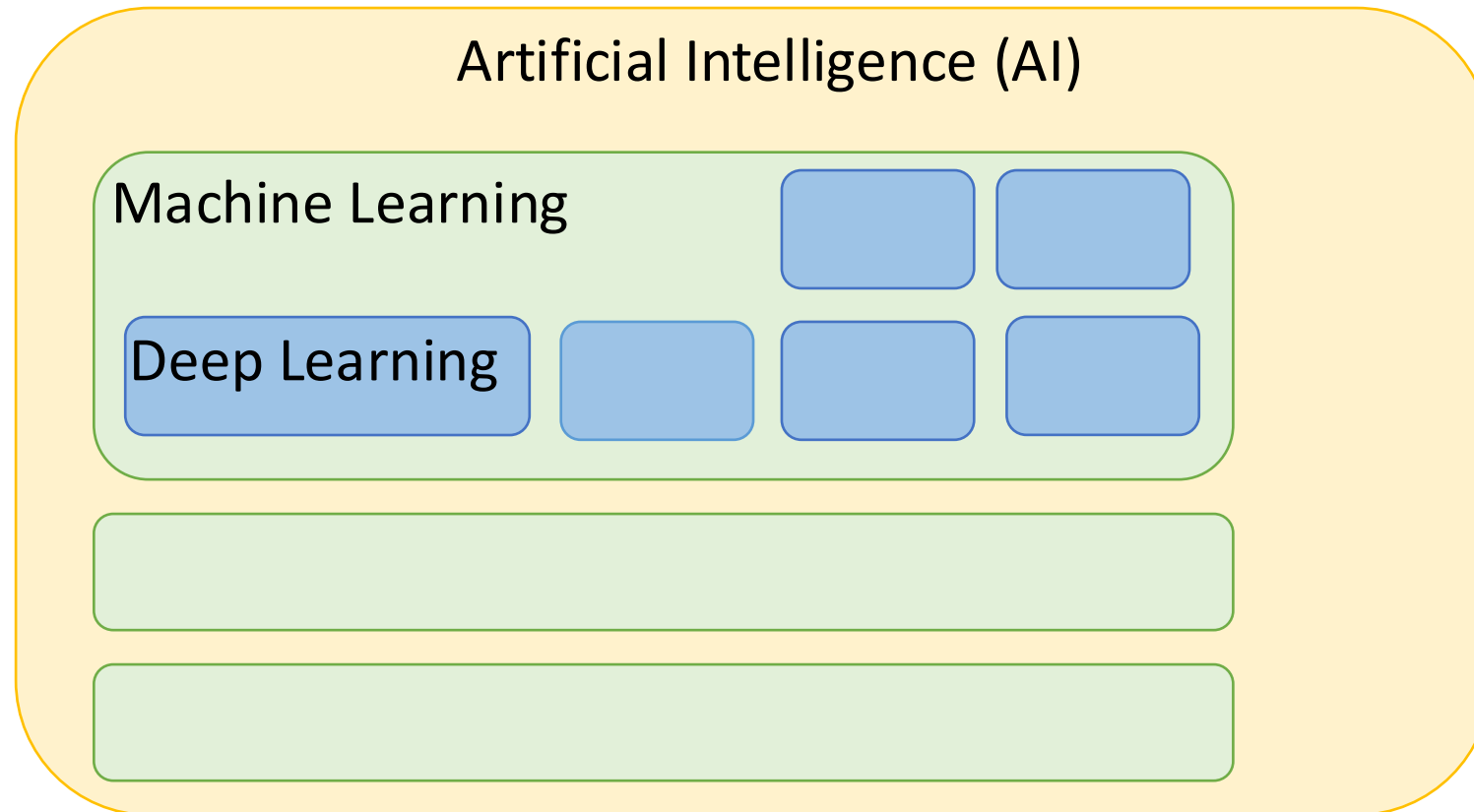
”Cooking?”

What is NOT Deep Learning

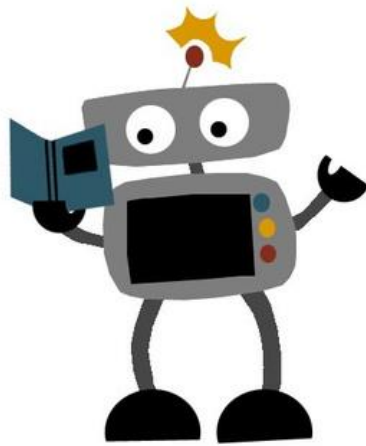


What is NOT Deep Learning?

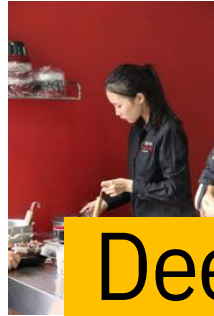
Deep Learning is NOT equivalent to AI



Recap



Input: X



Machine Learning

$$f(X) \rightarrow Y$$

Output: Y

"Cooking?"



Deep Learning is NOT equivalent to AI



Deep Learning DOES NOT mimic the brain!



Deep Learning

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



Questions?



Ice Breaker!

- 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?



<https://forms.gle/ufSws2Pxrt93ijt8>

Course Logistics

The Canvas Website

The screenshot shows the Canvas LMS interface for the course "CSCI1470/2470 Spring24 Deep Learning". The top navigation bar includes "2024 Spring", "Home", "Syllabus", "Media Library", "Quizzes", "Announcements", "Ed Discussion", "Gradescope", and "Assignments". The "Media Library" section is highlighted with a yellow box. The main content area displays the course title, a "Jump to Today" link, and an "Edit" button. Below the title, there is a welcome message and a paragraph about the course's focus on deep learning applications and ethical considerations. A second paragraph describes the course's practical approach to teaching deep learning concepts.

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
- Weekly quizzes

The Course Website



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

Brown Deep Learning Day!

- Course final project
- In-person mini conference!
- Poster sessions and presentations
 - Grouped by theme: e.g. vision, language, robotics, ...

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!

Week 1-4 Deep Learning Basics		Recording	Slides
1/24	Welcome to Deep Learning		
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		

Assignment logistics

- Assignments
 - Get stencils via Github Classroom
 - Submission via Gradescope
 - Due Wednesdays 10pm



Homework

- Homework 0 (will be released today!)
 - Review of relevant math and probability concepts
 - Setting up programming environment
 - Graded for completion only (**deadline Jan 29**)

Your UTAs!



Adam Lalani
he/him



Johnny Elias
he/him



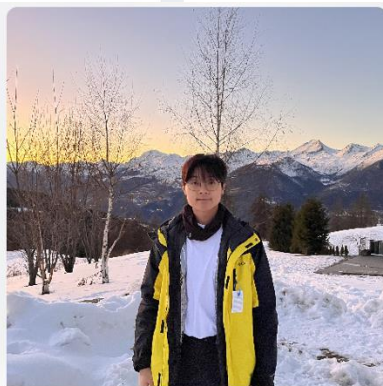
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Armaan Patankar
he/him



Bentzi Gitig
he/him



Dhruv Raghavan
he/him

Workshops and SRC Discussions

- SRC Discussion Sections focus on a variety of ethical issues in deep learning and how to overcome them.
- Workshops will important skills/applications of deep learning that we think are useful for working on your final project
 - How to read and implement an academic research paper
 - Other deep learning frameworks/tools
 - Applications (DL for biology, LLMs, theory, etc.)
- Each is an hour long with multiple time slots offered
- Required to attend 2 of each

Acknowledgements



Ritambhara Singh
(taught in Spring 2024)



Professor Chen Sun
(taught 2470 in Fall 2024)



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

Questions?

