

# Deep Learning (1470)

**Randall Balestriero**

**Jan 20th, 2026**




# Who Am I?

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- 2016 -> 2021  RICE
- 2021 -> 2023 **facebook** AI Research
- 2024 ->  BROWN
- 2025 ->  **Meta AI**

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- Theory everything!
- Foundation Models!
- World Models!
- Self Supervised Learning!
- Signal Processing!

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- Theory everything!
- Foundation Models!
- World Models!
- Self Supervised Learning!
- Signal Processing!
- Office Hours @ CIT453:
  - Monday: 11am to noon
  - Wednesday: 11am to noon

# Why Deep Learning?

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- What about you?
- No wrong answers!

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- -> edge cases everywhere, ugly code...
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- What about you?
- No wrong answers!



# Think Big!



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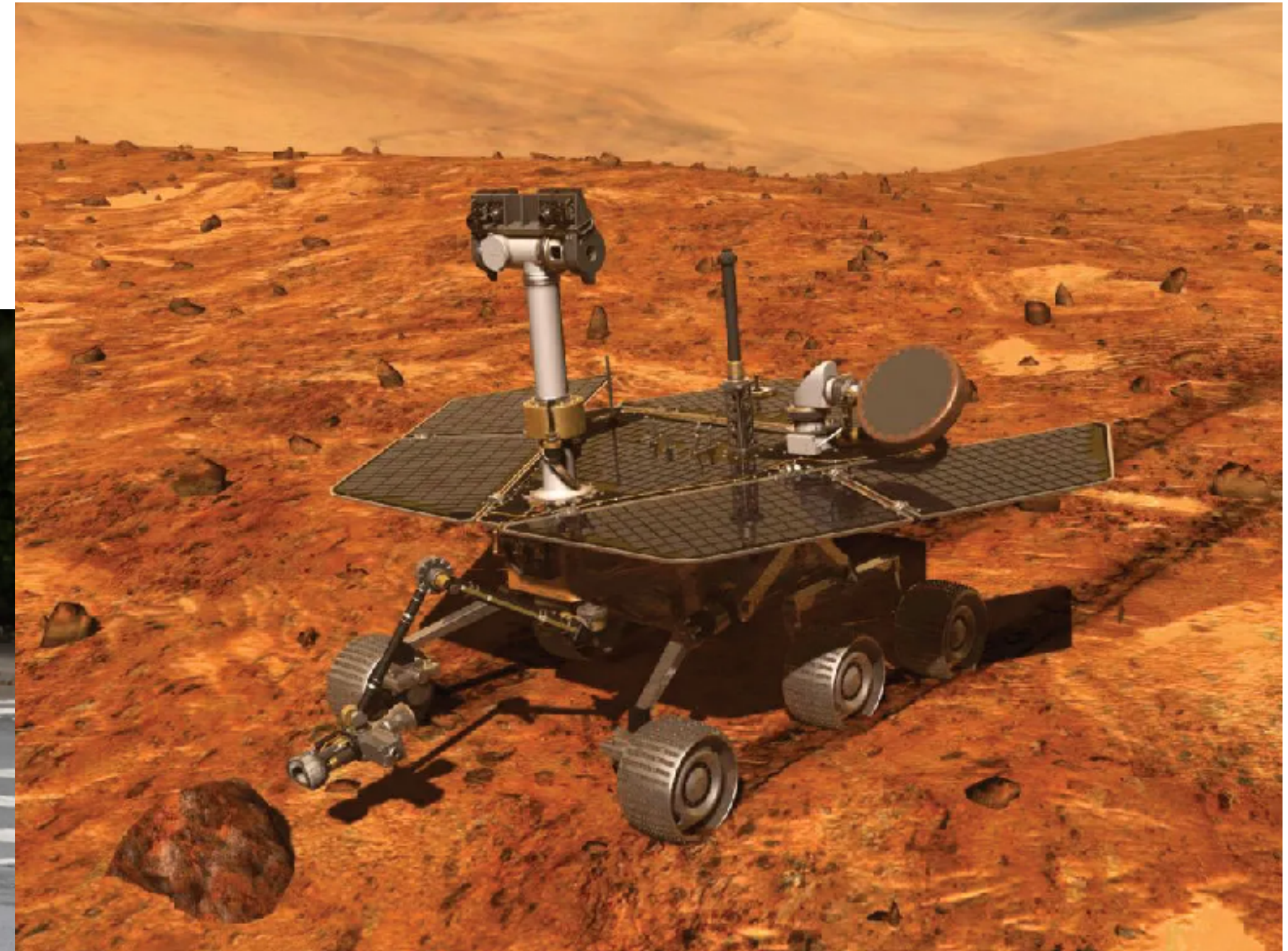


# Think Big!





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# Our goal is to show you the way!

- What is Deep Learning:
  - The models
  - The use-cases
  - The code
- How to iterate/debug
- How to approach a problem

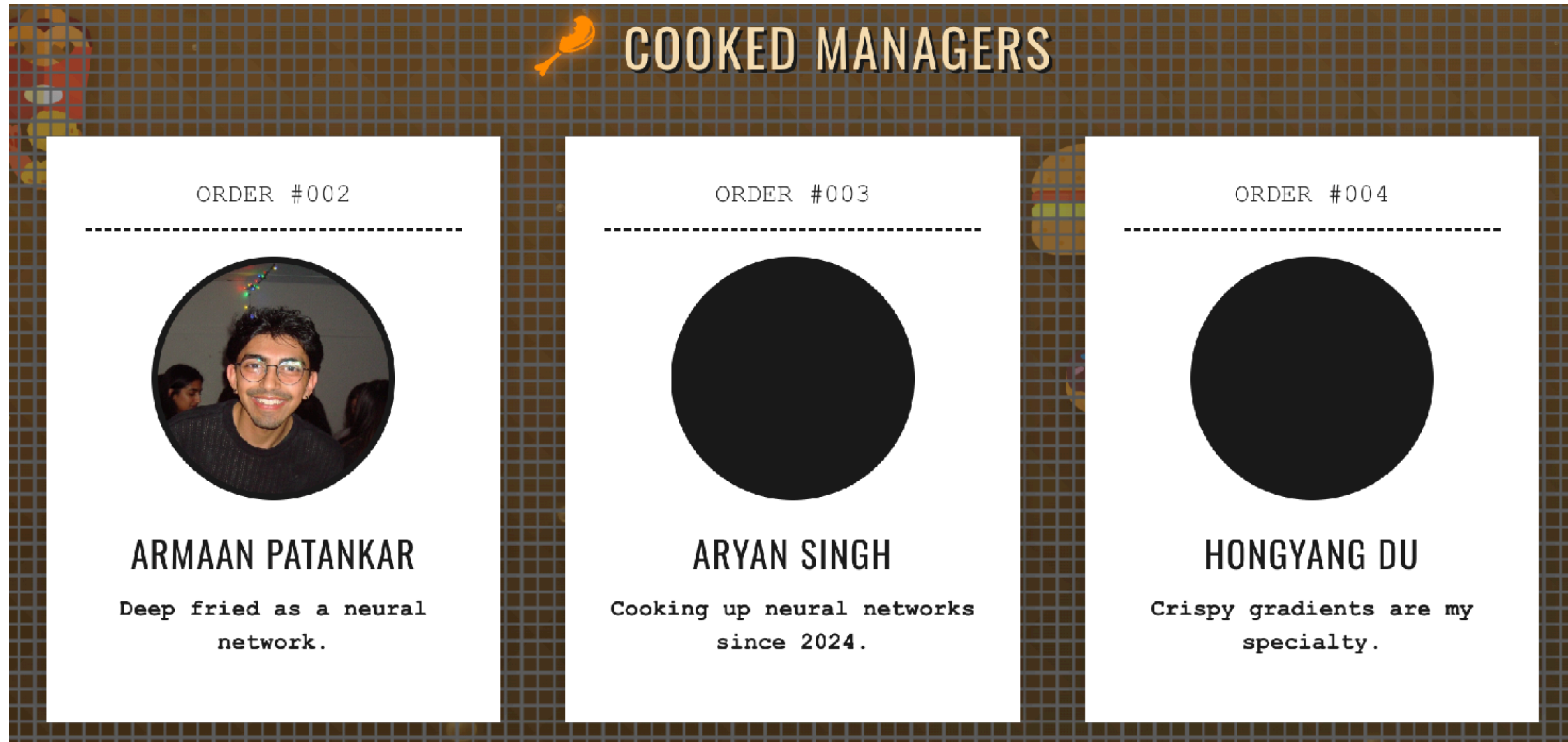
# Our goal is to show you the way!

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# How?

## Amazing HTAs





# How?

## And amazing TAs

ORDER #100



**JOHNNY ELIAS**

Crispy gradients are my specialty.

ORDER #101



**DURU HUSYENI**

Master of the deep fried descent.

ORDER #102



**JASON LIN**

Serving hot batches of tensors.

ORDER #103



**DANIEL ZHU**

Seasoning models with extra bias.

ORDER #104



**BUMJIN JOO**

Frying up features layer by layer.

ORDER #105



**PETER POPESCU**

Extra crispy loss functions only.

ORDER #106



**DEVESH KUMAR**

Grilling weights until they converge.



# How?

## And amazing materials

### Acknowledgements



Prof. Eric Ewing  
(last semesters)



Ritambhara Singh  
(taught in Spring 2024)



Professor Chen Sun  
(taught 2470 in Fall 2024)

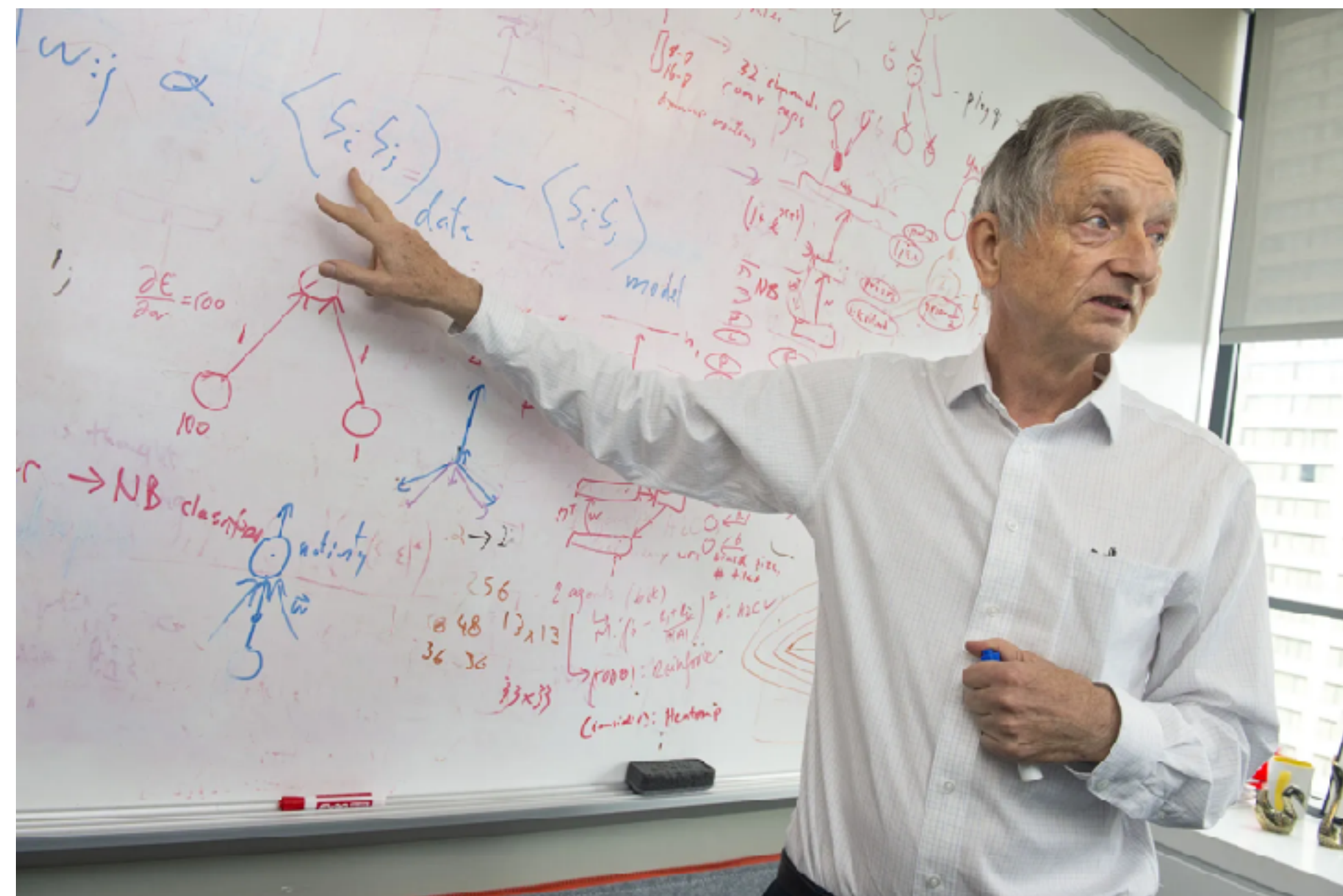


Original course material developed by  
Professor Daniel Ritchie and  
previous FABULOUS TA staff



# How?

## And making you “do” stuff!



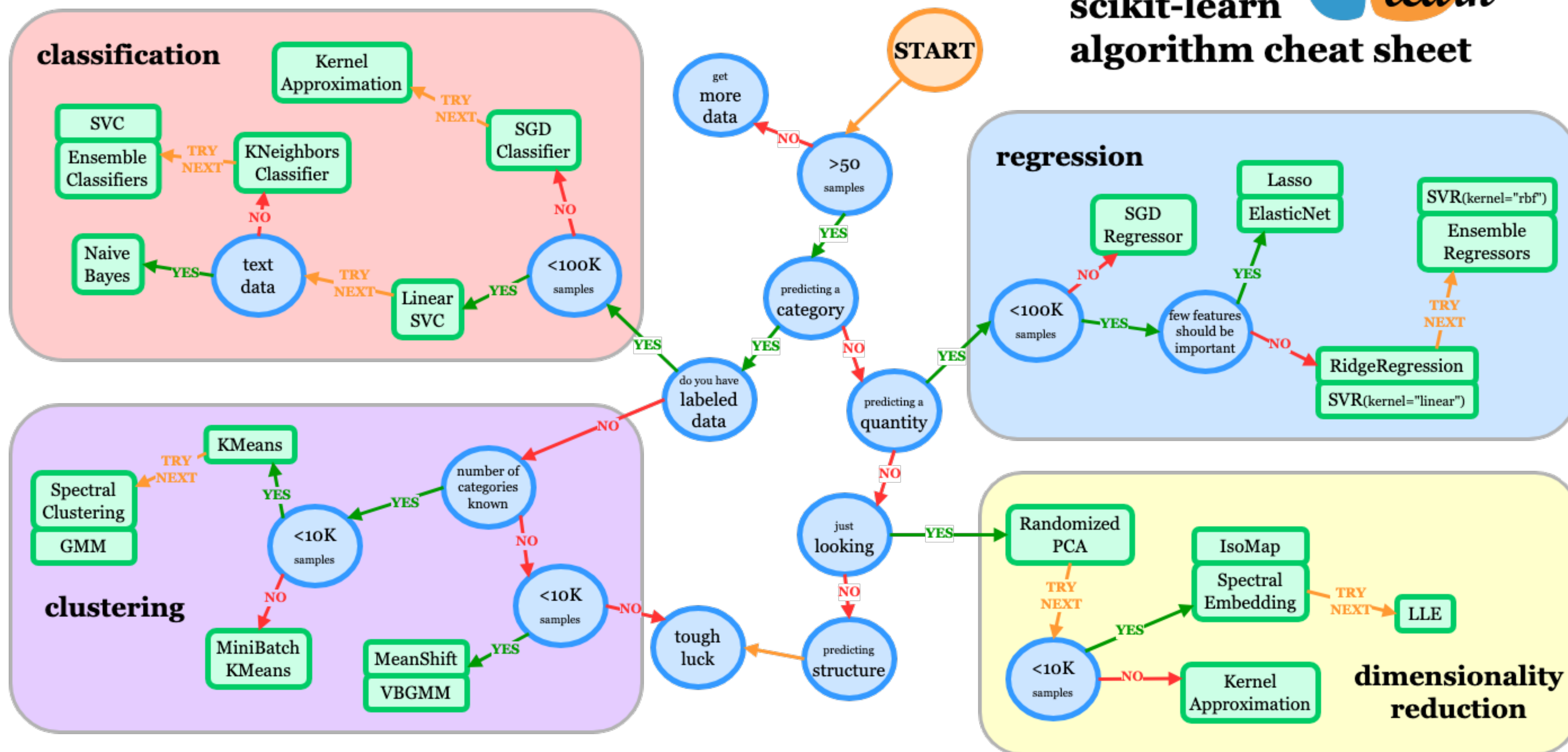
# Today's (light) Goals

- What is Machine Learning?
- What about Deep Learning?
- What is NOT Deep Learning?



# What is Machine Learning

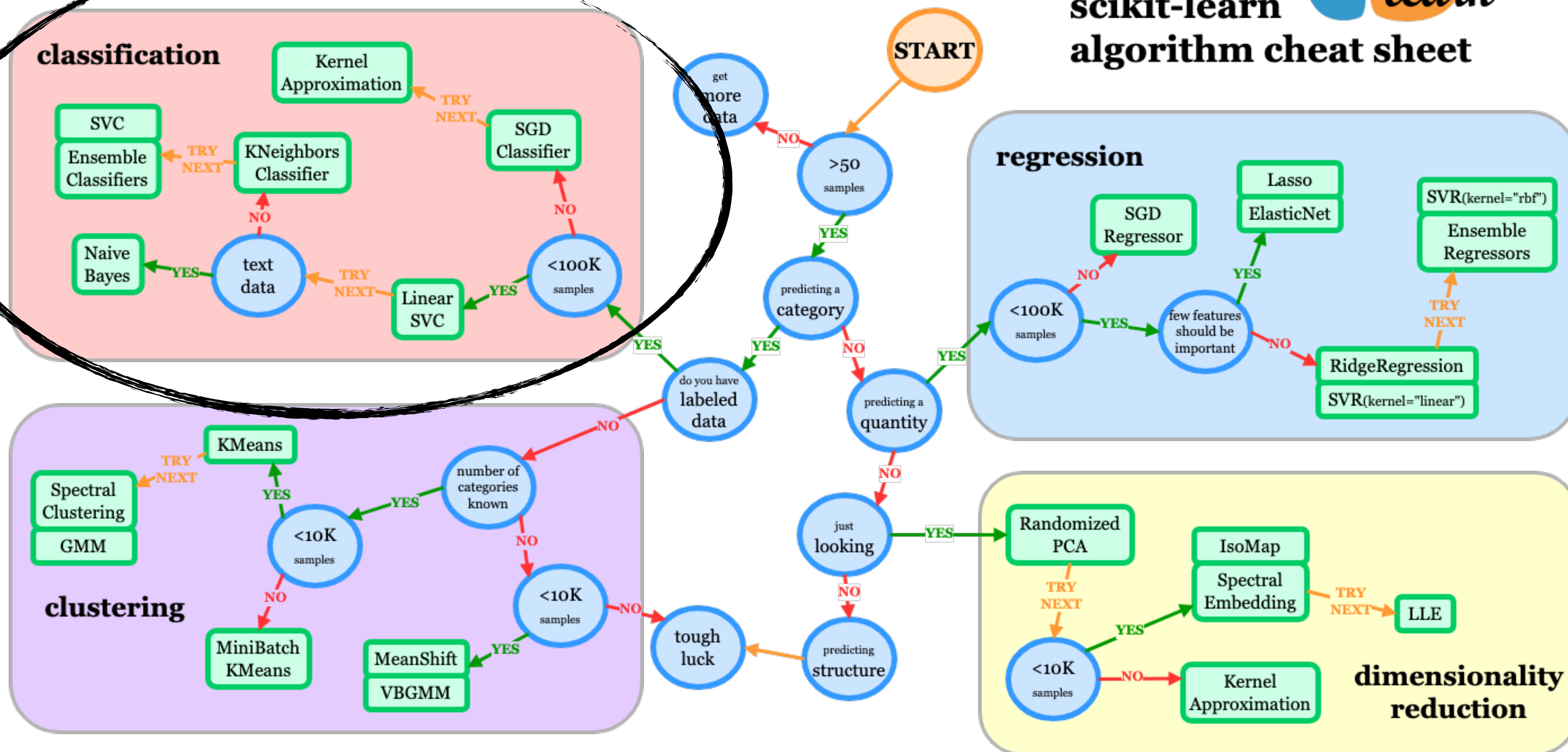
scikit-learn   
algorithm cheat sheet





# What is Machine Learning

scikit-learn  
algorithm cheat sheet



# What is Machine Learning/Supervised Learning

- You have a goal (task) in mind

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Input: X



Output: Y

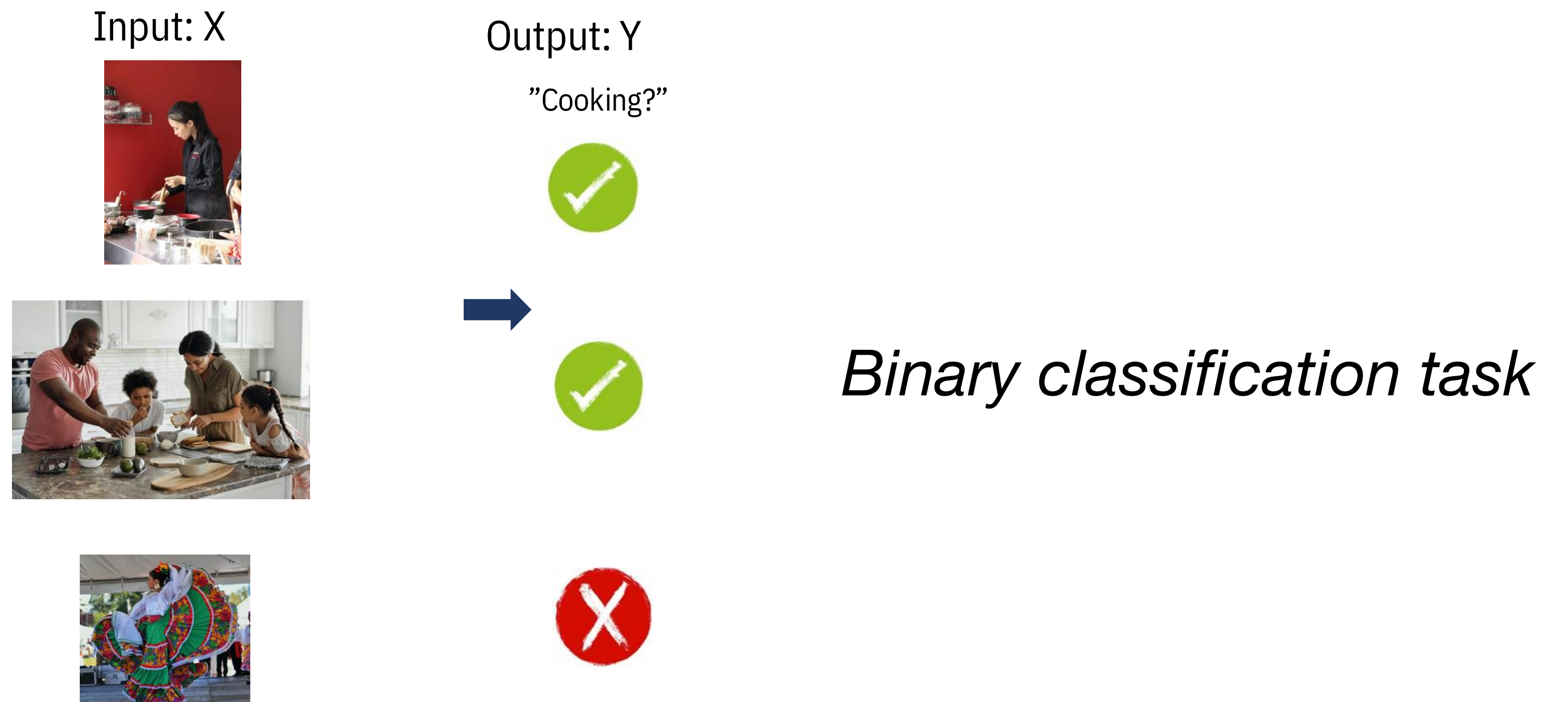
"Cooking?"





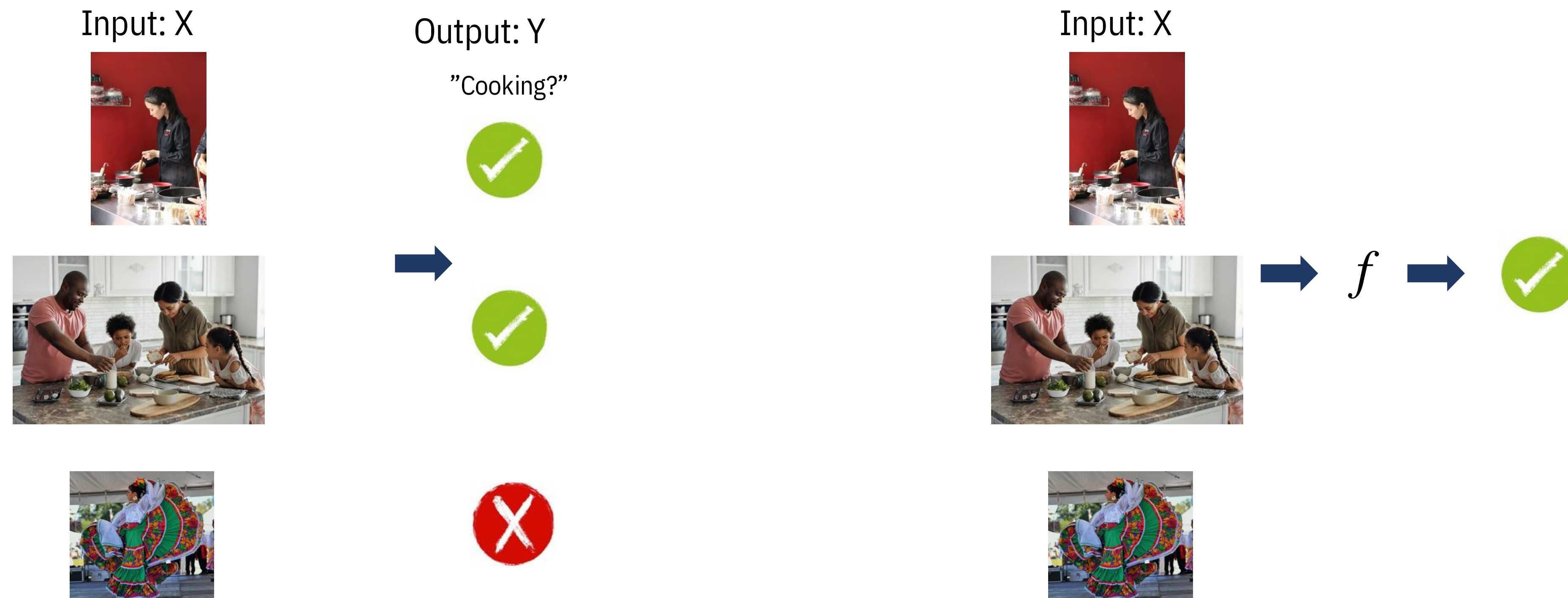
# What is Machine Learning/Supervised Learning

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# What is Supervised Learning

- You have a goal (task) in mind



# What is Supervised Learning

- The function/algorithm  $f$  is learned from many paired samples

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- The function/algorithm  $f$  is learned from many paired samples
- The same principle works for any supervised task



Input: X

I do not want  
sour cream in my  
burrito



Learned  
function:  $f$



Output: Y

No quiero crema  
agrea en mi  
burrito

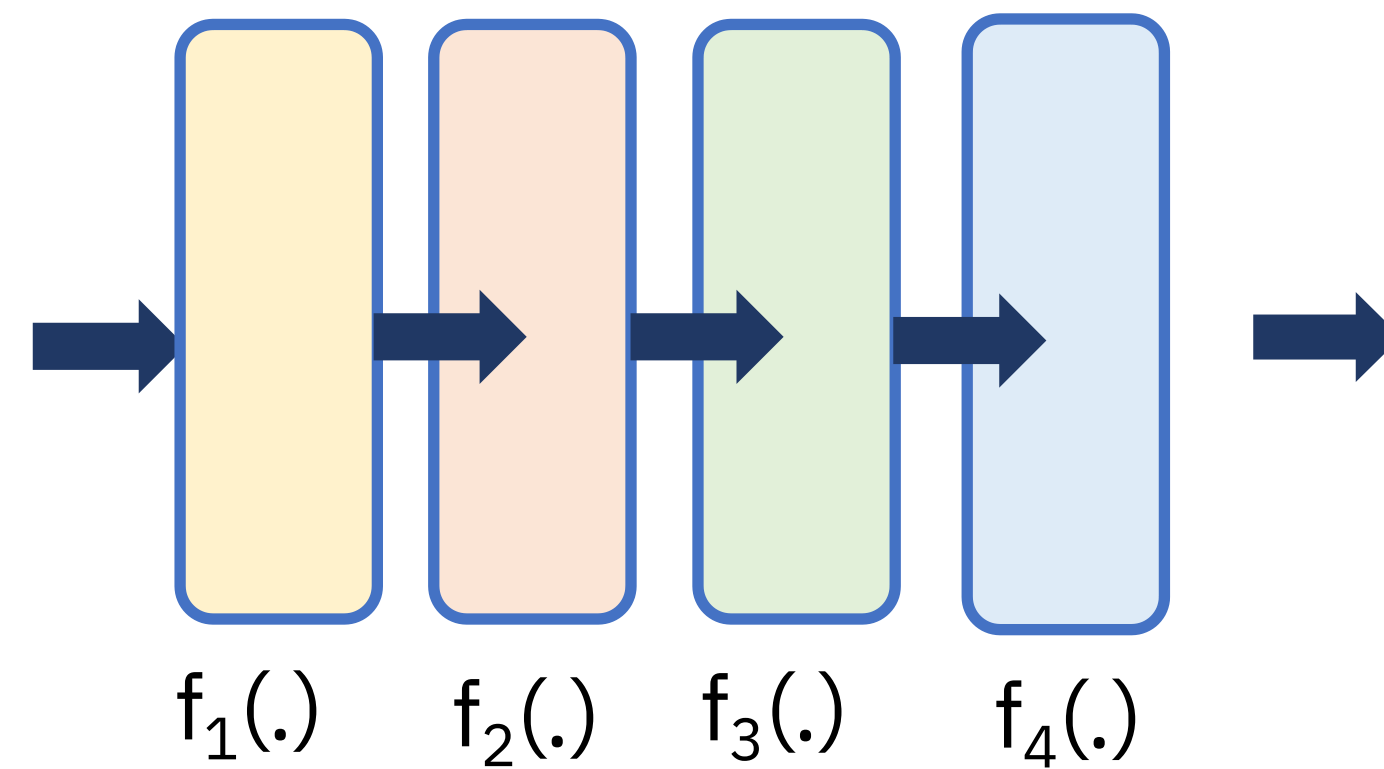


# **What is Deep Learning?**

# What is Deep Learning?

- It is a particular choice of  $f$

Input: X



Output: Y

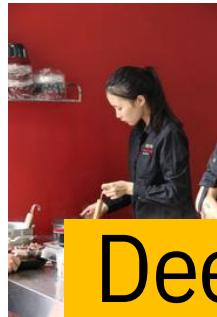
"Cooking?"



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

# What is NOT Deep Learning?

Input: X

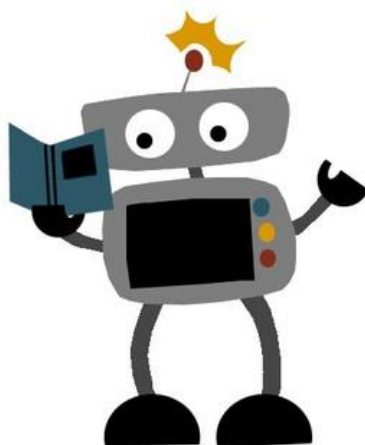


Machine Learning

$$f(X) \rightarrow Y$$

Output: Y

"Cooking?"



Deep Learning is NOT equivalent to AI



Deep Learning DOES NOT mimic the brain!

Deep Learning

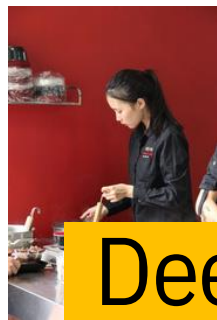


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# What is NOT Deep Learning?

Input: X



Machine Learning

$$f(X) \rightarrow Y$$

Output: Y

"Cooking?"



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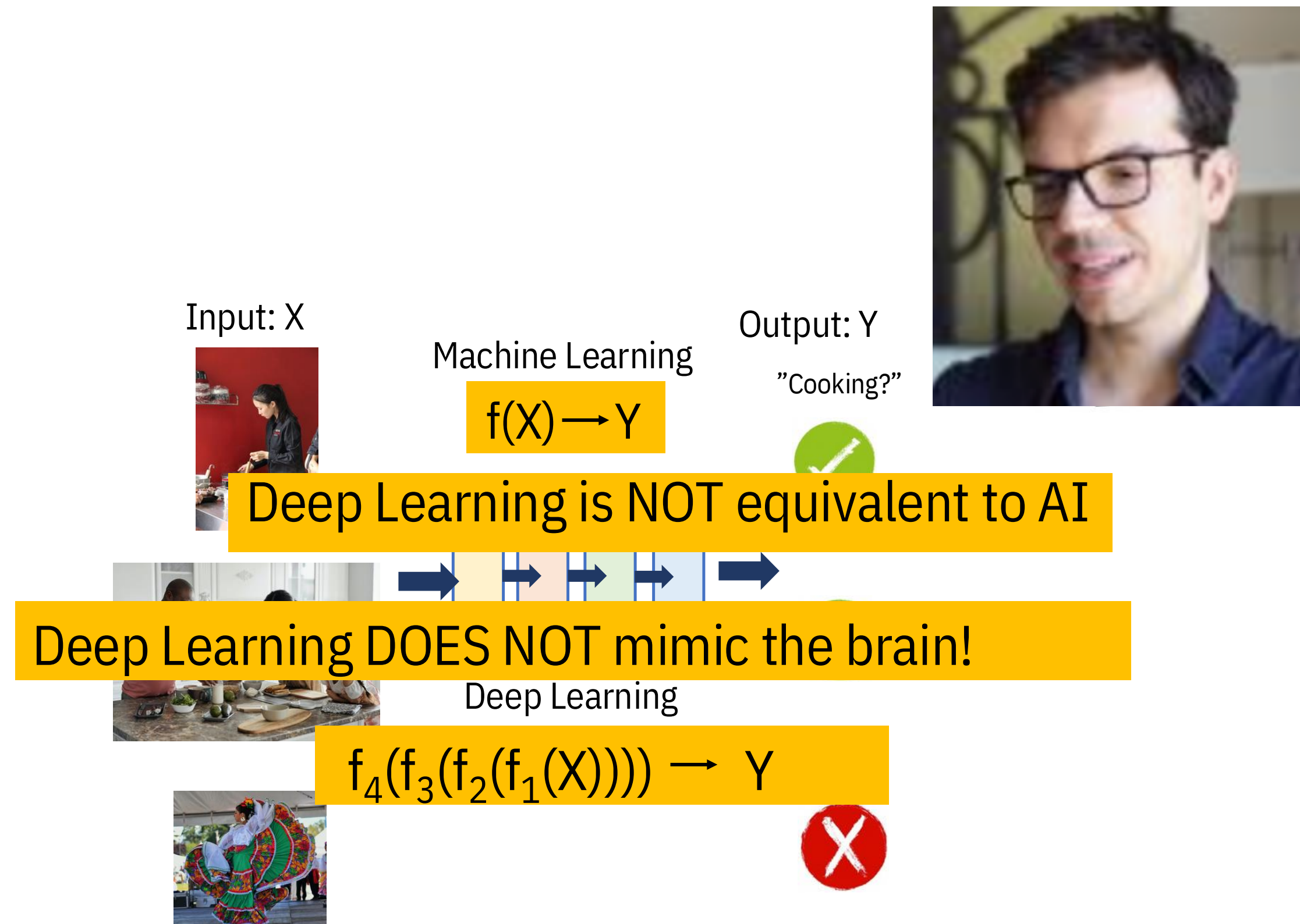
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Deep Learning

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



# What is NOT Deep Learning?



No AI without Deep Learning

Strong alignment between Deep Learning models and Human brain activation patterns

Many “old-school” algorithm can be written as Deep Learning models

**Questions?**

Turing Award Winner?



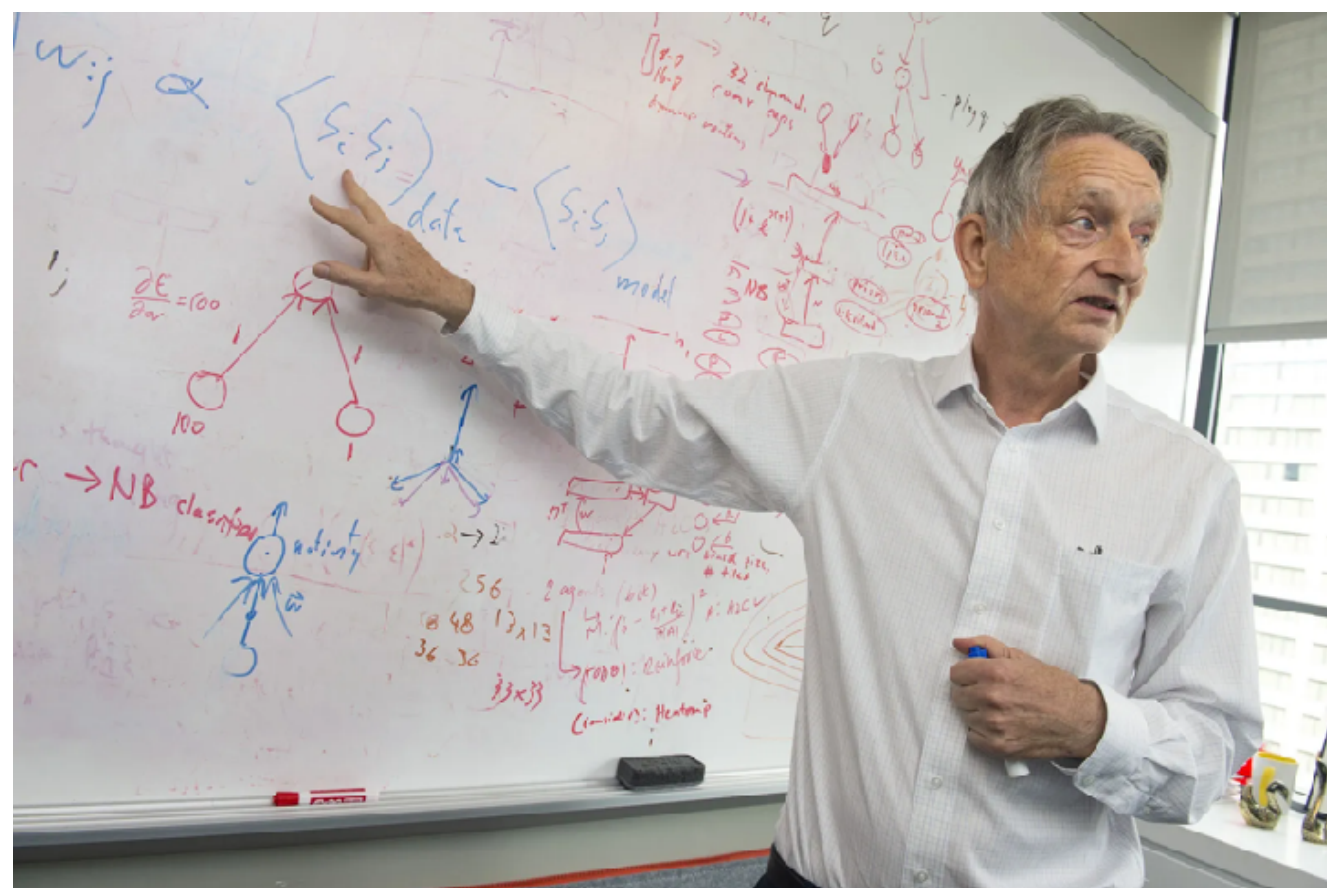
# Turing Award Winner?



Yes



Yes



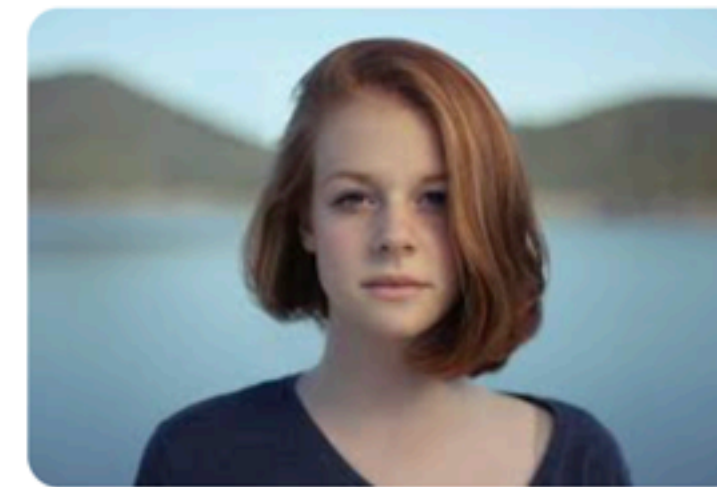
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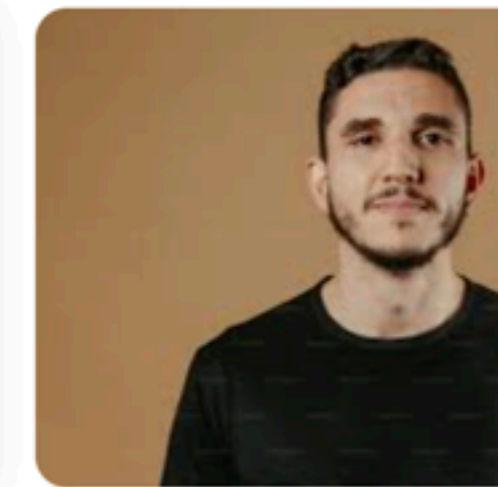
Yes



Unsplash  
Random People Pictures | Download Fr...



Unsplash  
Random People Pic...

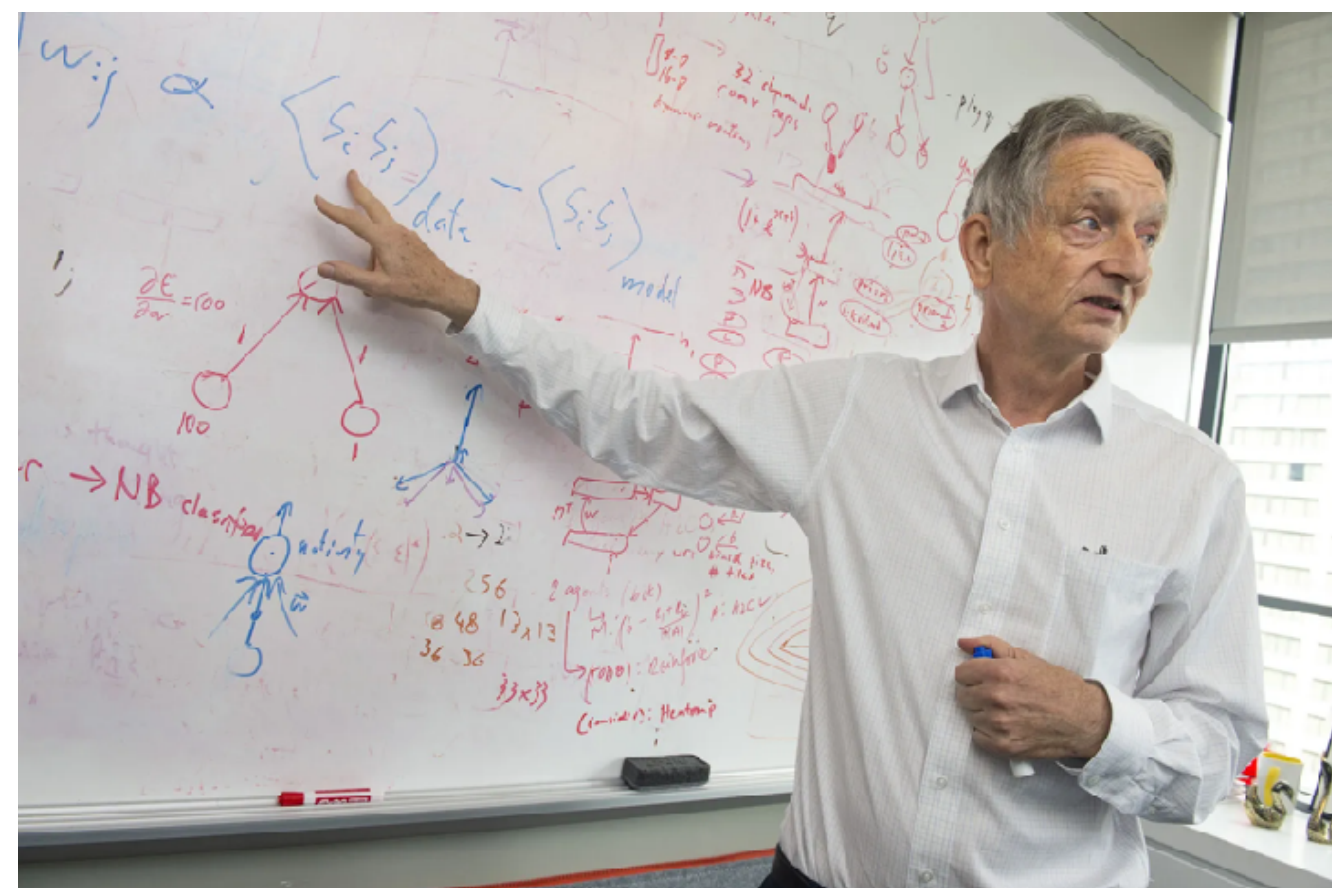
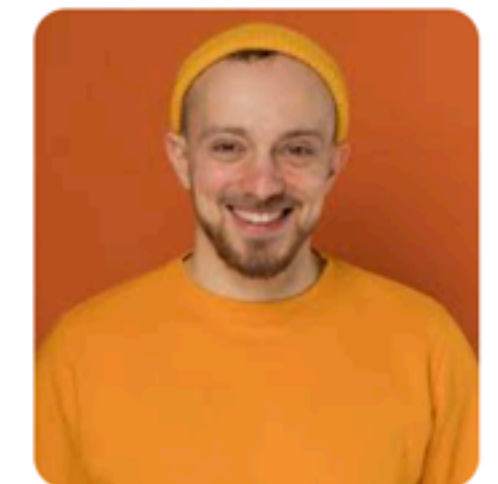


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1000+ Random Person Pic

No



Yes



Yes



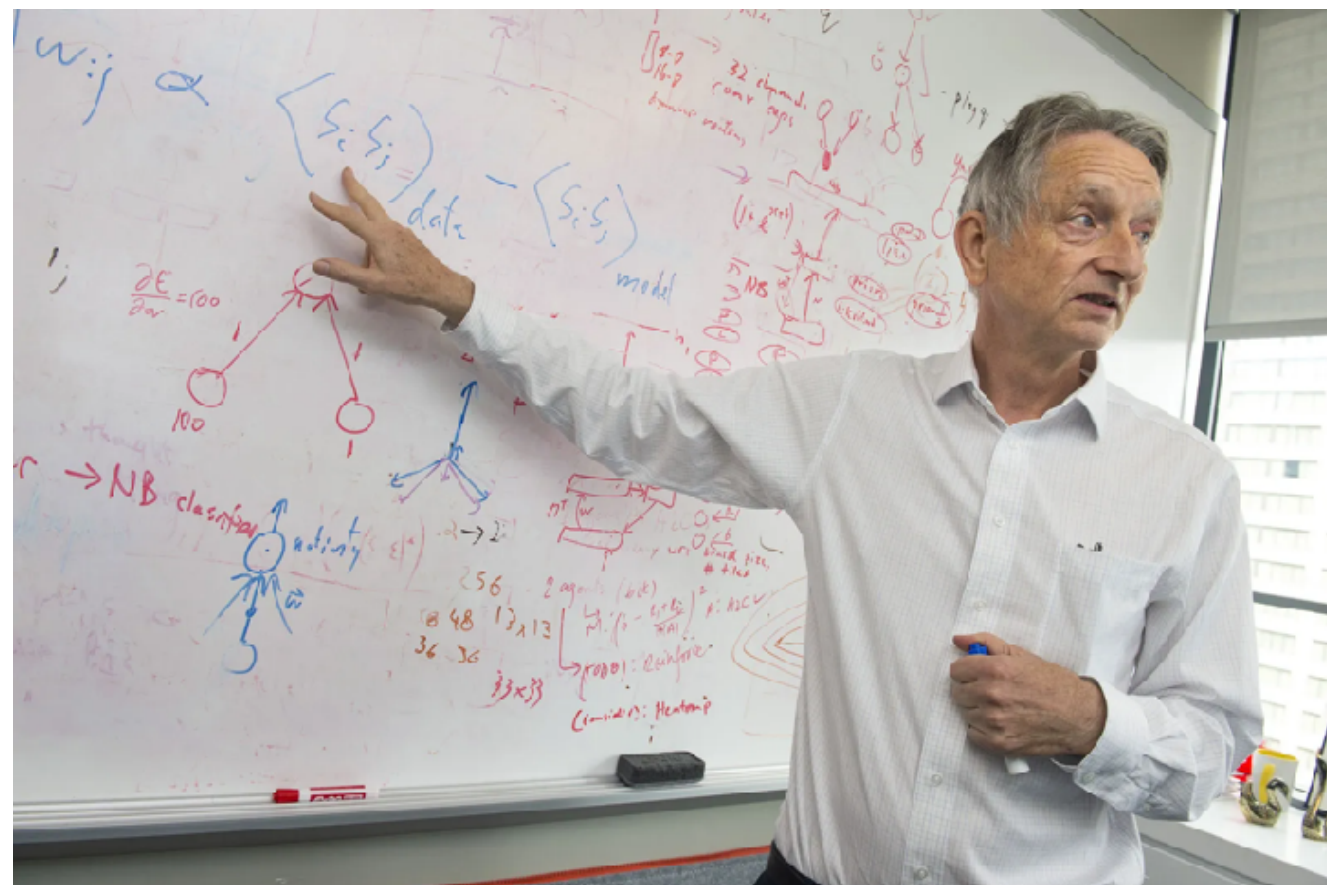
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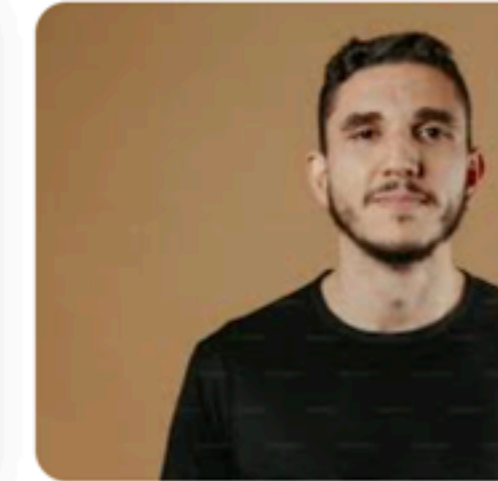
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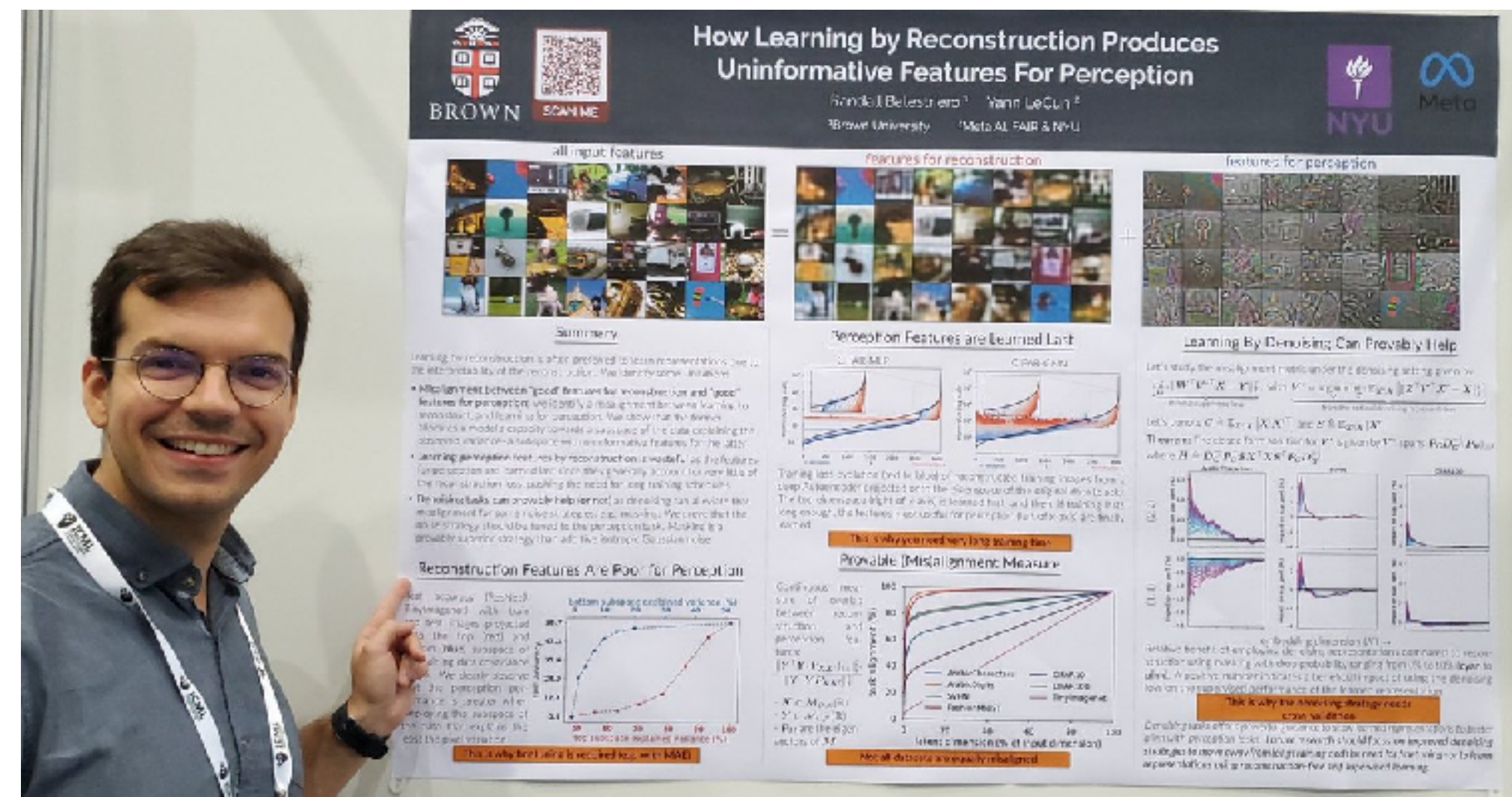
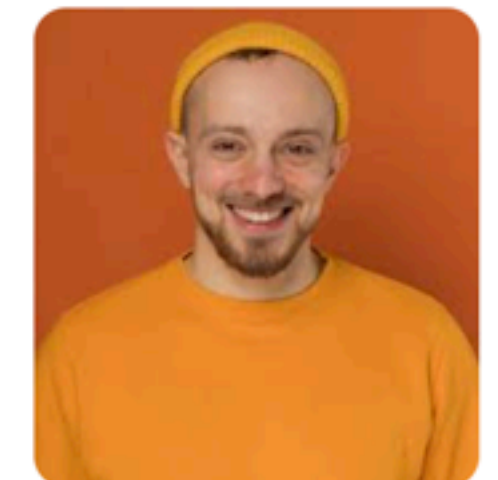


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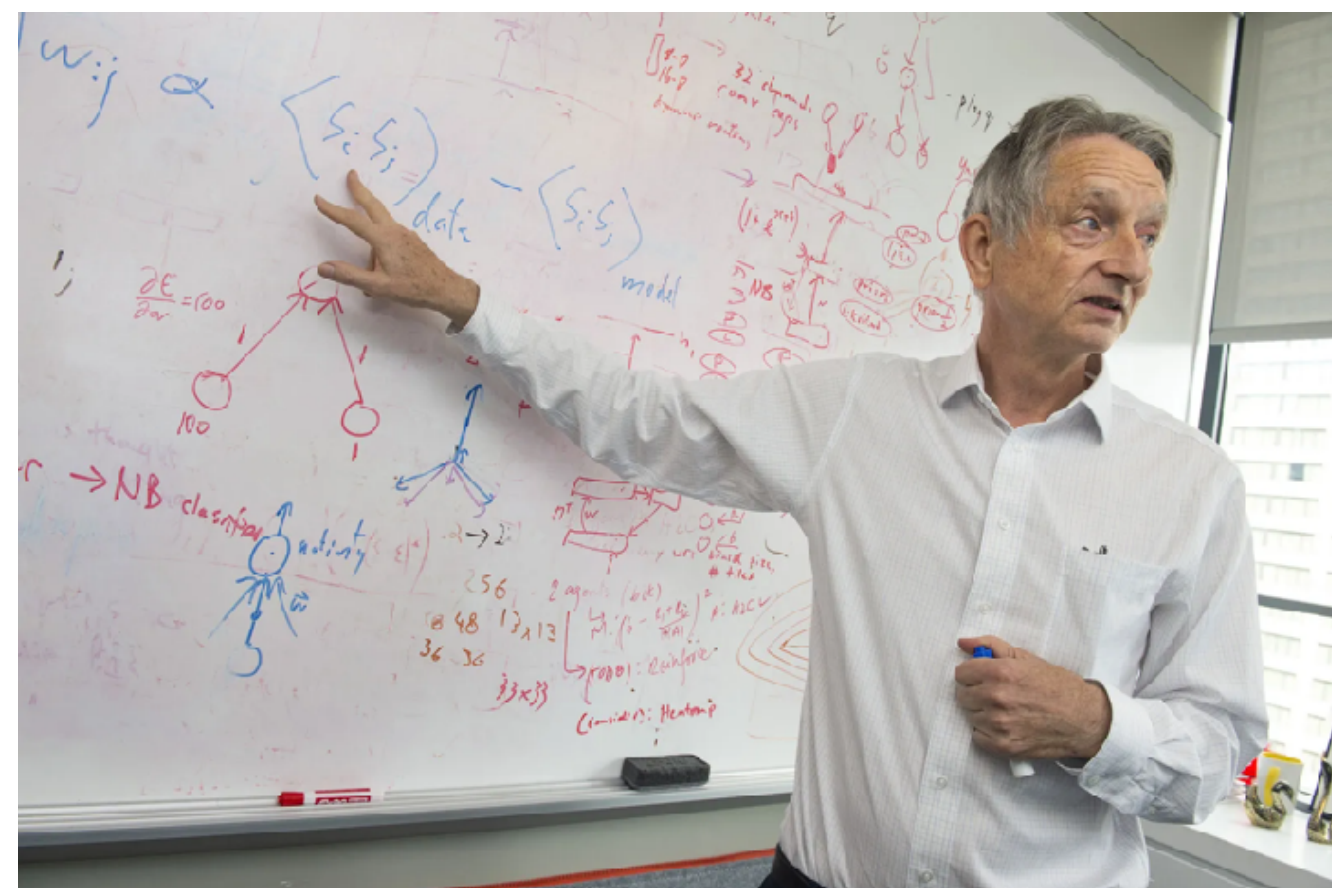
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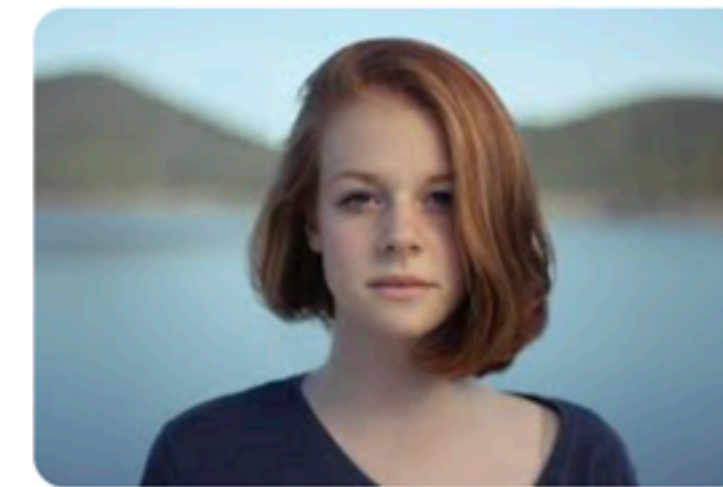
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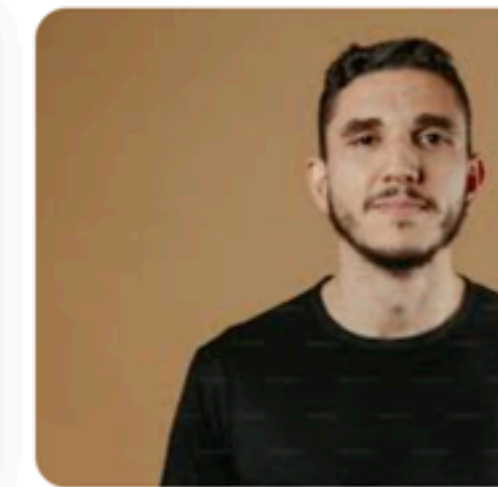
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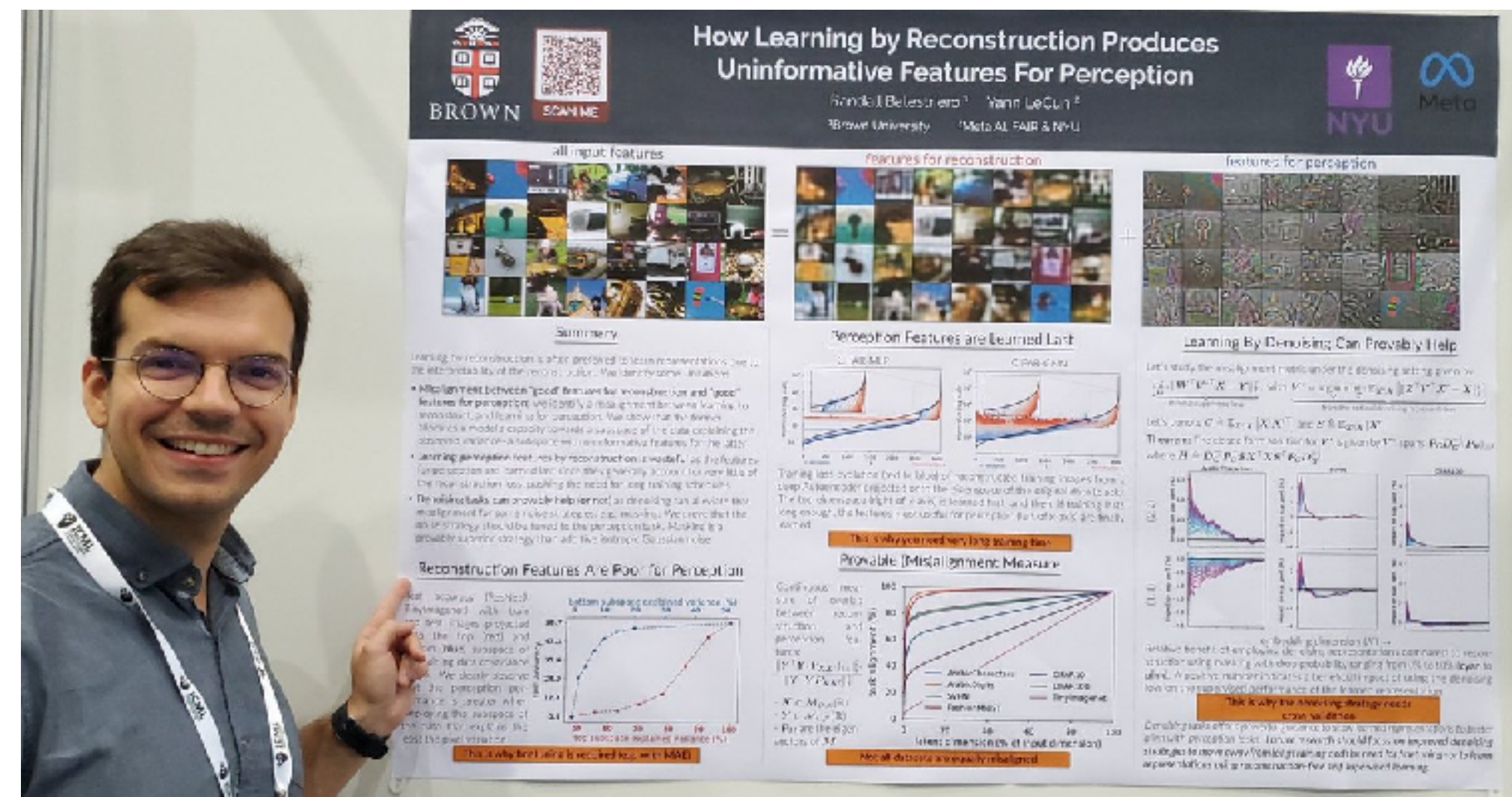
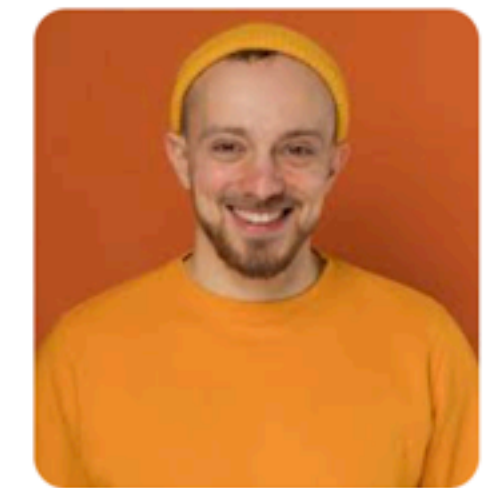


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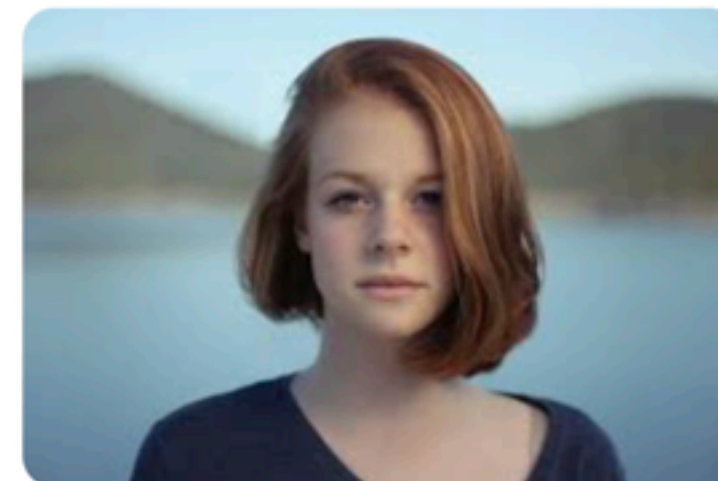
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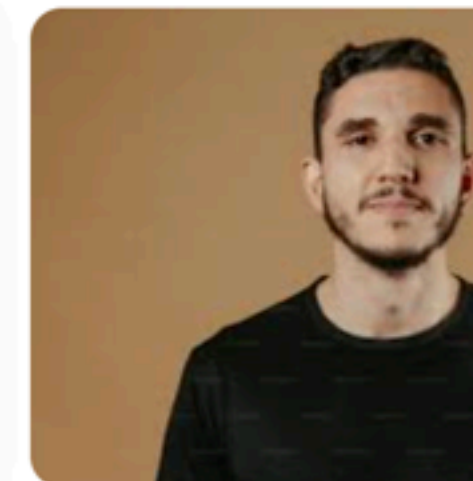
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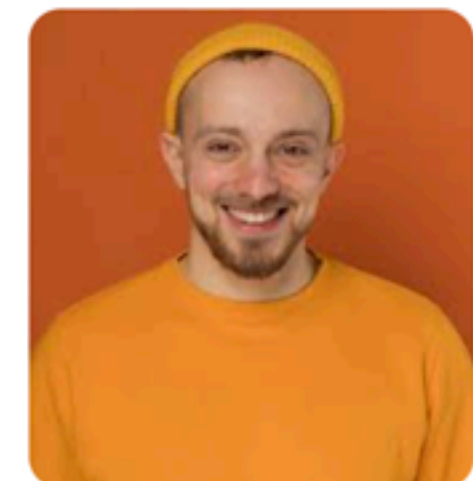


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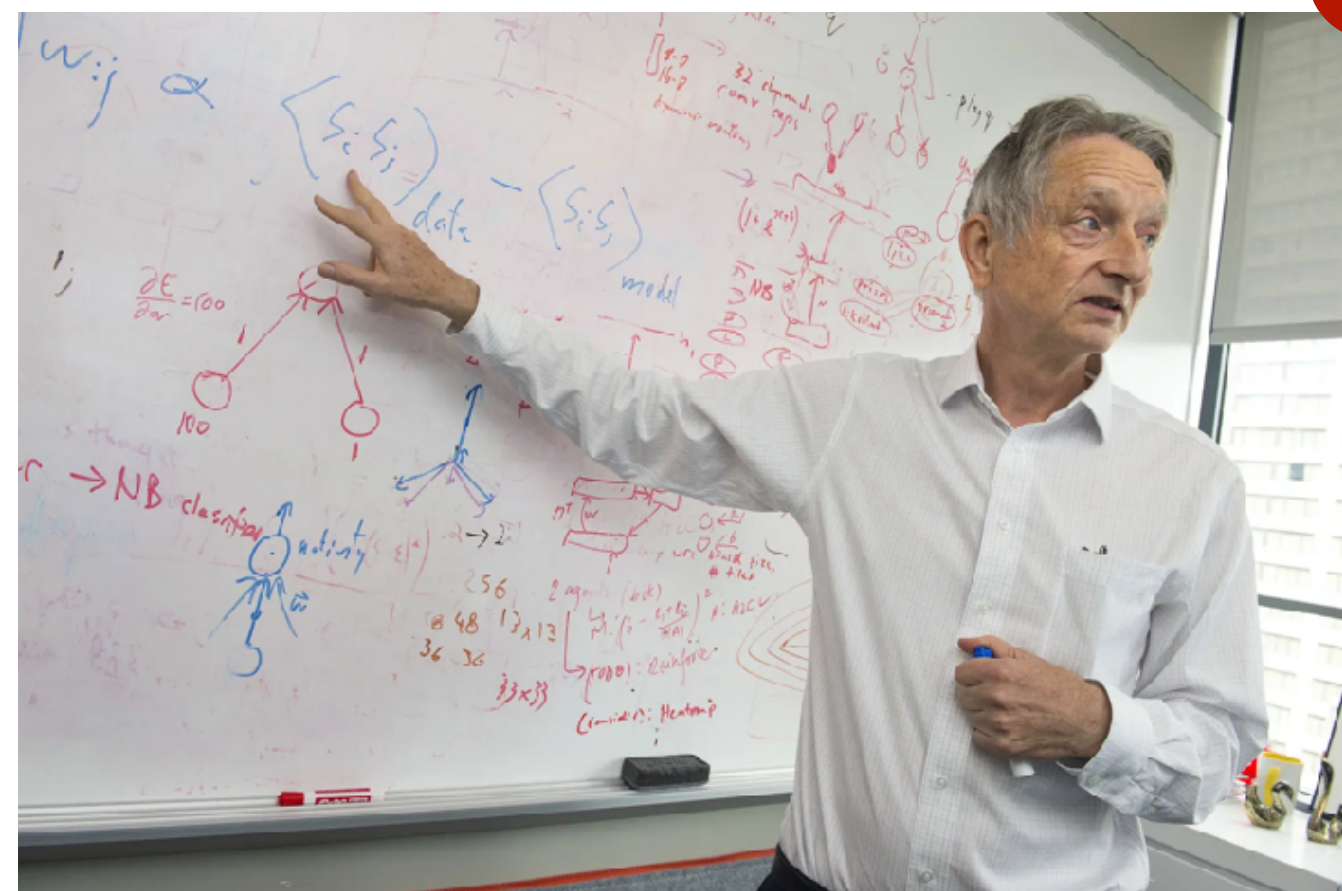
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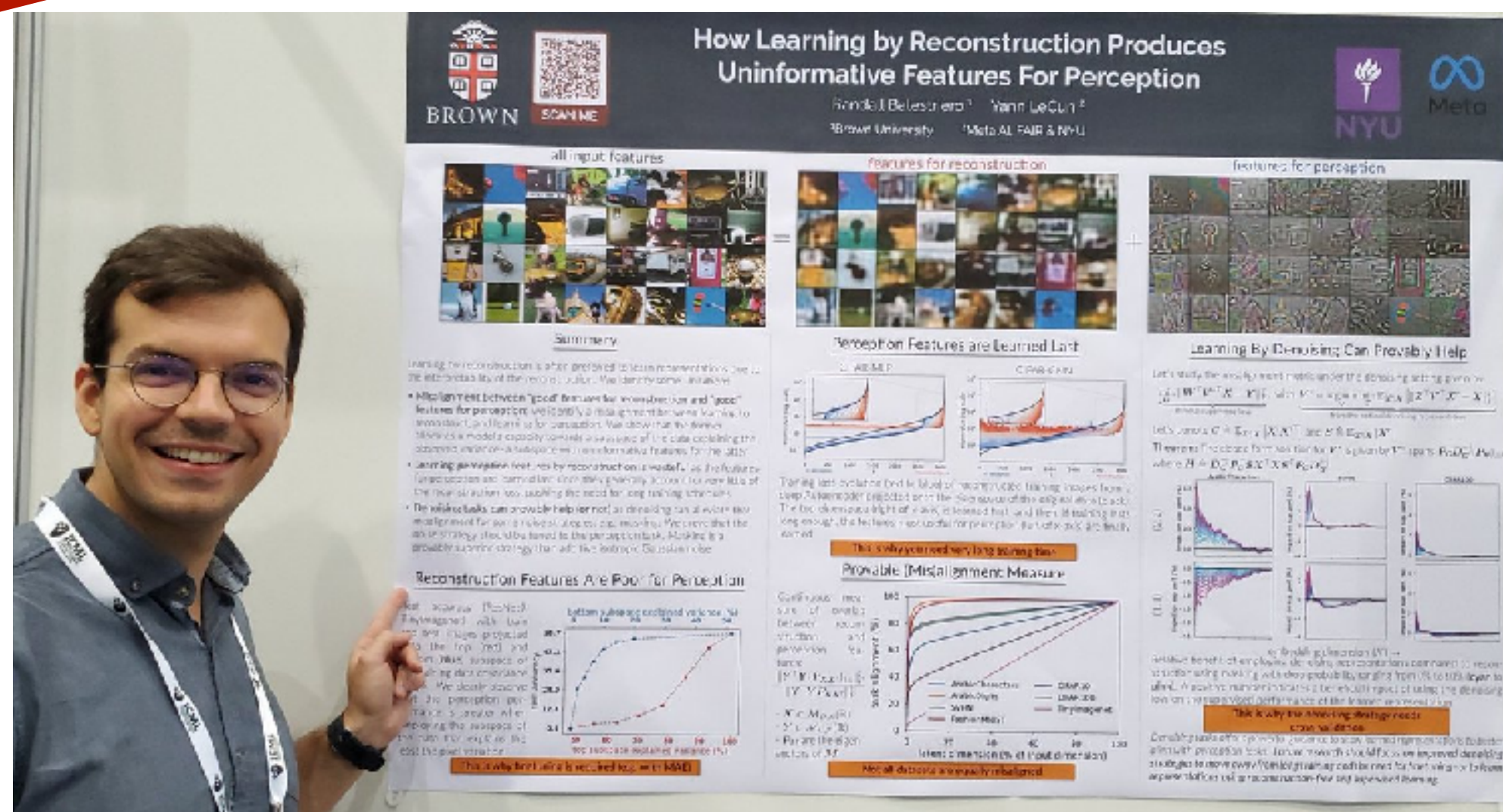
Yes



Spurious Correlations!



Yes



Yes!



# Logistic Details: Canvas

The screenshot shows a Canvas LMS course page. On the left is a navigation sidebar with links: Home, Syllabus, Media Library, Quizzes, Announcements, Ed Discussion, Gradescope, and Assignments. The 'Media Library' link is highlighted with a yellow box. The main content area has the course title 'CSCI1470/2470 Spring24 Deep Learning' at the top, followed by a welcome message and a paragraph about the course's focus on deep learning applications and ethical considerations. At the top right of the main area are links for 'Jump to Today' and an 'Edit' button.

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



# Logistic Details: Website



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

# Logistic Details: Classes

- 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		
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	



# Logistic Details: HW + Grading

- Homework 0 released today
  - Review of relevant math and probability concepts
  - Setting up programming environment
  - Graded for completion only
- Assignments
  - Get stencils via Github Classroom
  - Submission via Gradescope
  - Due Wednesdays 10pm





# Logistic Details: HW + Grading

- SRC Discussion sections focus on societal impact of deep learning and AI
- Workshop focus on skills/applications of deep learning that are useful for your final project (and your future you)
  - How to read/reproduce academic research paper
  - Write your own visualization tooling
  - Applications (finance, biology, medical)
- Each is an hour long with many time slots offered
- Requires to attend 2 of each

# 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)

Questions?







Brainstorm with the person seating next to you: what do you want to solve?