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Basics of AI: what you need to know

Dr. Katie Stolee
Associate Professor
Department of Computer Science
North Carolina State University

Computer Science is Everywhere

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Medicine and Global Health

Education

Energy and Sustainability

Scientific Discovery

Security and Privacy

Transportation

Technology for Development

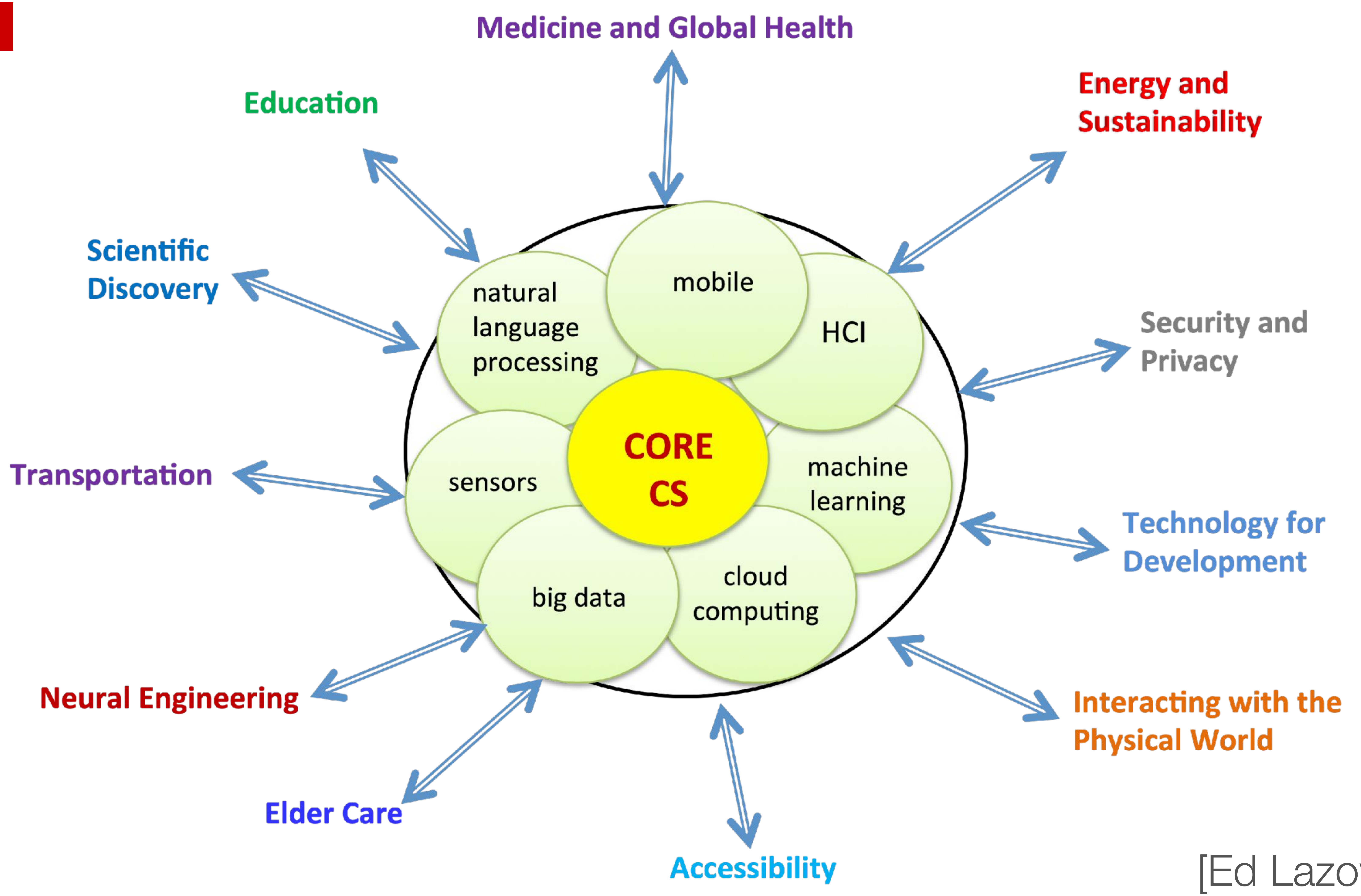
Neural Engineering

Interacting with the Physical World

Elder Care

Accessibility

[Ed Lazowska]


Medicine and Global Health
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Accessibility
natural language processing
mobile
HCI
sensors
CORE CS
machine learning
big data
cloud computing

[Ed Lazowska]

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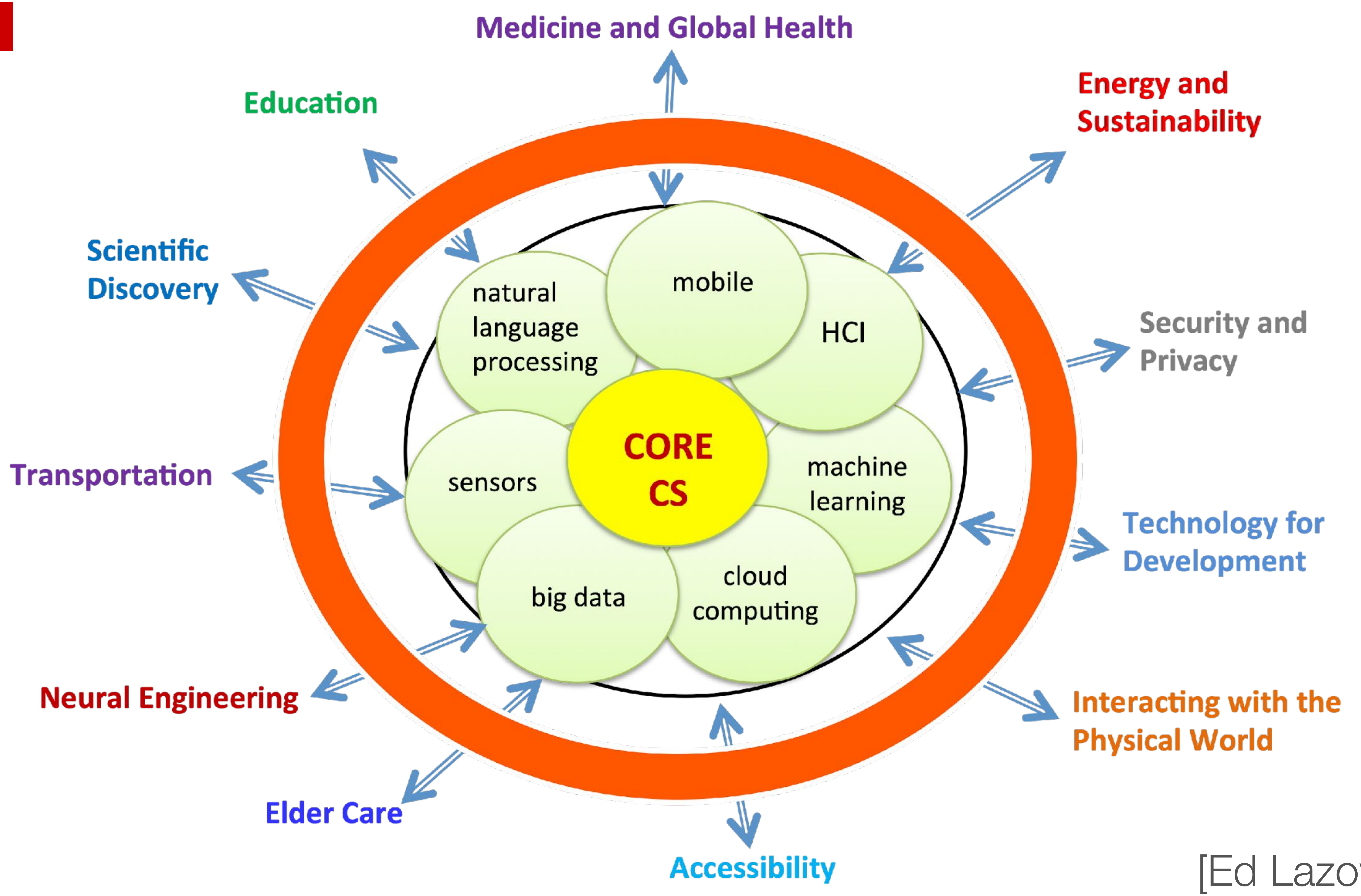

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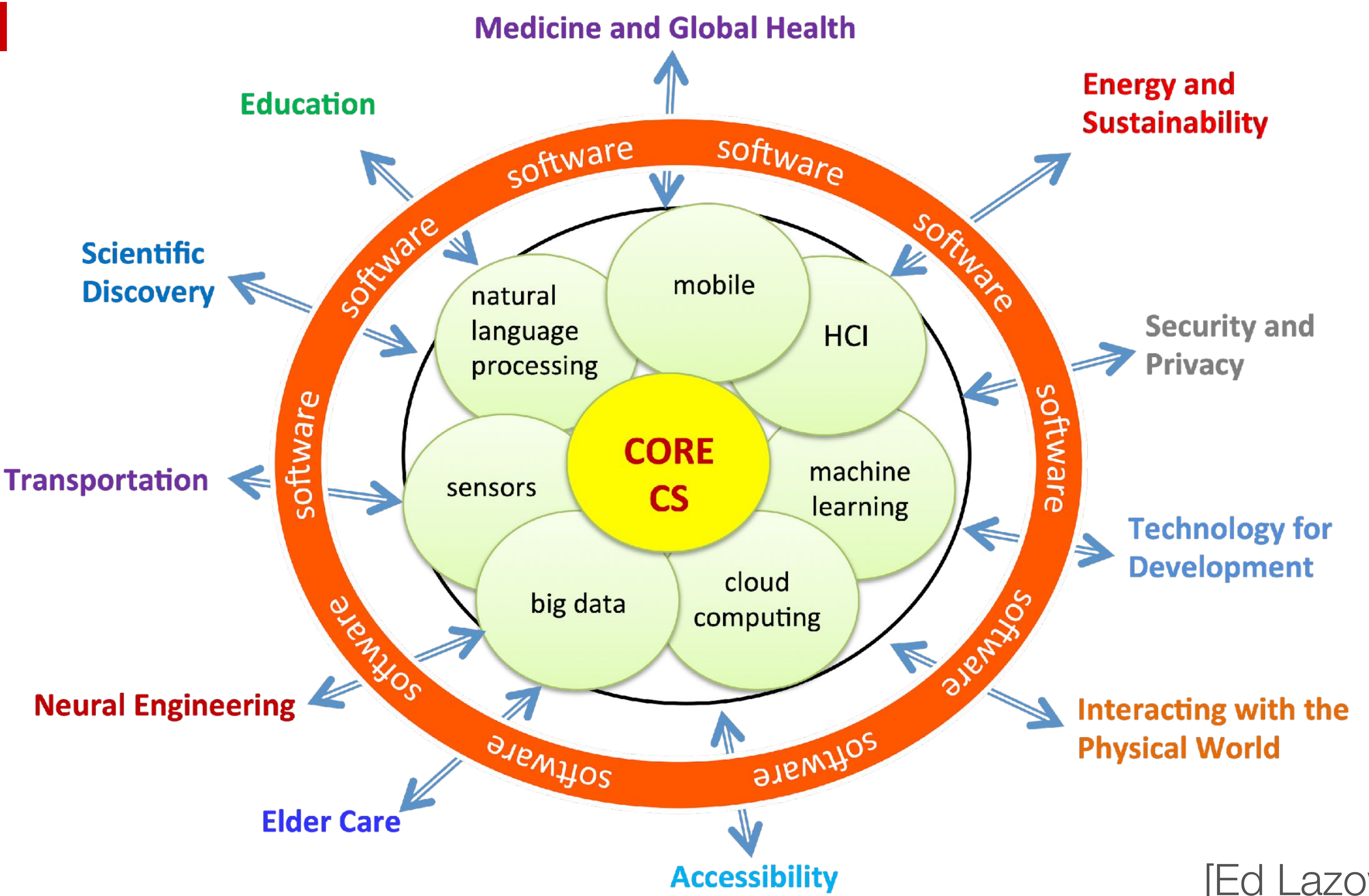

[Ed Lazowska]

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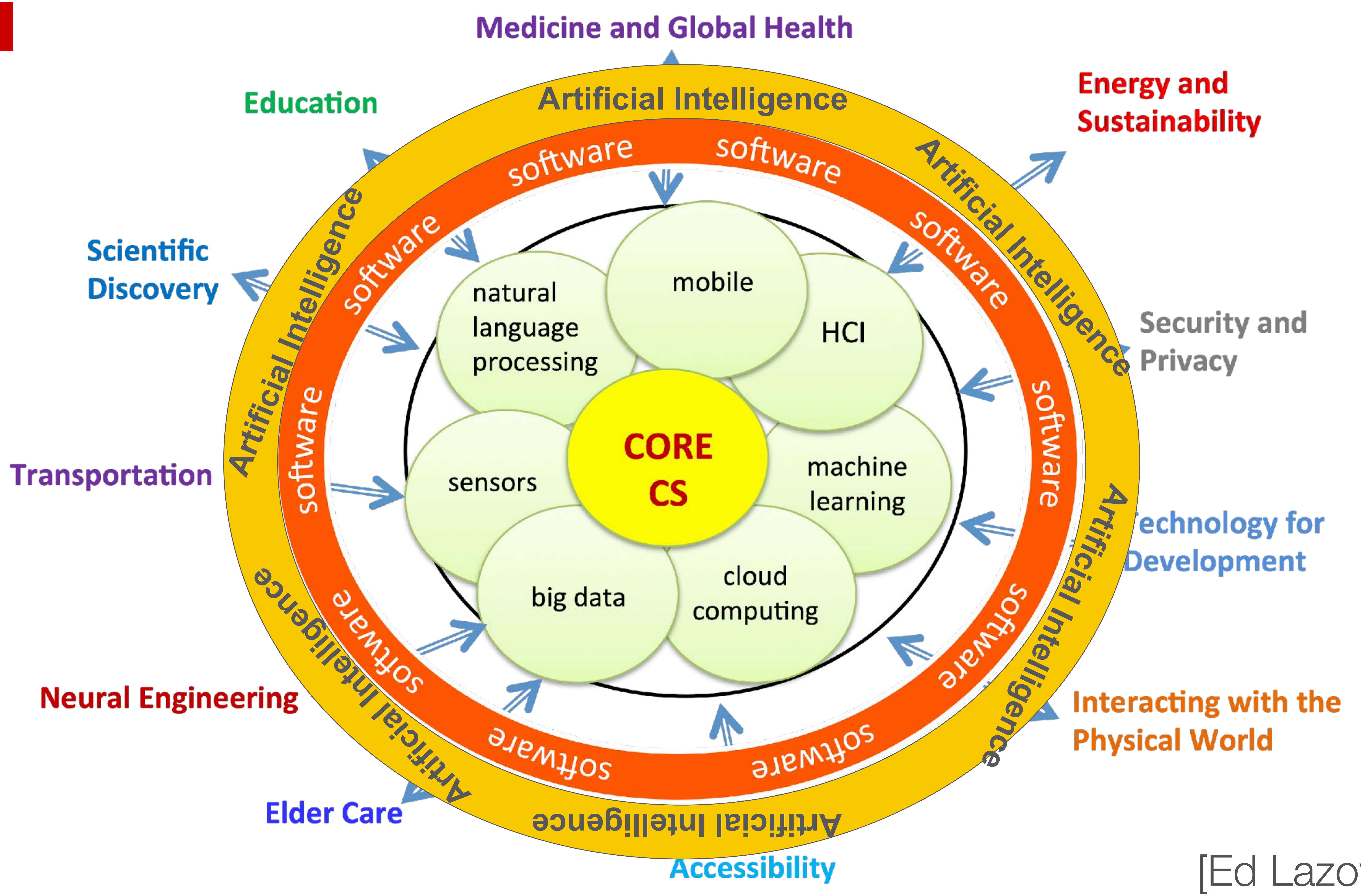
your
life
depends
on
code

[https://upload.wikimedia.org/wikipedia/commons/2/20/SkyTrain_Passing_By_On_The_Bridge.jpg]



Medicine and Global Health
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mobile
HCI
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big data
cloud computing

[Ed Lazowska]

What do you know about AI?

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Artificial Intelligence

Machines that mimic human cognition

Building machines that can solve problems and make decisions

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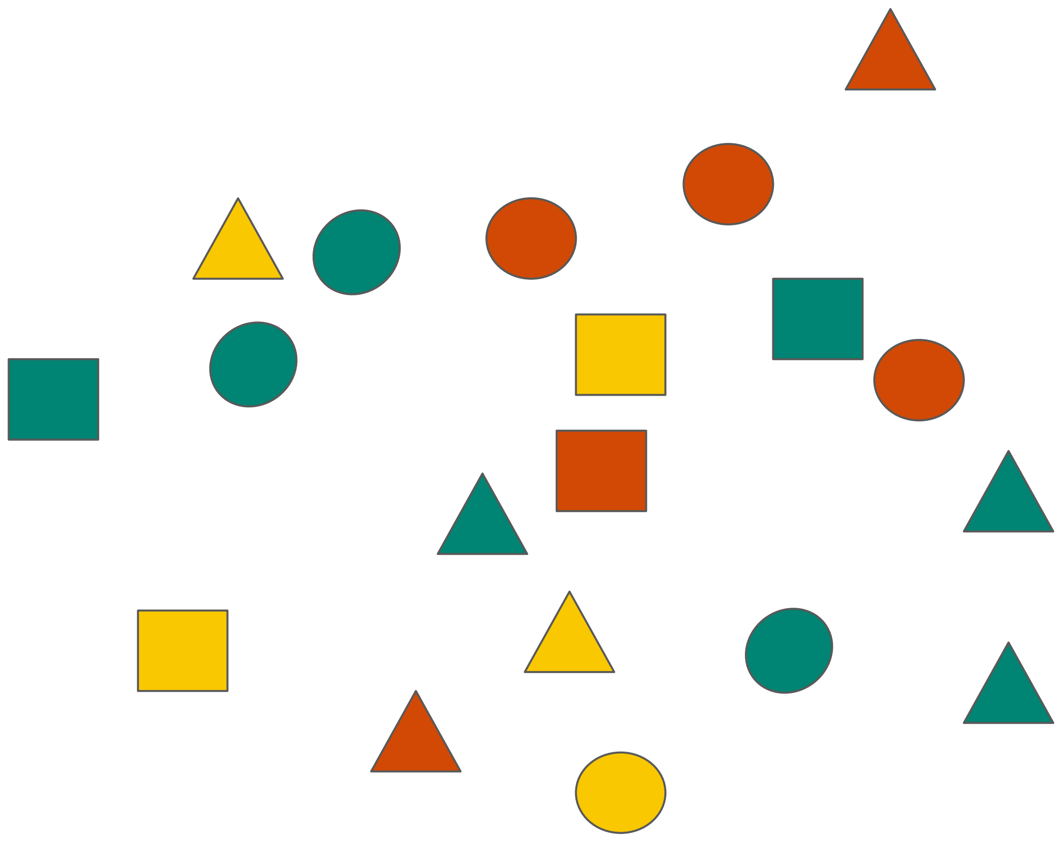
Artificial Intelligence vs. Machine Learning

Machines that mimic human cognition

Building machines that can solve problems and make decisions

A form of artificial intelligence

Pattern matching. It “learns” based on training data.



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Machines that mimic human cognition

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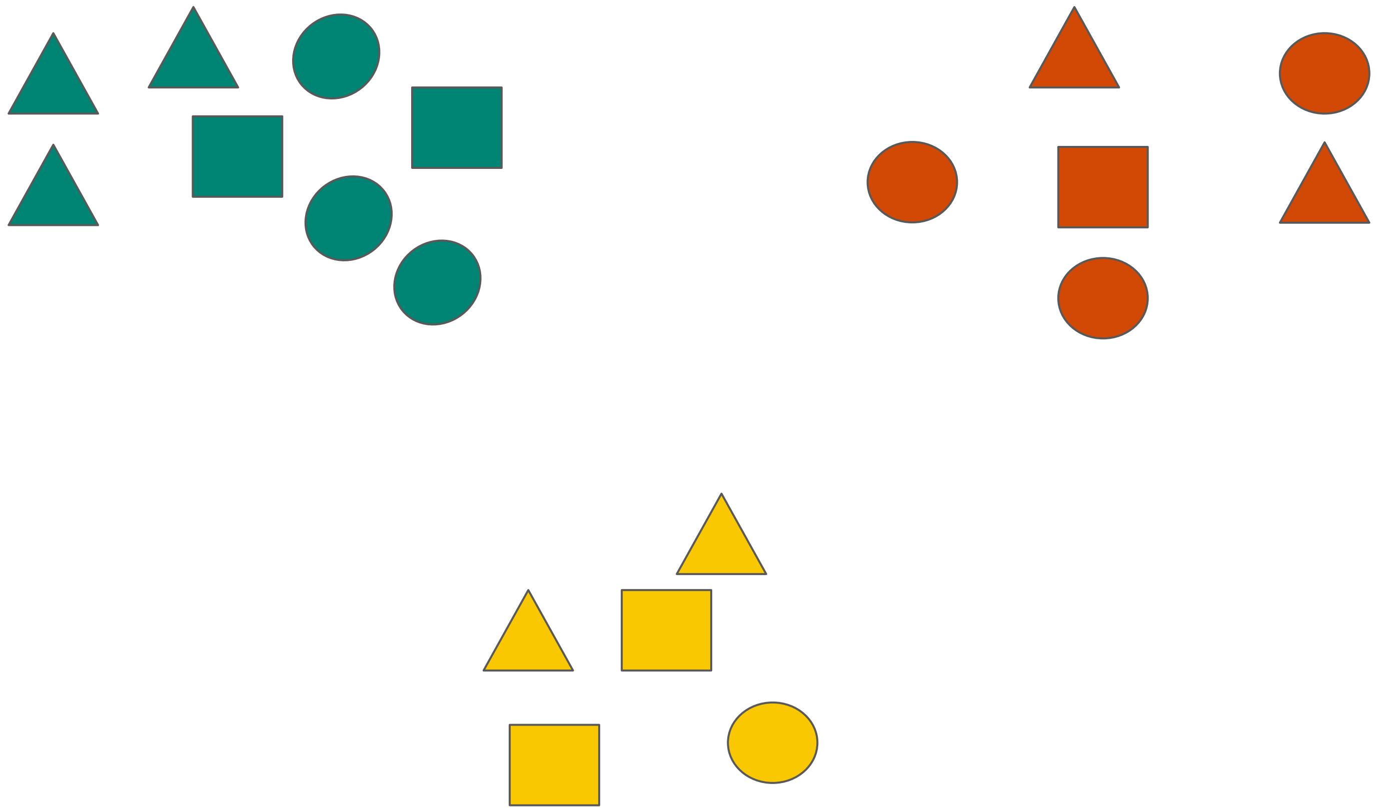

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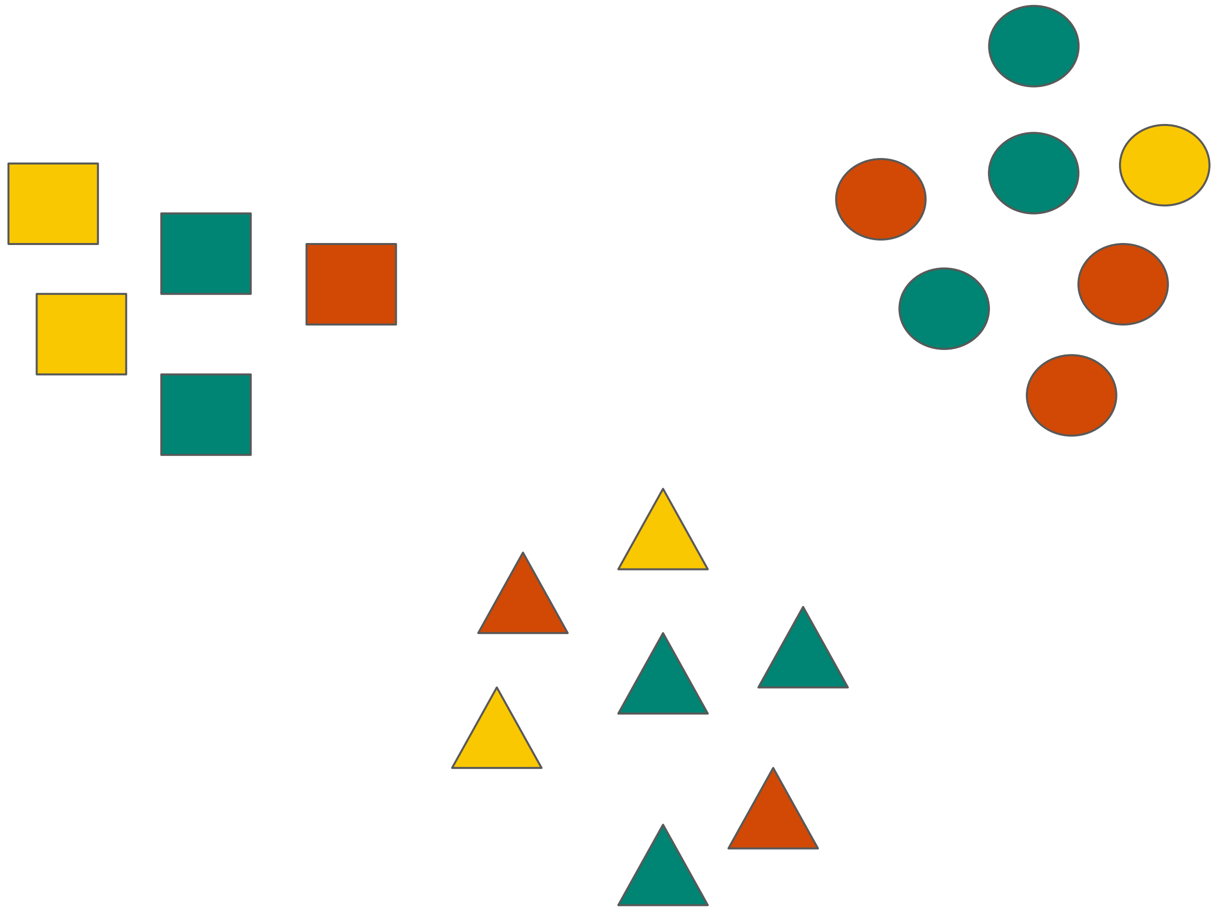

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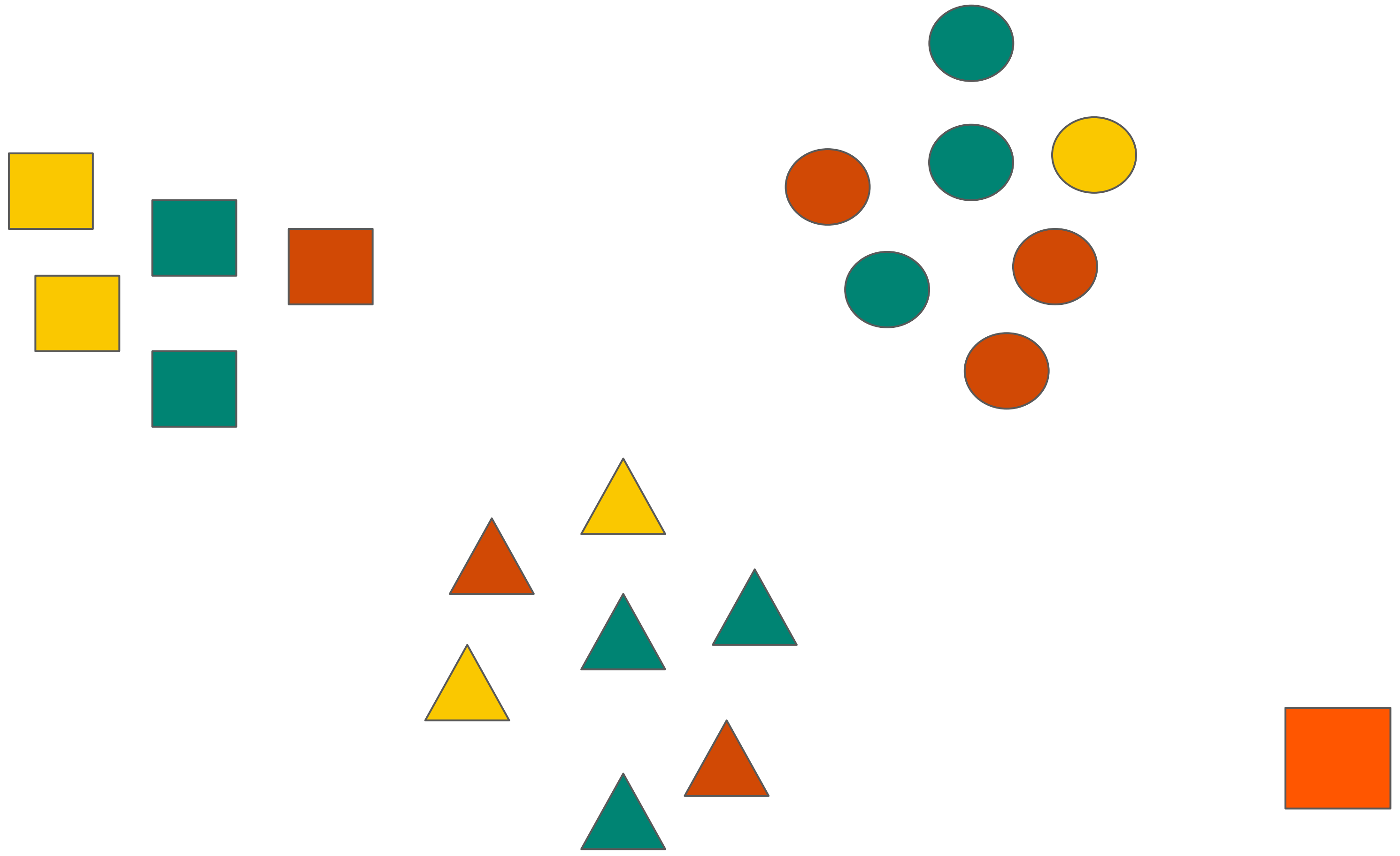

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Artificial Intelligence vs. Machine Learning

Machines that mimic human cognition

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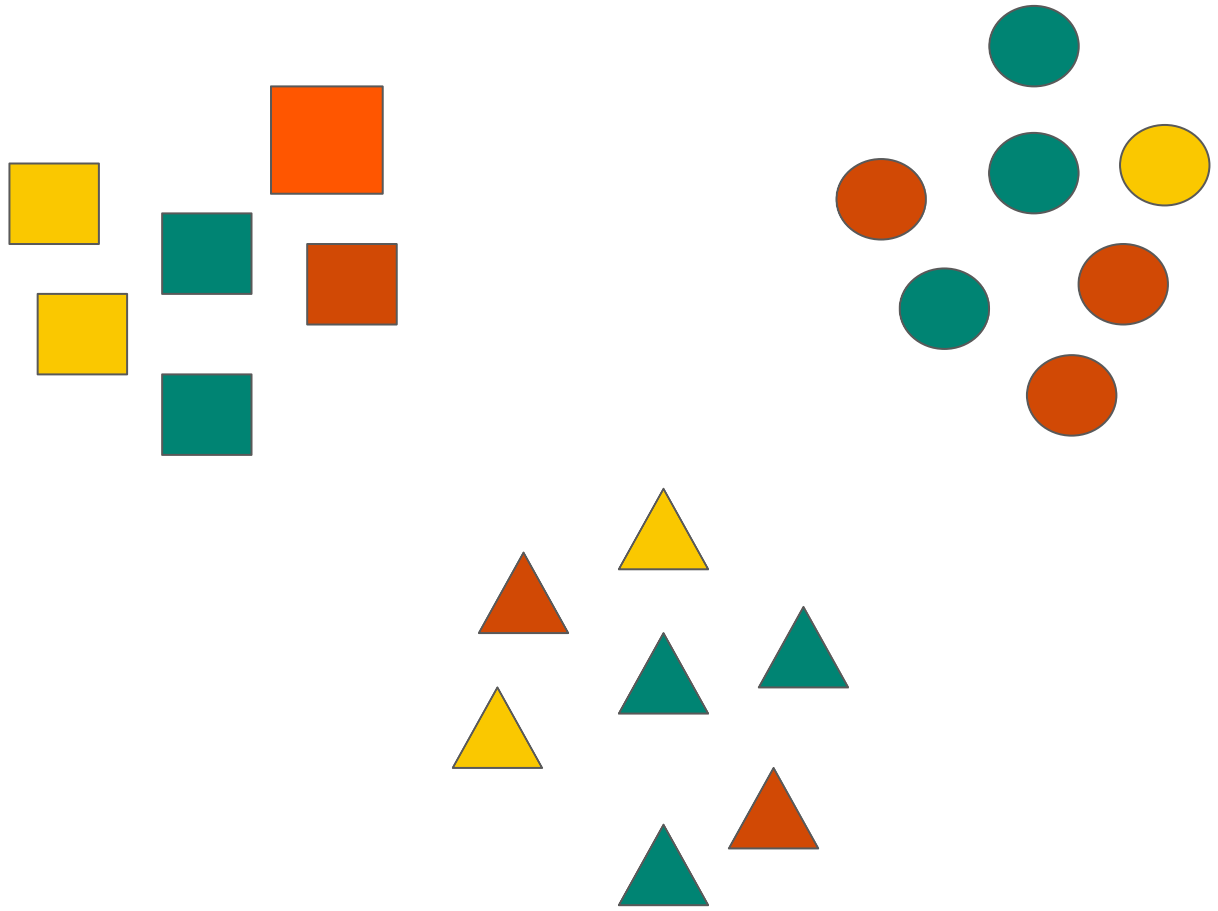
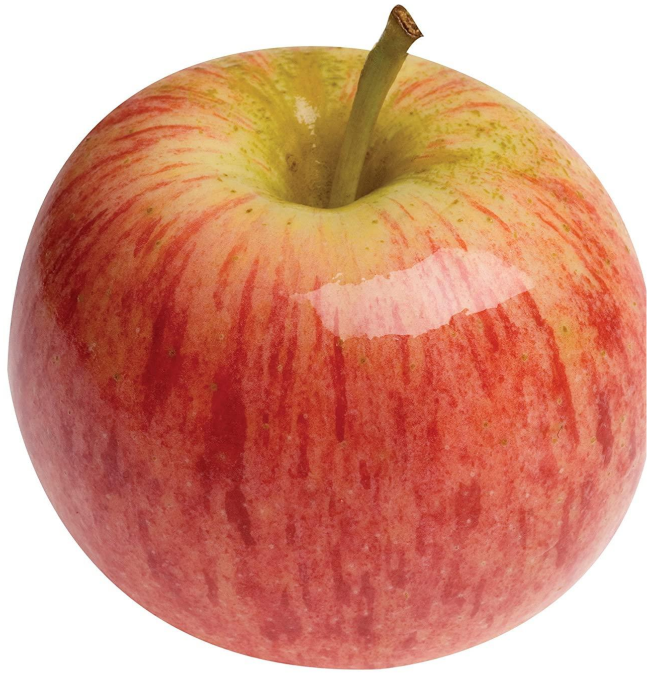


Bias



Apple

Banana

Apple

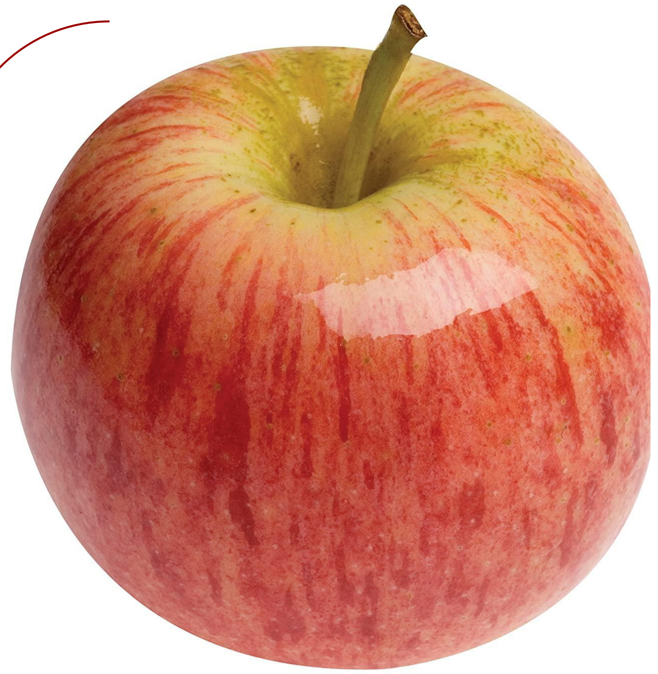
Apple

Apple

Apple

Banana

Apple



Apple

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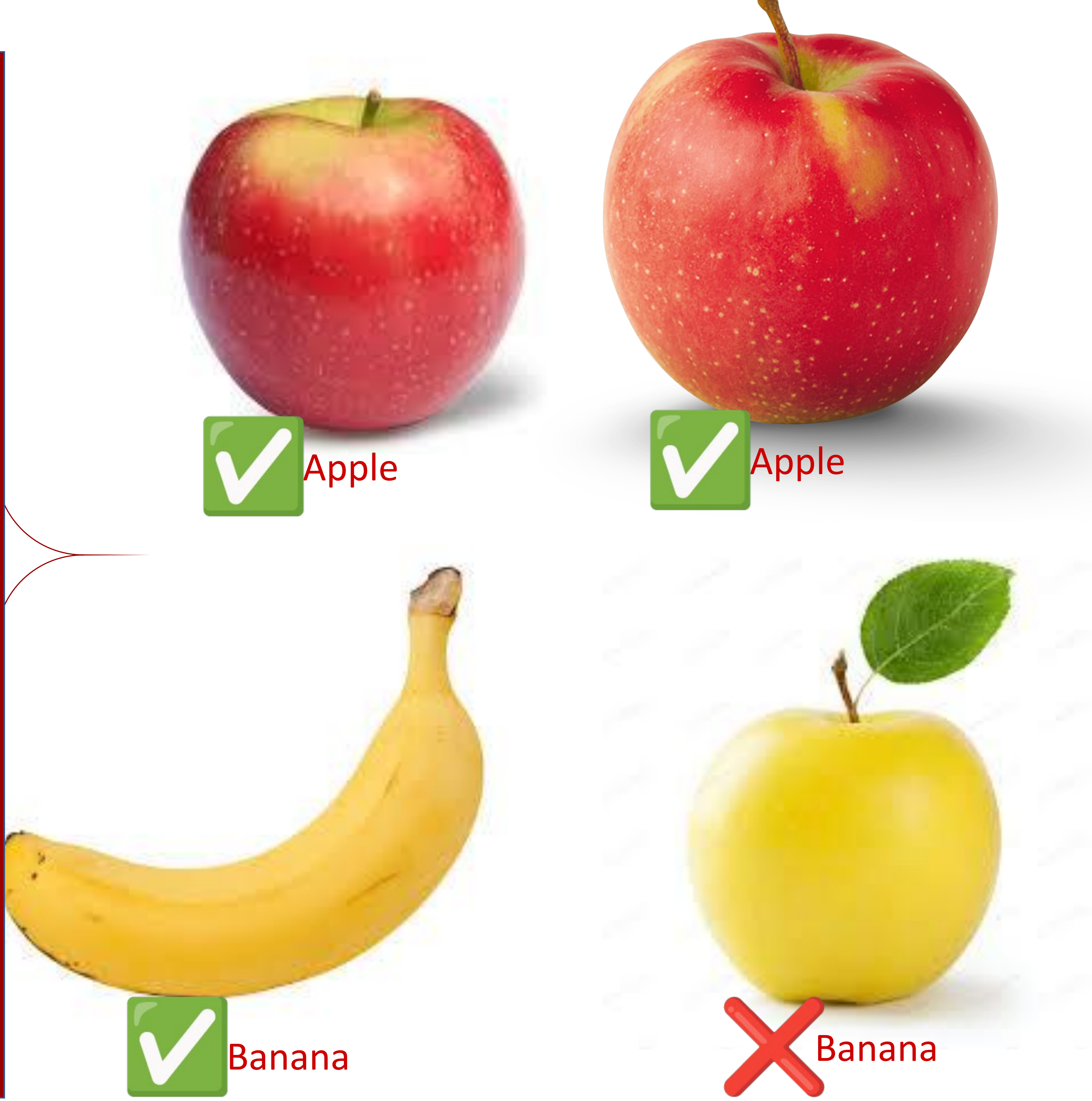
Apple

Apple

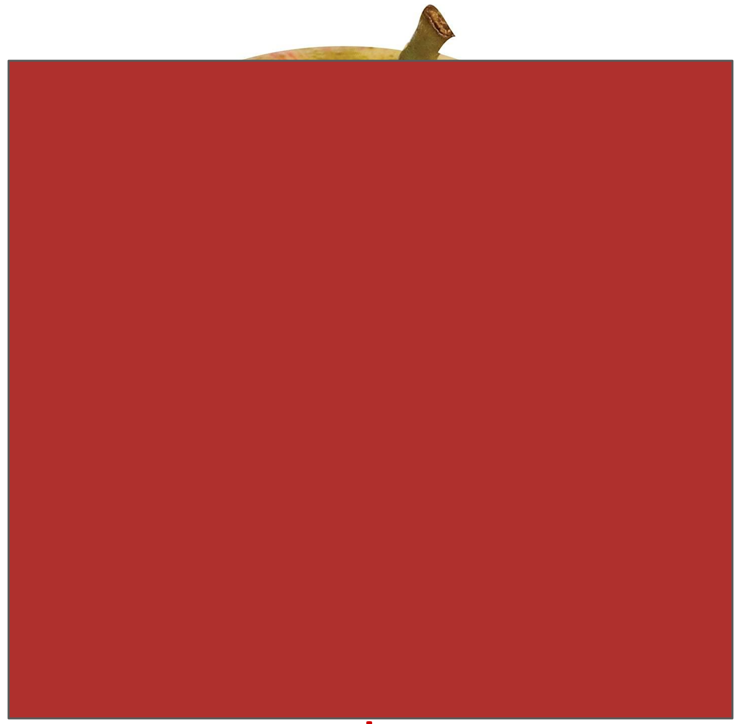
Learn a model from this training data

Model

Model



Why?



Apple

Banana

Apple

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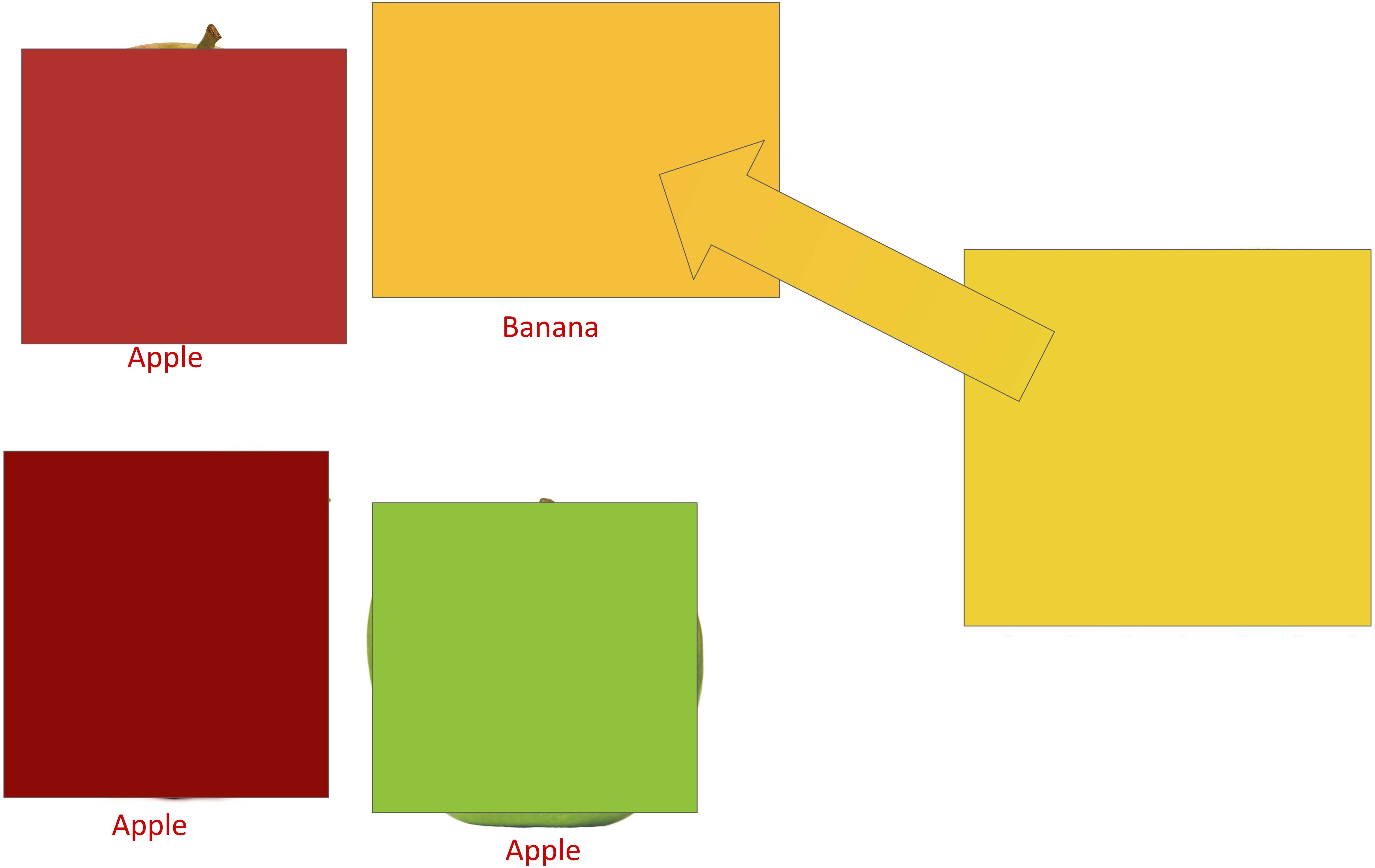
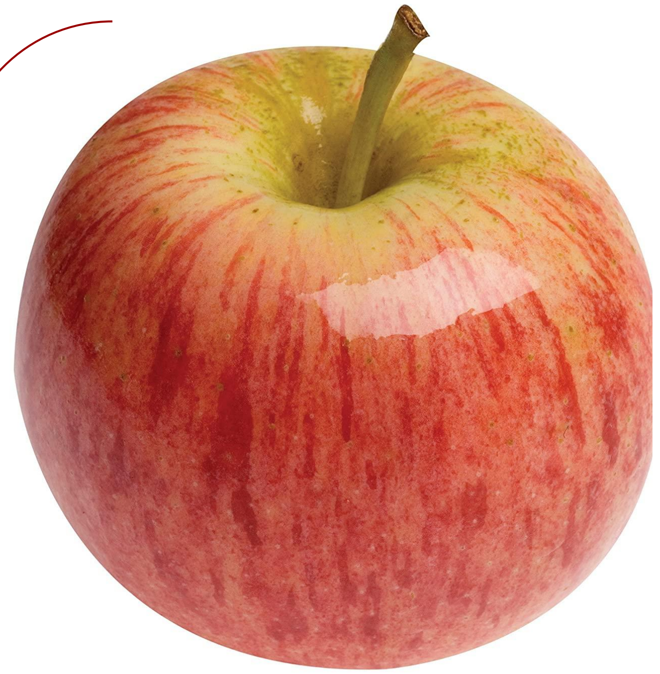
Why?



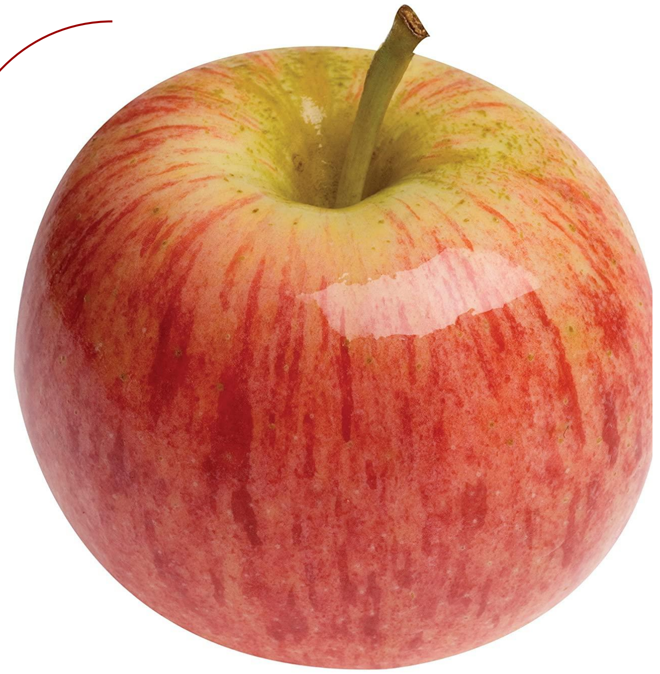


Apple

Banana

Apple

Apple

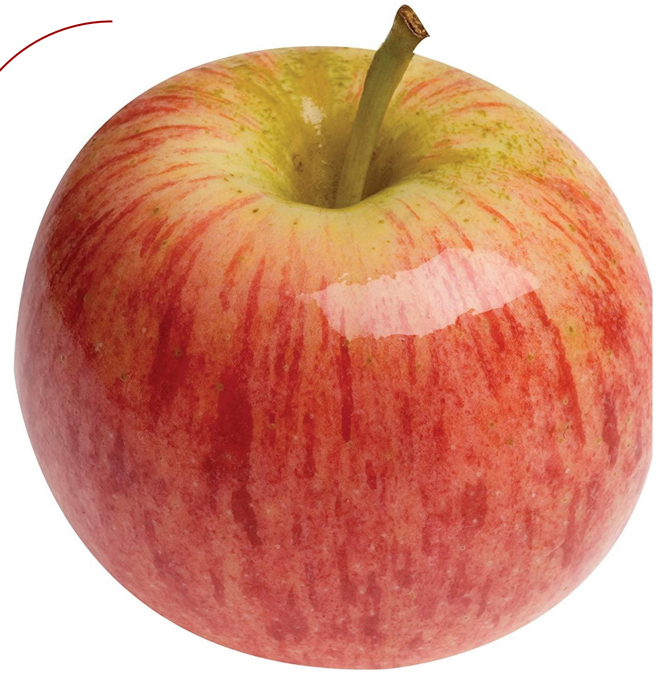


Apple

Banana

Apple

Apple



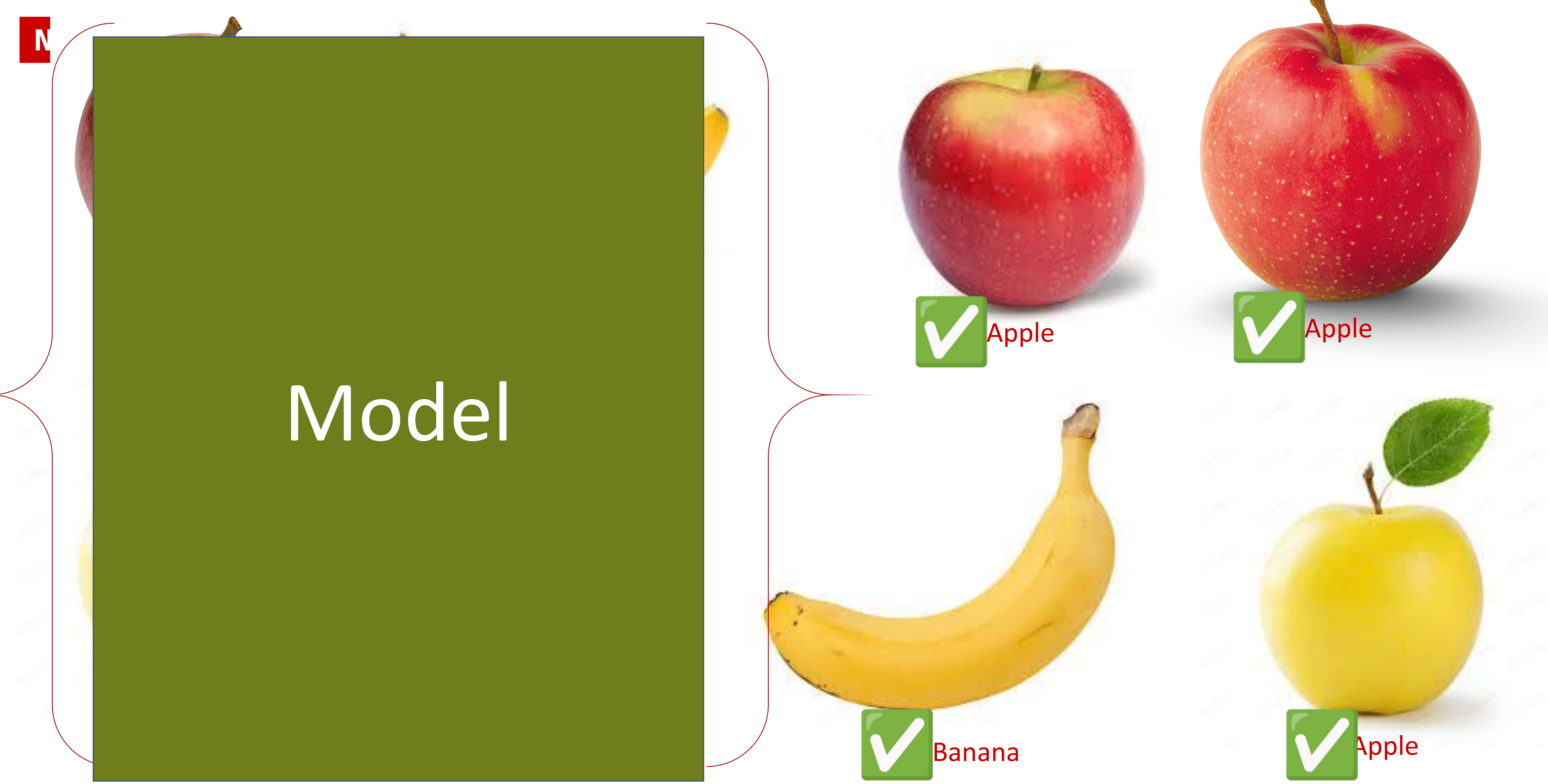
Apple

Banana

Apple

Apple

Learn a model from this more diverse training data


Model
Apple
Apple
Banana
Apple

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Let's make this more real-world

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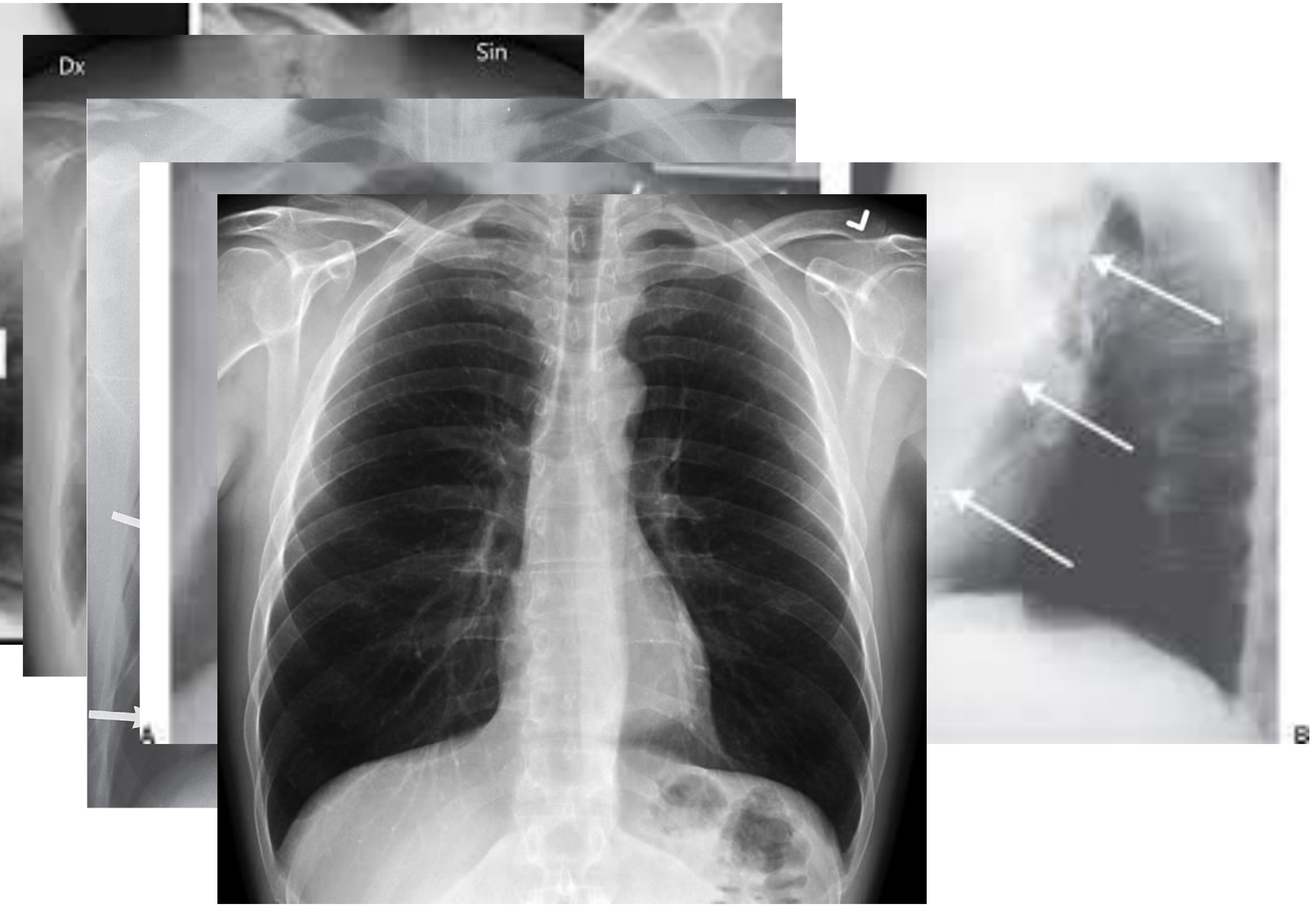
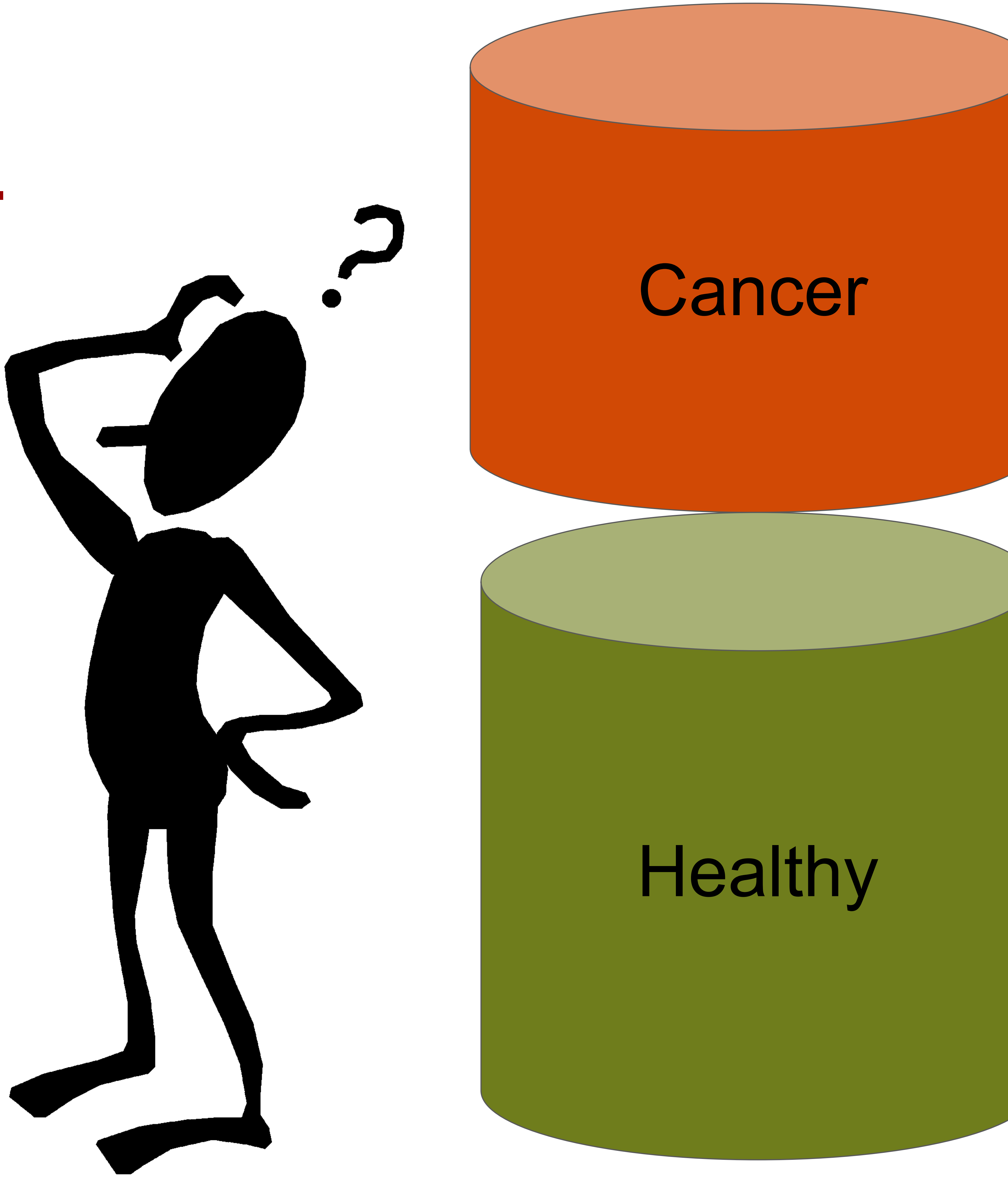
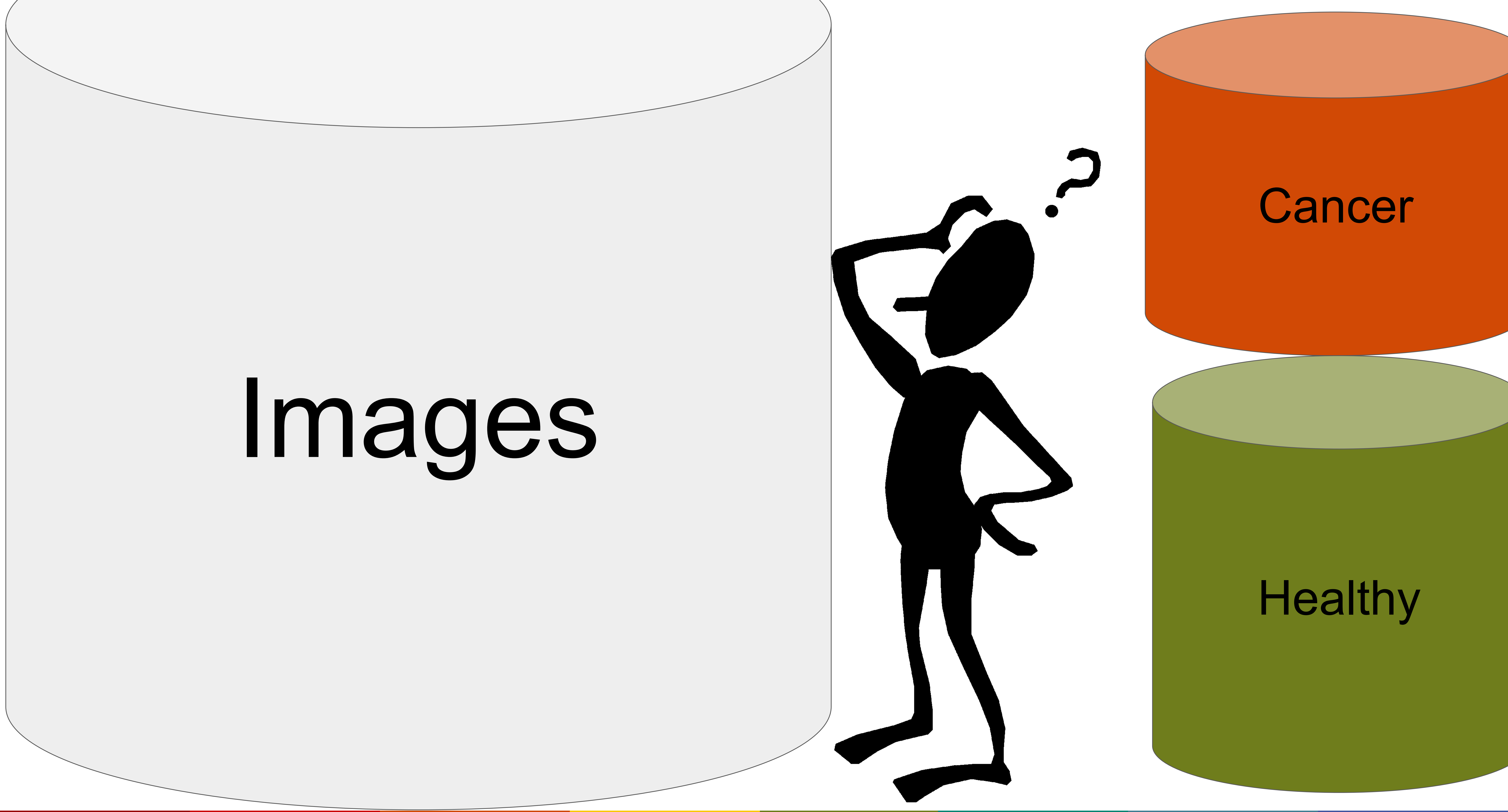
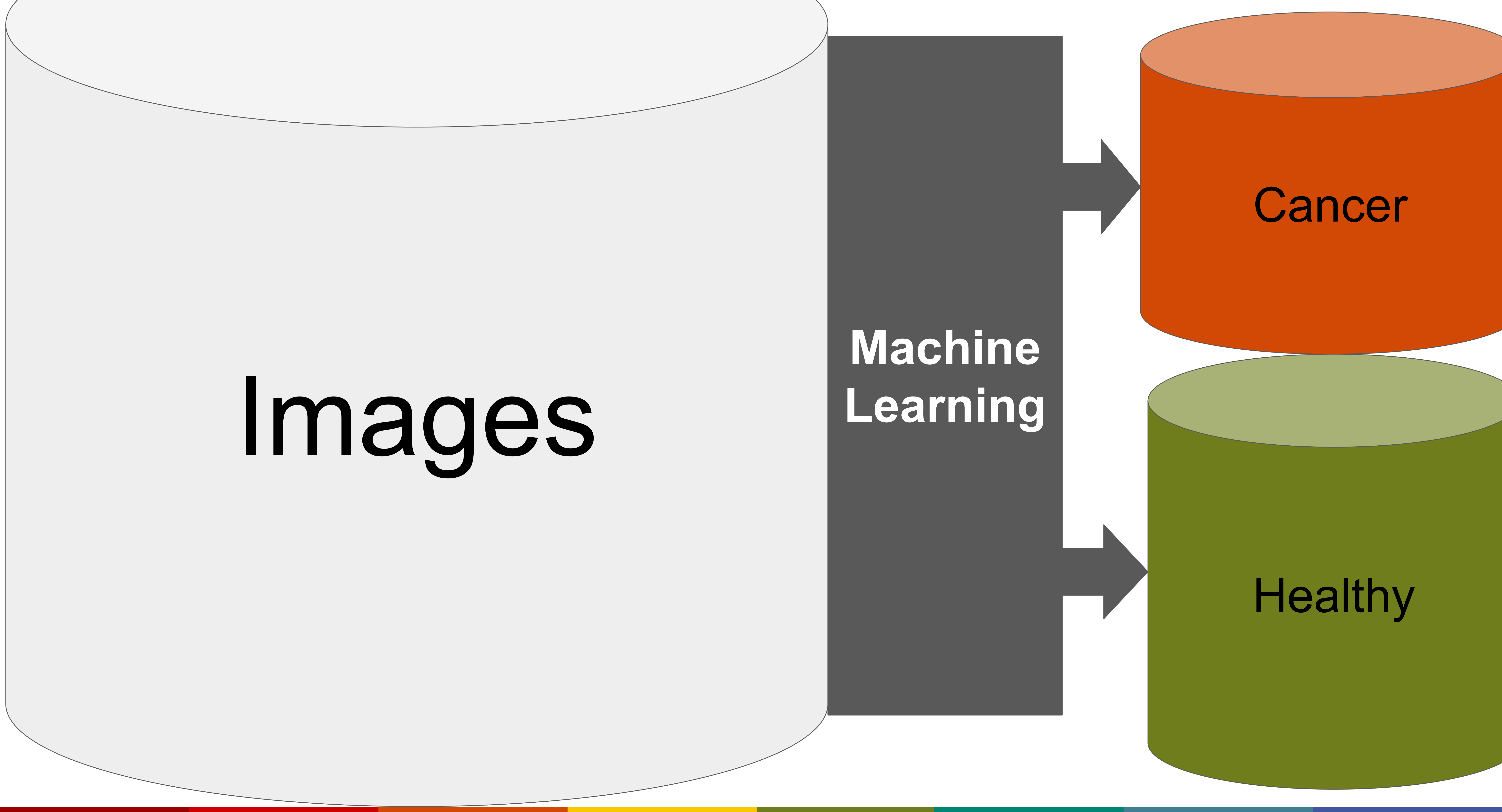
Imagine you are a radiologist.

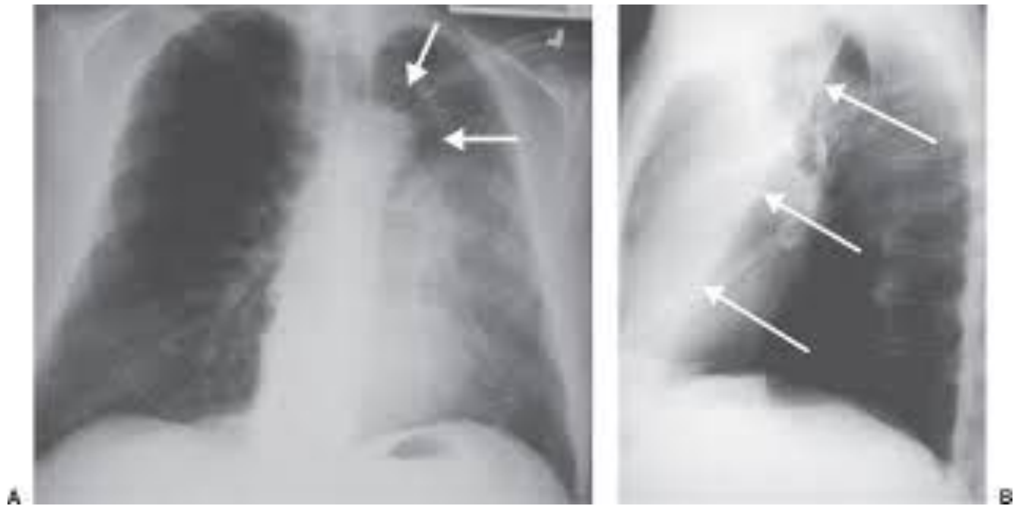


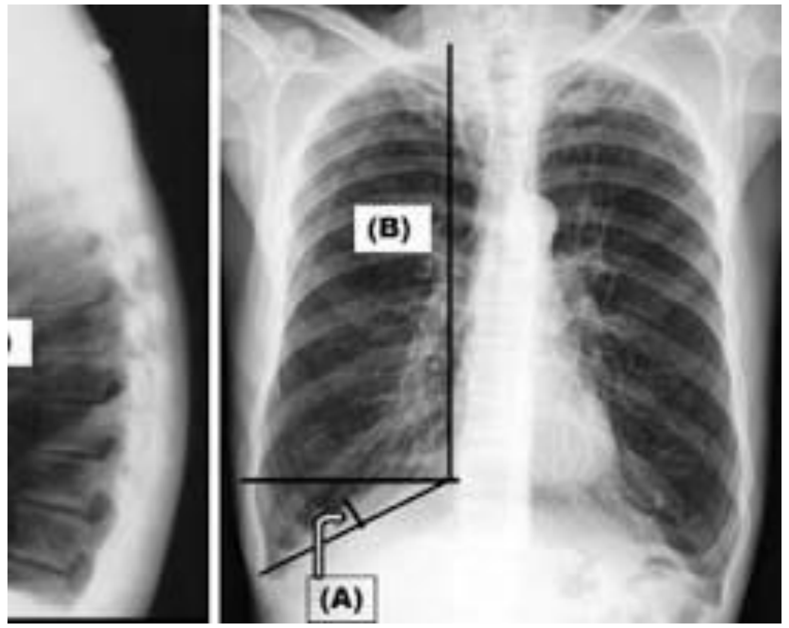


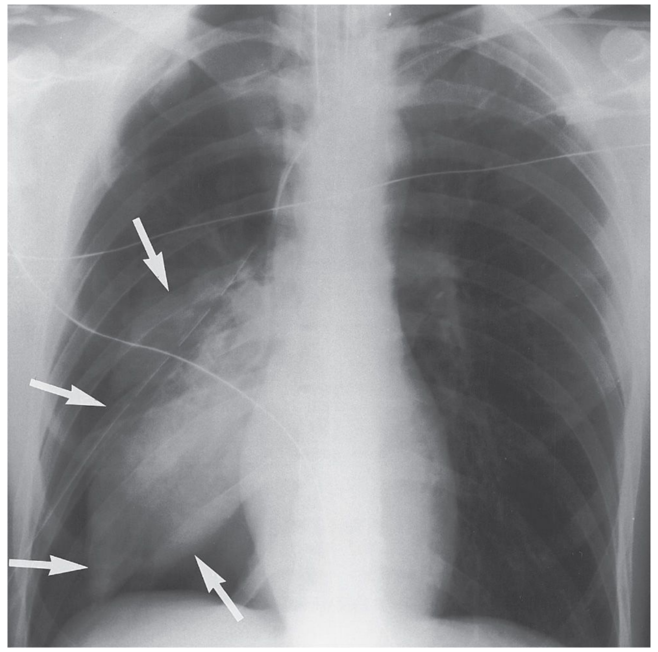

Images
Cancer
Healthy


Images
Machine Learning
Cancer
Healthy

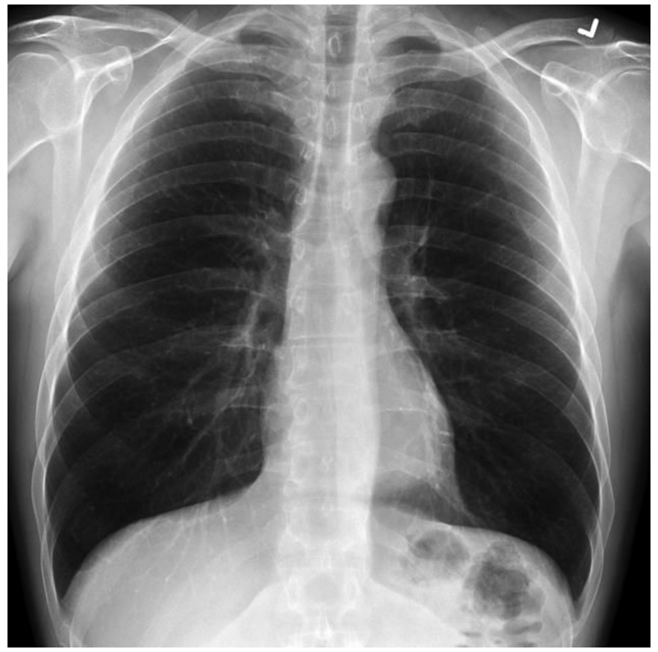
Cancer





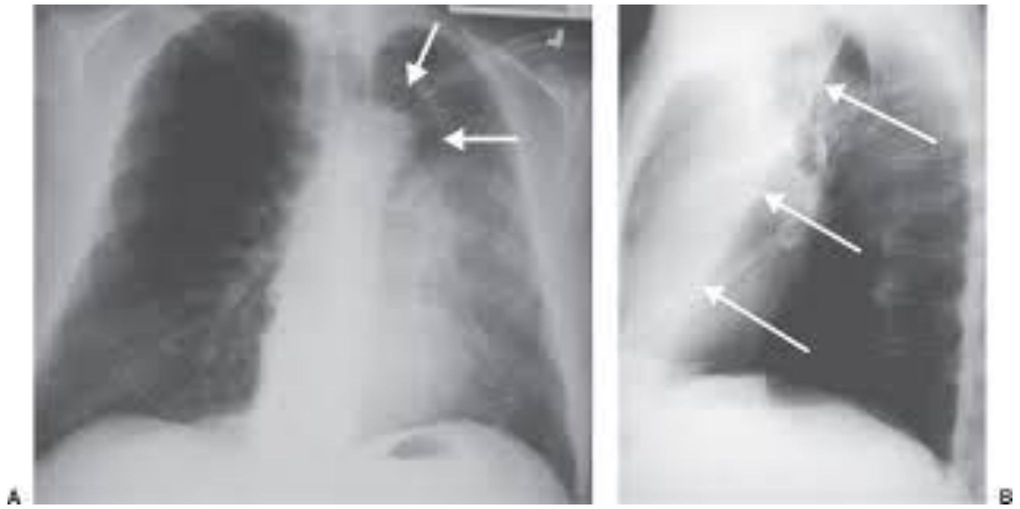


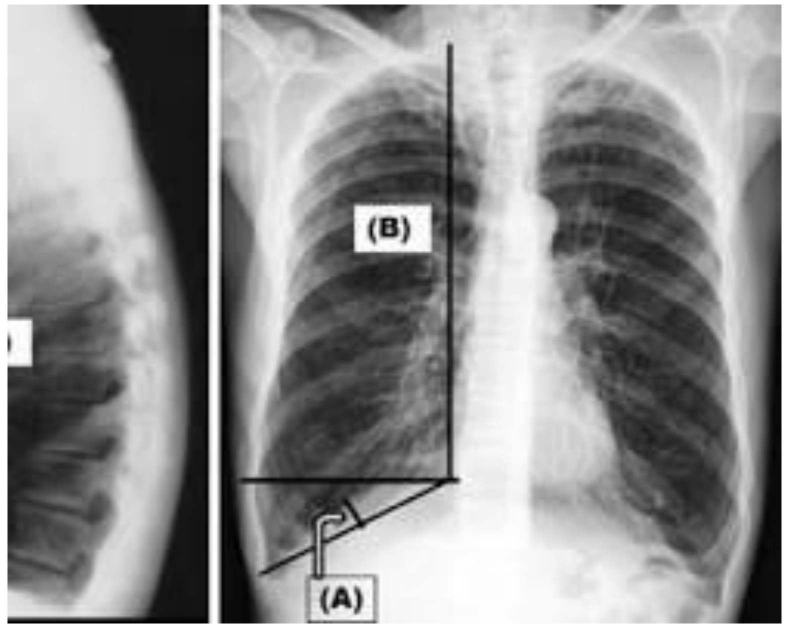
Healthy

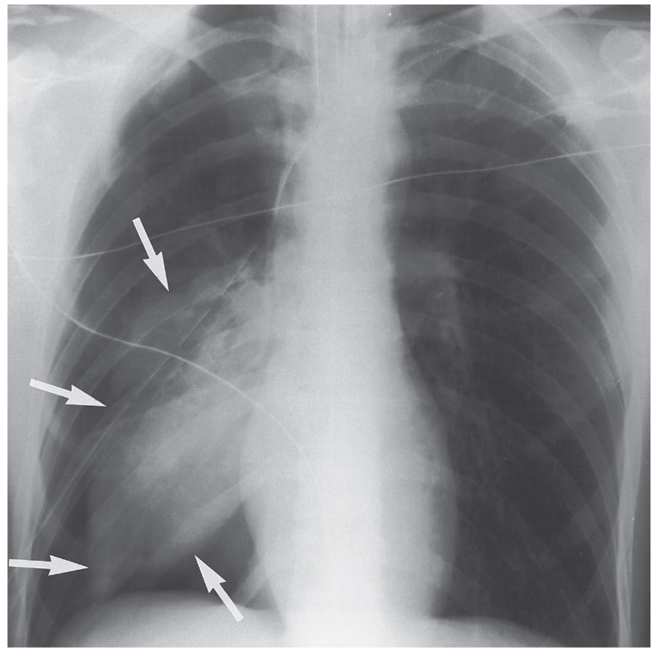


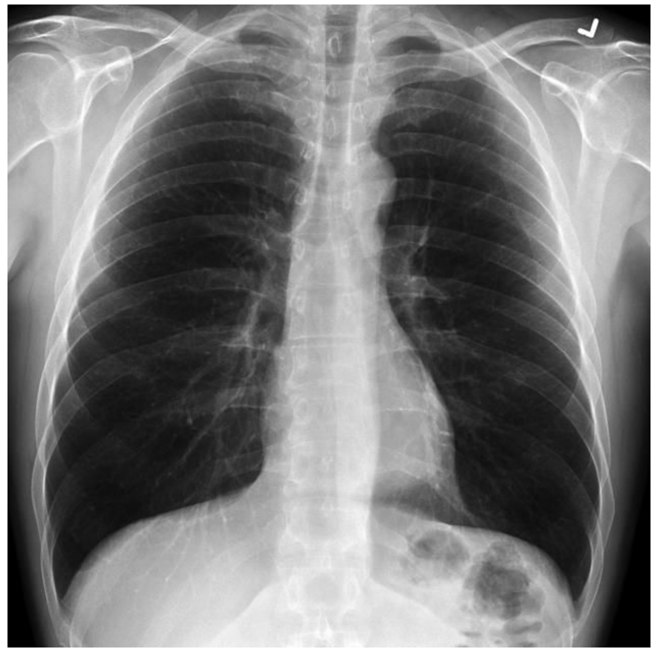
Cancer

Healthy









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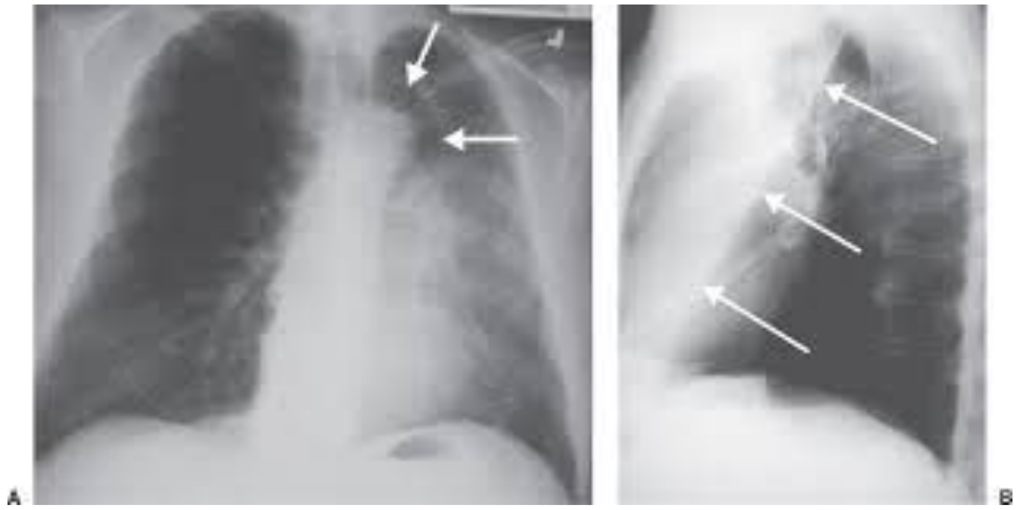

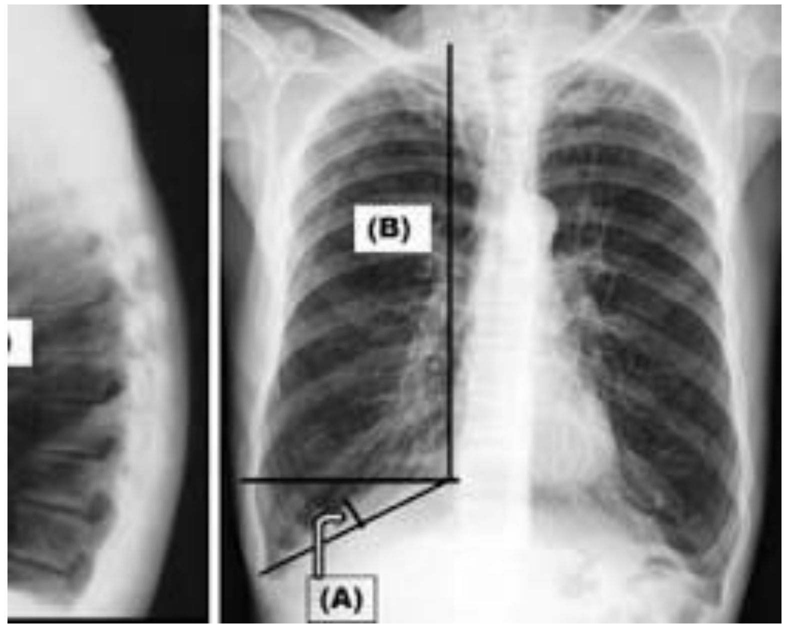

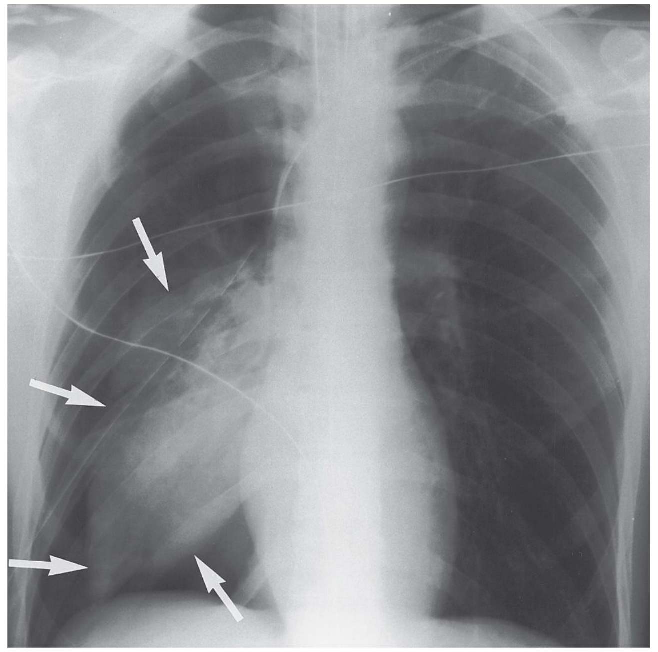

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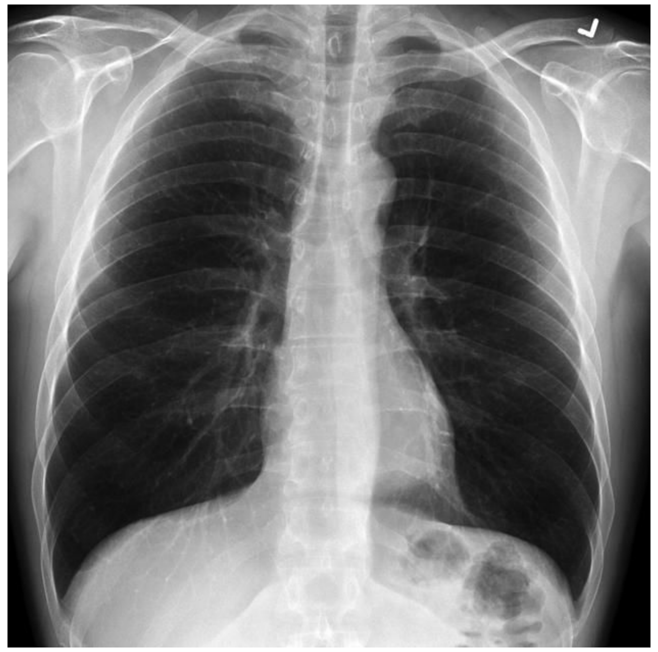

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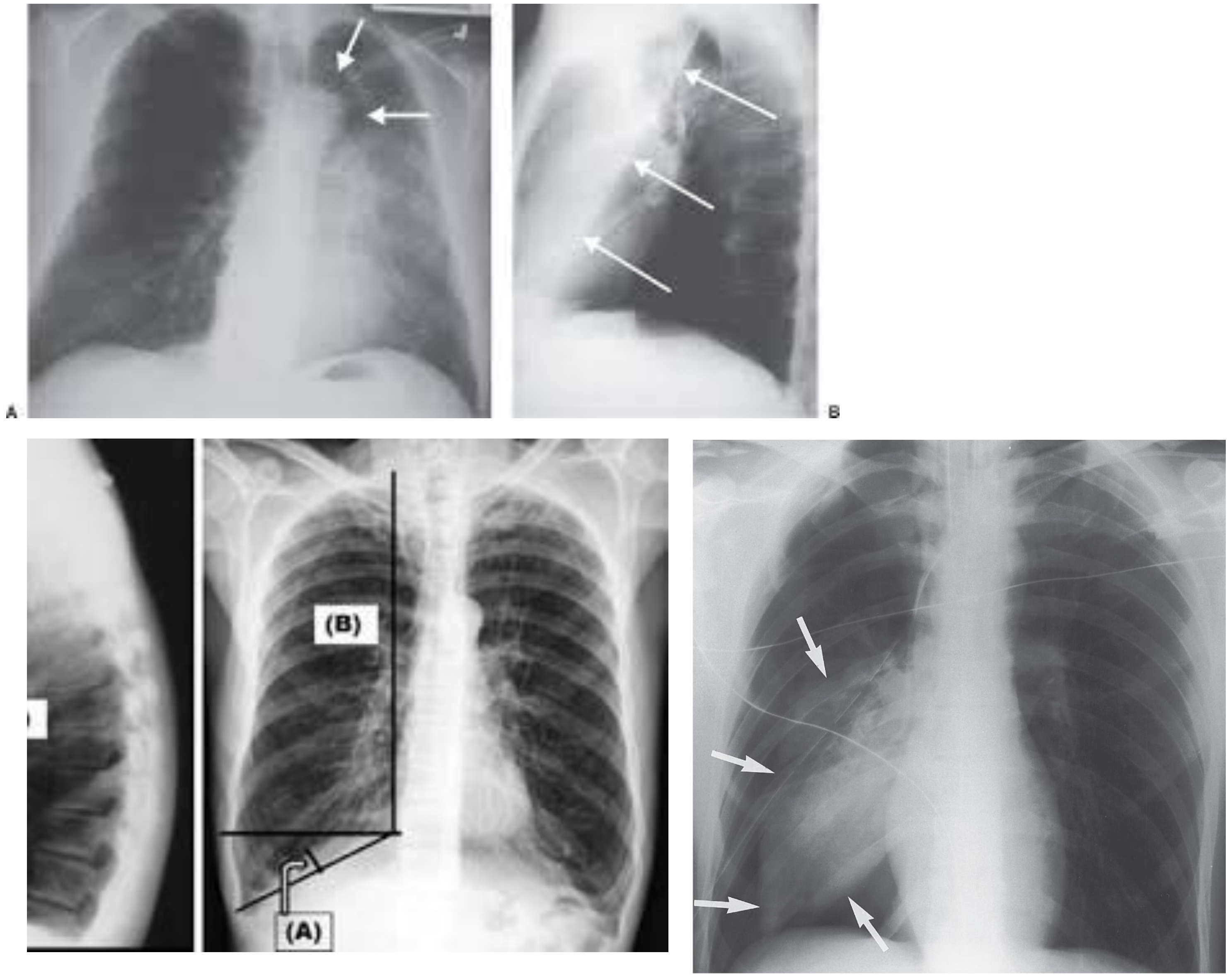
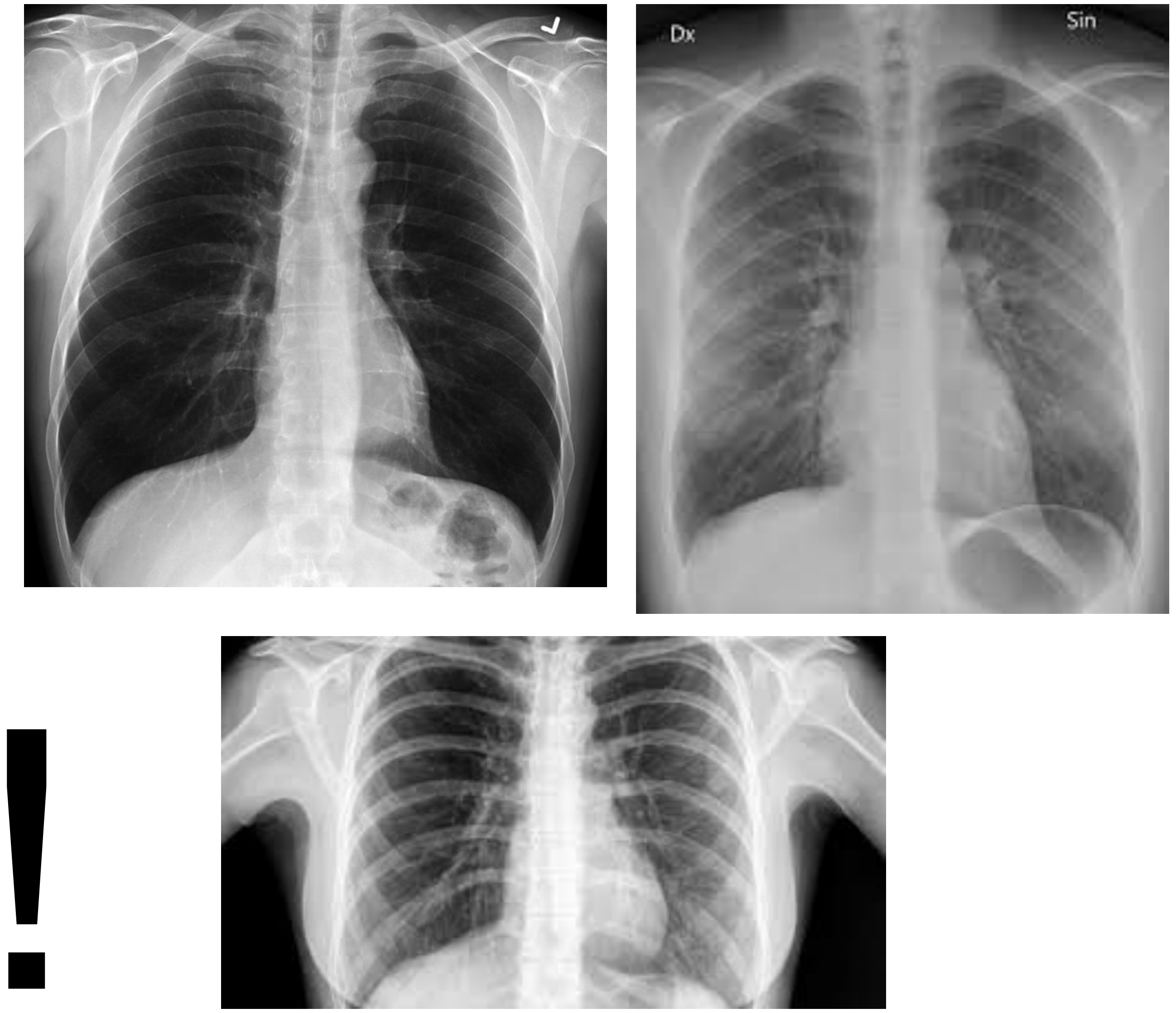
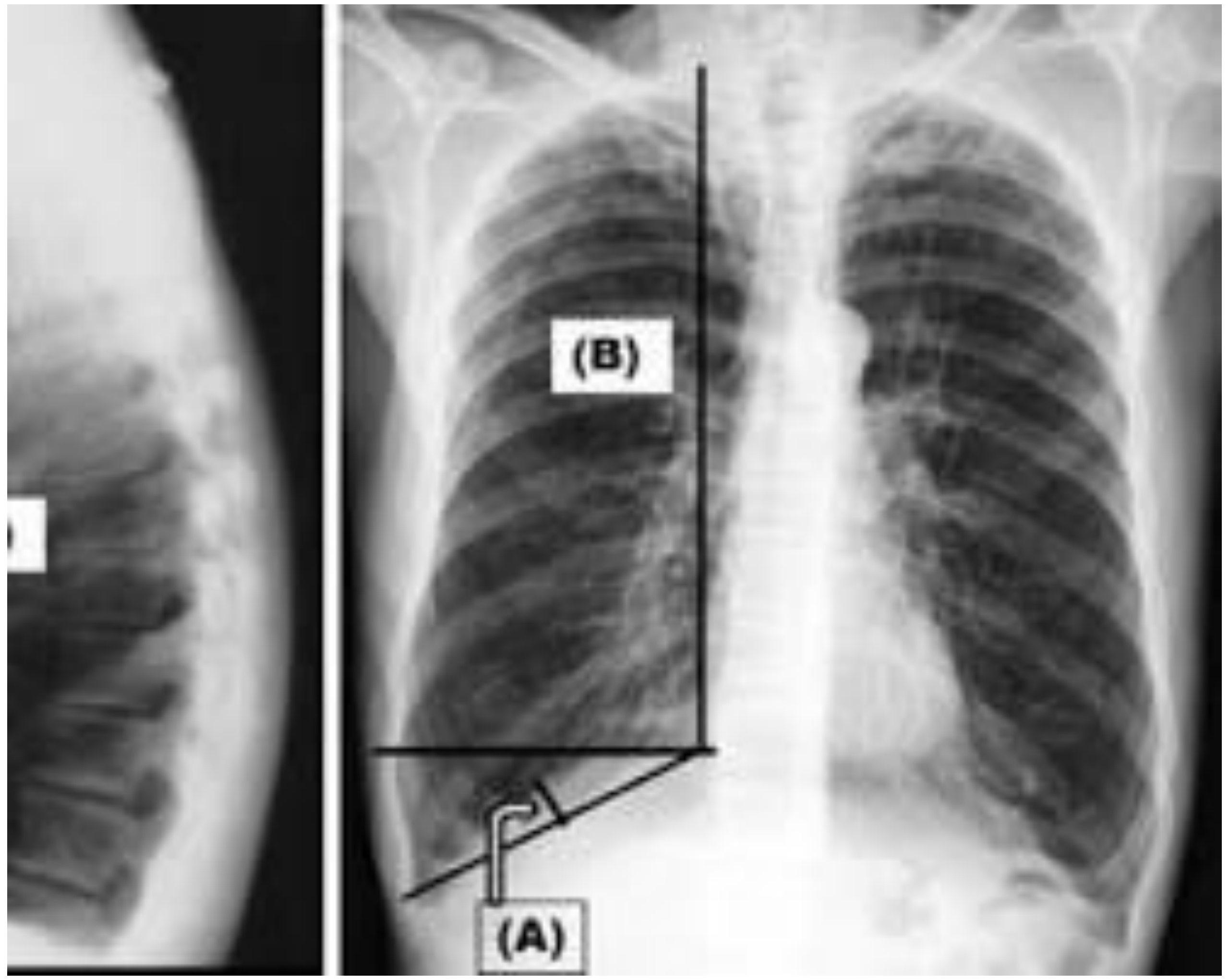
Cancer

Healthy





This was real.



VB Live

VB

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When AI flags the ruler, not the tumor — and other arguments for abolishing the black box (VB Live)

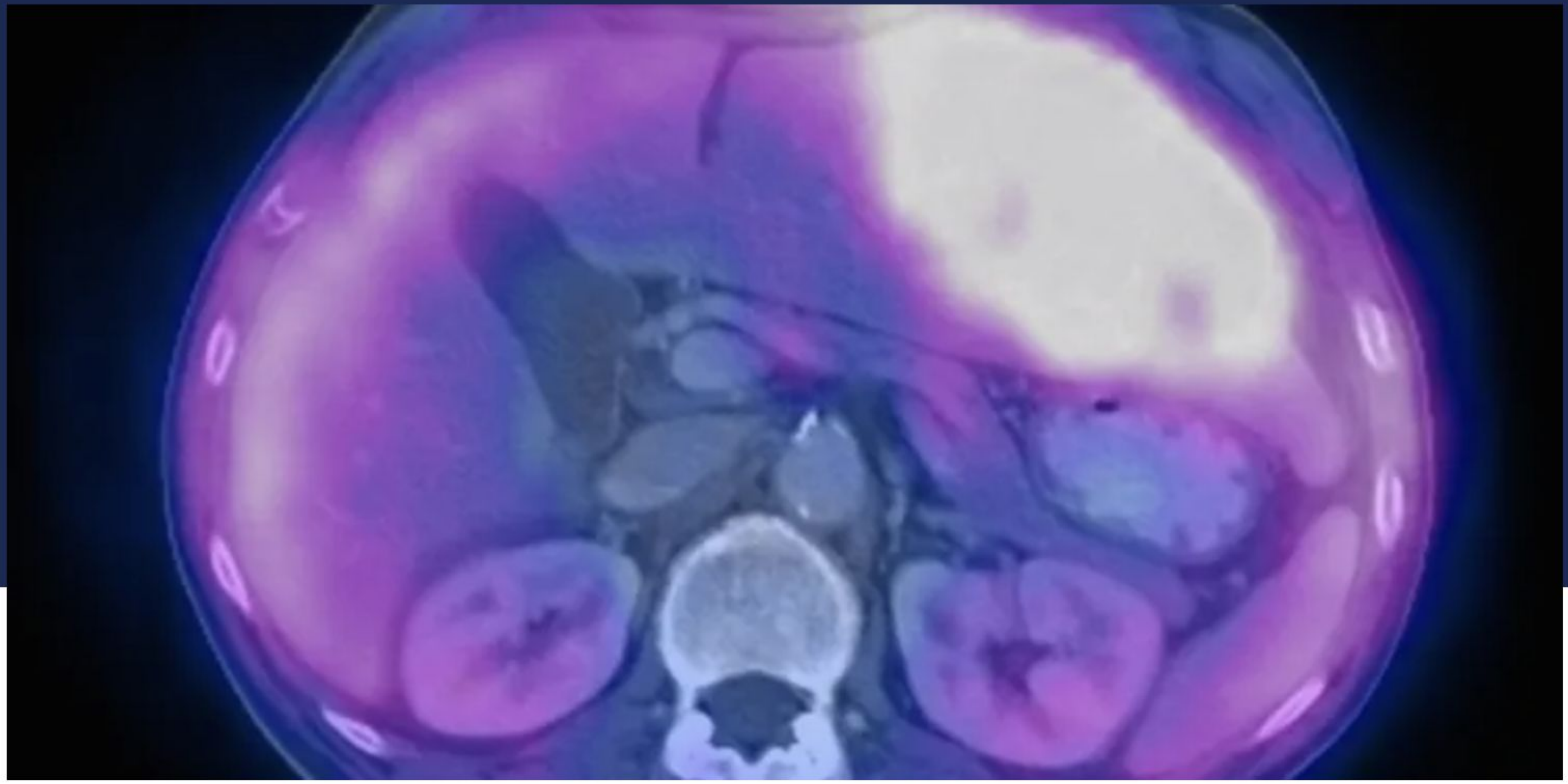
Image Credit: Getty Images

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AI helps health care experts do their jobs efficiently and effectively, but it needs to be used responsibly, ethically, and equitably. In this VB Live event, get an in-depth perspective on the strengths and limitations of data, AI methodology and more

What is ChatGPT?

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Start simple: A bigram language model

Let’s build a model based on counting. This is where prediction began.

We care about predicting *the next word* after a single word.

This is called a **bigram**.

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From fairest creatures we desire increase,
That thereby beauty's rose might never die,
But as the riper should by time decease,
His tender heir might bear his memory;

	from	fairest	creatures	we	desire
from					
fairest					
creatures					
we					
desire					

NC STATE

From fairest creatures we desire increase,
That thereby beauty's rose might never die,
But as the riper should by time decease,
His tender heir might bear his memory;

	from	fairest	creatures	we	youth
from	0	0	0	0	0
fairest	0	0	0	0	0
creatures	0	0	0	0	0
we	0	0	0	0	0
youth	0	0	0	0	0

From fairest creatures we desire increase,
That thereby beauty's rose might never die,
But as the riper should by time decease,
His tender heir might bear his memory;

	from	fairest	creatures	we	youth
from	0	1	0	0	0
fairest	0	0	0	0	0
creatures	0	0	0	0	0
we	0	0	0	0	0
youth	0	0	0	0	0

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From fairest creatures we desire increase,
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His tender heir might bear his memory;

	from	fairest	creatures	we	youth
from	0	1	0	0	0
fairest	0	0	1	0	0
creatures	0	0	0	0	0
we	0	0	0	0	0
youth	0	0	0	0	0

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From fairest creatures we desire increase,
That thereby beauty's rose might never die,
But as the riper should by time decease,
His tender heir might bear his memory;

	from	fairest	creatures	we	youth
from	0	1	0	0	0
fairest	0	0	1	0	0
creatures	0	0	0	1	0
we	0	0	0	0	0
youth	0	0	0	0	0

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From fairest creatures we desire increase,
That thereby beauty's rose might never die,
But as the riper should by time decease,
His tender heir might bear his memory;
.
.
.
From youth convertest.

	from	fairest	creatures	we	youth
from	0	1	0	0	0
fairest	0	0	1	0	0
creatures	0	0	0	1	0
we	0	0	0	0	0
youth	0	0	0	0	0

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And so on and so forth for the complete works of Shakespeare.

From fairest creatures we

That thereby beauty’s rose might never die,

But as the riper should by time decease,

His tender heir might bear his memory;

.

.

.

From youth convertest.

		airest	creatures	we	youth
from	0	1	0	0	1
fairest	0	0	1	0	0
creatures	0	0	0	1	0
we	0	0	0	0	0
youth	0	0	0	0	0

Inference

Now our model is trained.

Let's say we want to start writing likes Shakespeare!

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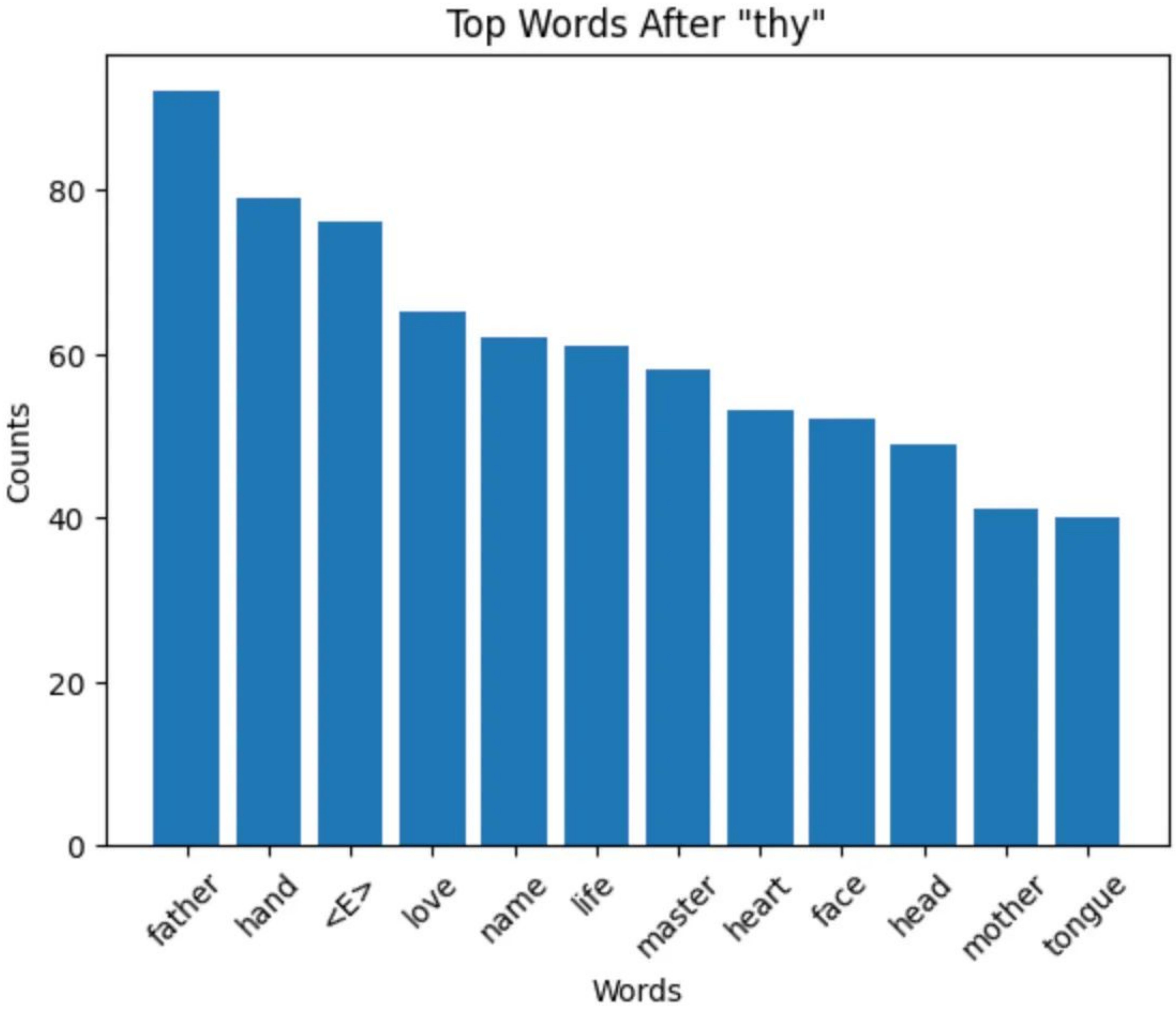
Inference

Now our model is trained.

Let’s say we want to start writing likes Shakespeare!

> Thy



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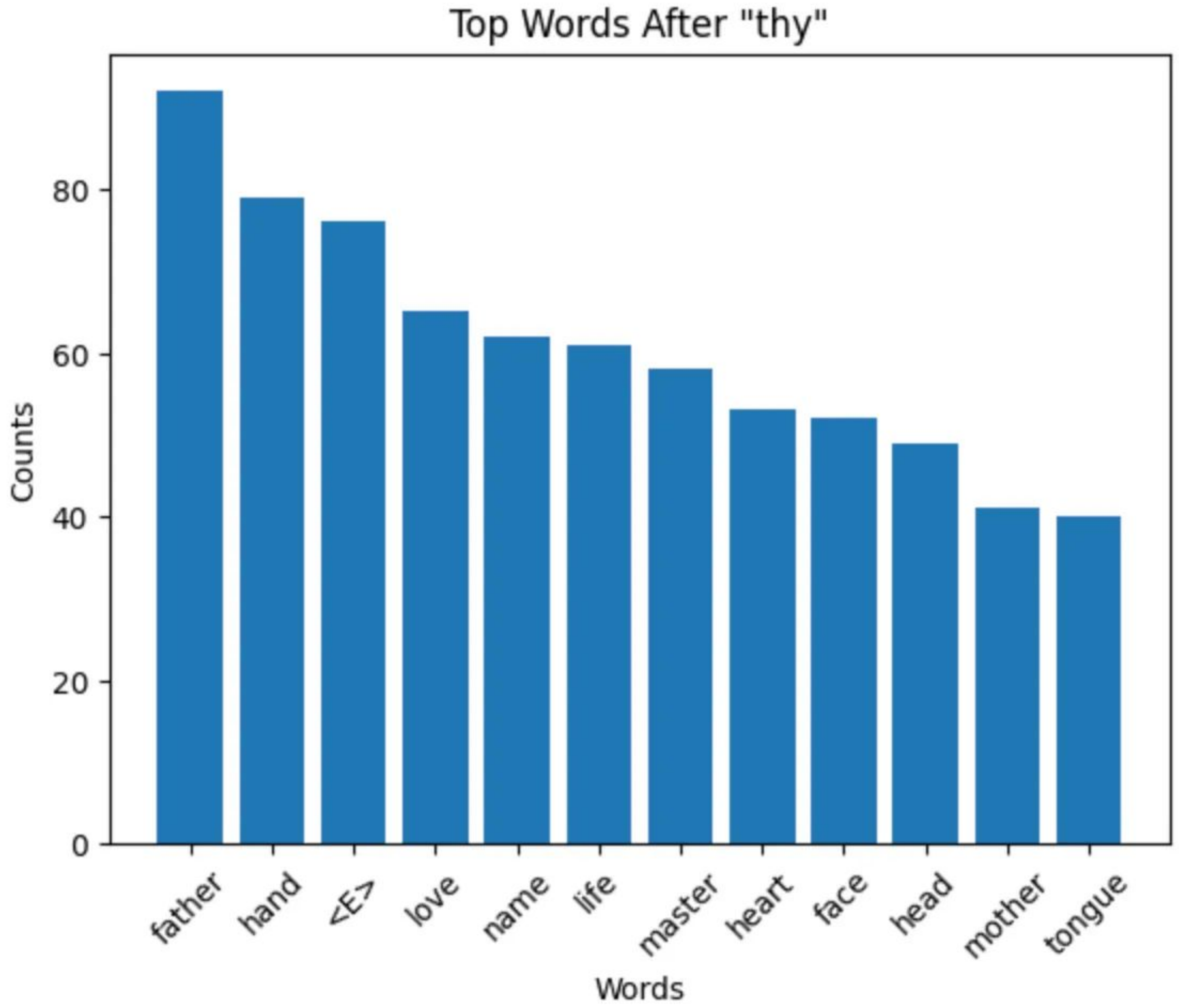
Inference

Now our model is trained.

Let’s say we want to start writing likes Shakespeare!

> Thy father



Inference

Now our model is trained.

Let's say we want to start writing likes Shakespeare!

> Thy father and there were…

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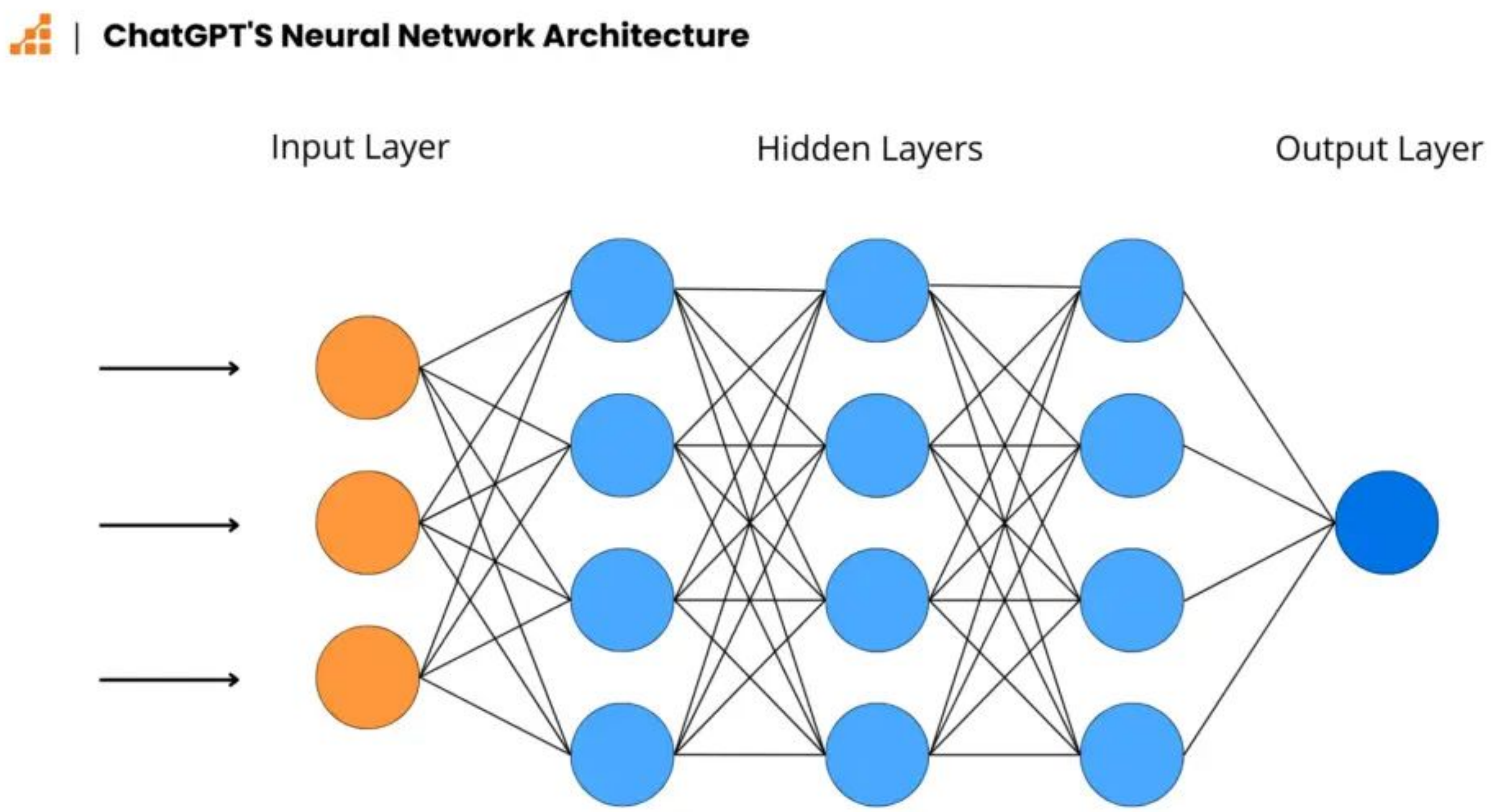
Does it work?

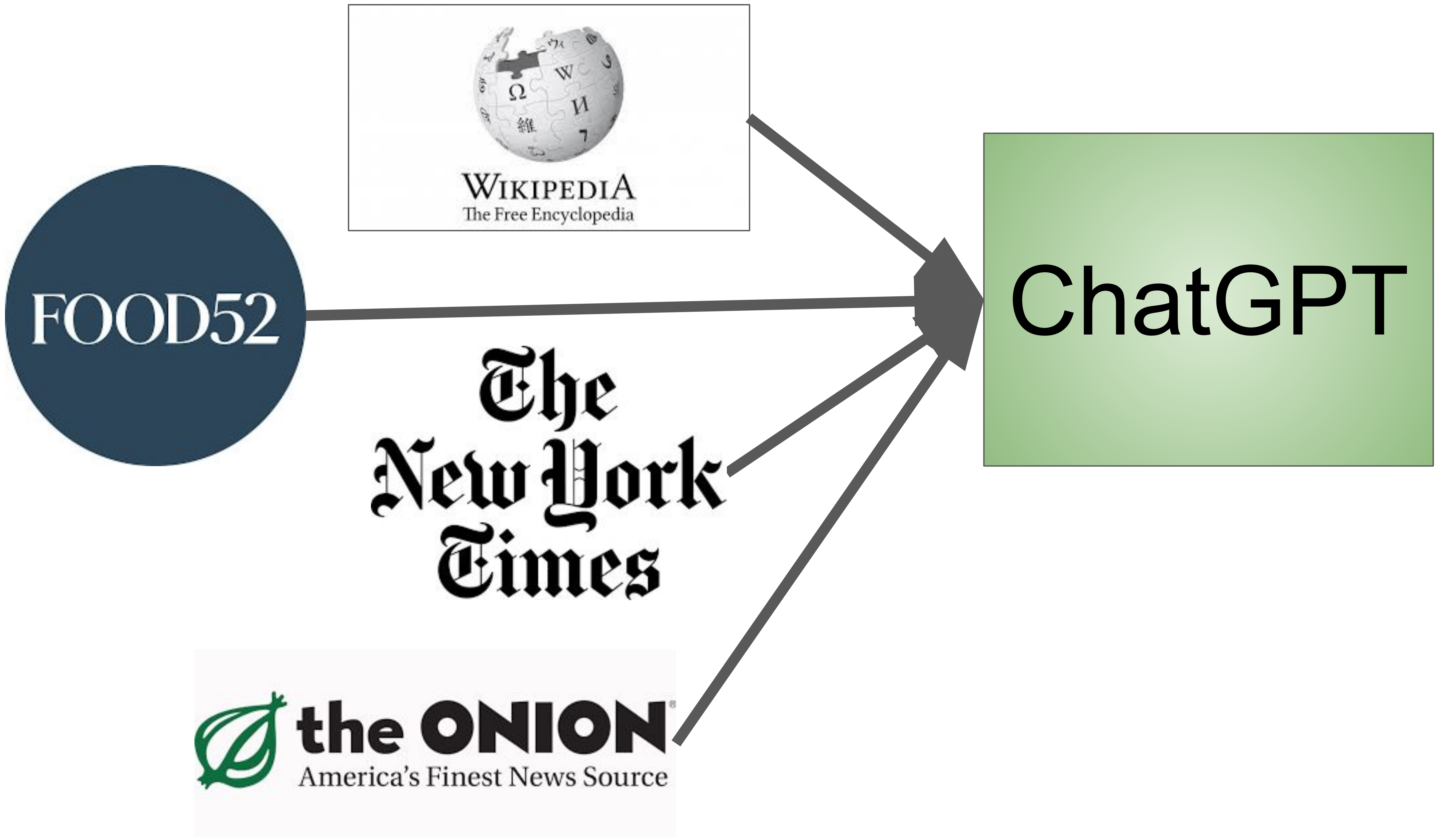
Bigrams are very simplistic.

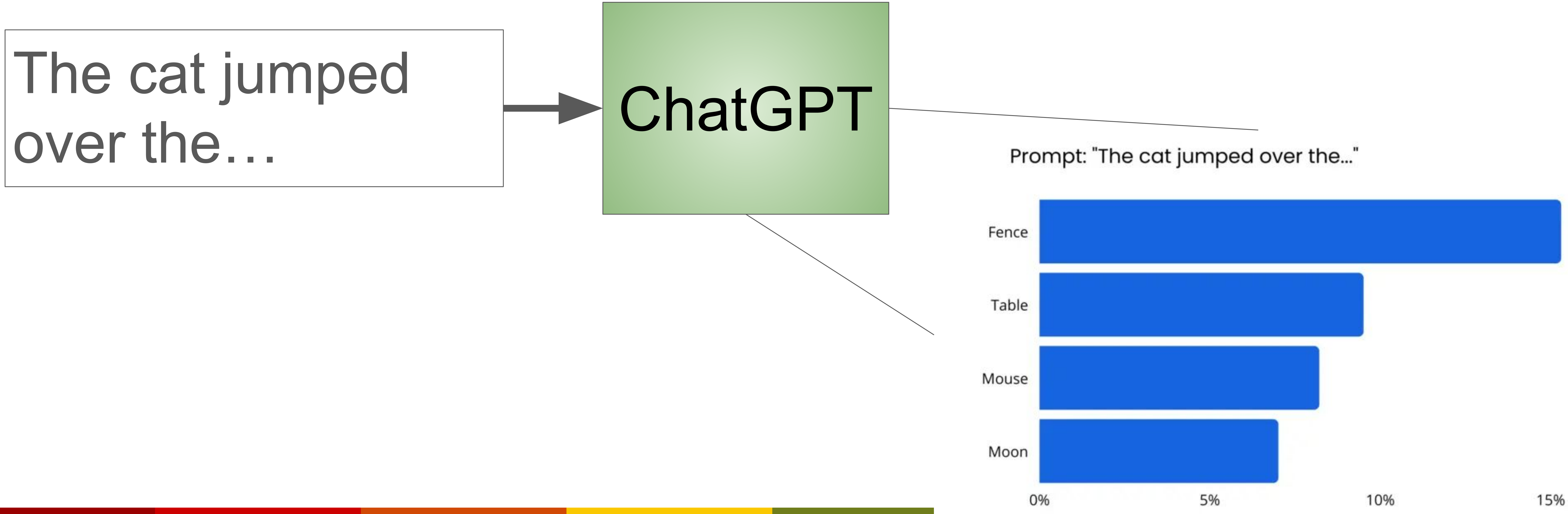
They lack *context*.

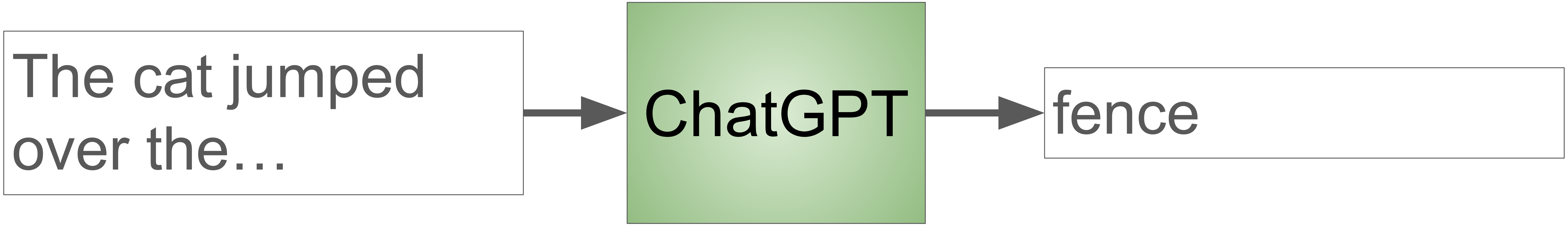
So, actual language models do more than bigrams. ChatGPT uses a neural network.



What goes into the Input Layer?




The cat jumped over the…
ChatGPT
Prompt: "The cat jumped over the..."
Fence
Table
Mouse
Moon
0%
5%
10%
15%


The cat jumped over the…
ChatGPT
fence

Some Neural Networks are Probabilistic

Complete the sentence, "the cat jumped over the..."

...fence."

Complete the sentence, "the cat jumped over the..."

...lazy dog."

Complete the sentence, "the cat jumped over the..."

...candlestick."

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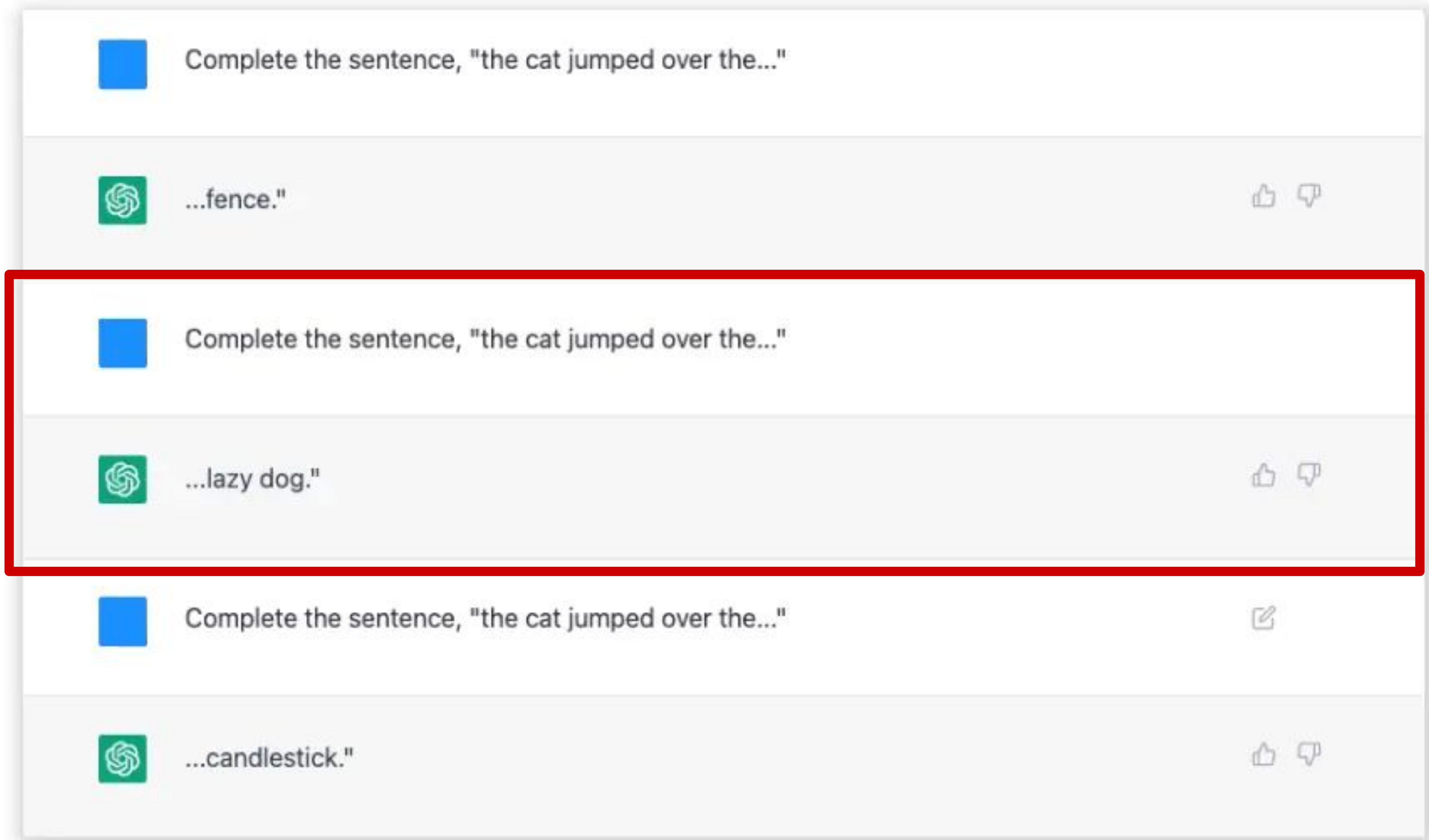
Some Neural Networks are Probabilistic



Some Neural Networks are Probabilistic

Key Takeaway 1:
Garbage in, Garbage out

Lots of hidden complexities and risks

Bias

Hallucinations (a.k.a. Correctness)

Privacy

Bias

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Sources of bias

Training data

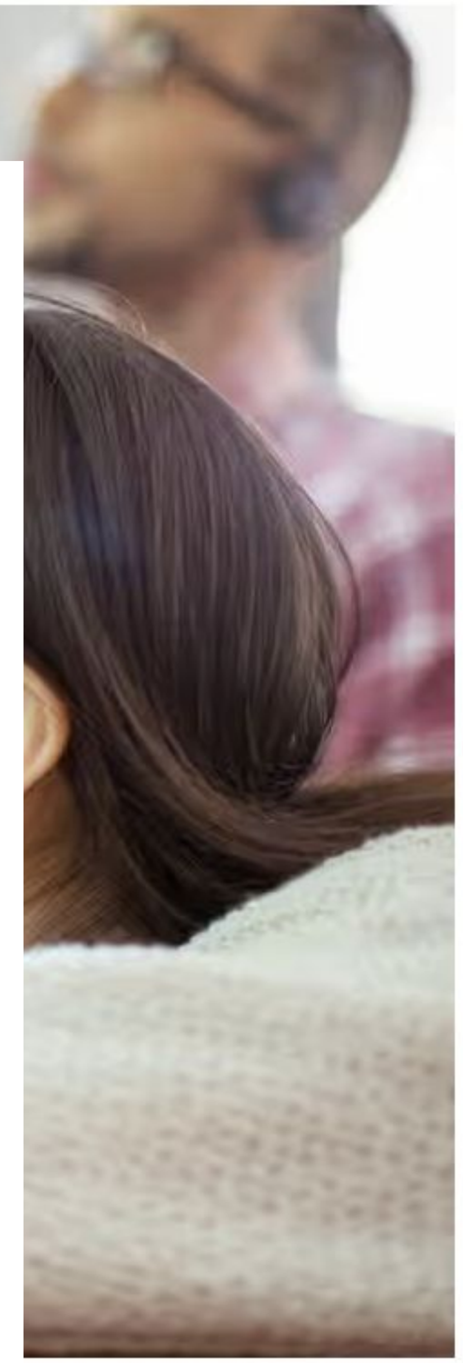
Algorithmic bias (e.g., color is more important than shape in classifying fruit)

Cognitive bias (e.g., based on societal factors)

Bias is common

Women less likely to be shown ads for high-paid jobs on Google, study shows

Automated testing and analysis of company's advertising system reveals male job seekers are shown far more adverts for high-paying executive jobs



Insight - Amazon scrap
recruiting tool that sho
women

TECH

Apple cofounder Steve Wozniak says Apple Card offered his wife a lower credit limit

Isobel Asher Hamilton Nov 11, 2019, 7:21 AM ET

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How can we detect bias or prevent bias?

Explicitly test for bias using datasets designed for that purpose

Train models on unbiased datasets

Reinforcement learning (use rewards and punishments in training)

Hallucinations

Hallucinations

It's when an AI creates something that isn't real.

Tell me everything you know about orcas.

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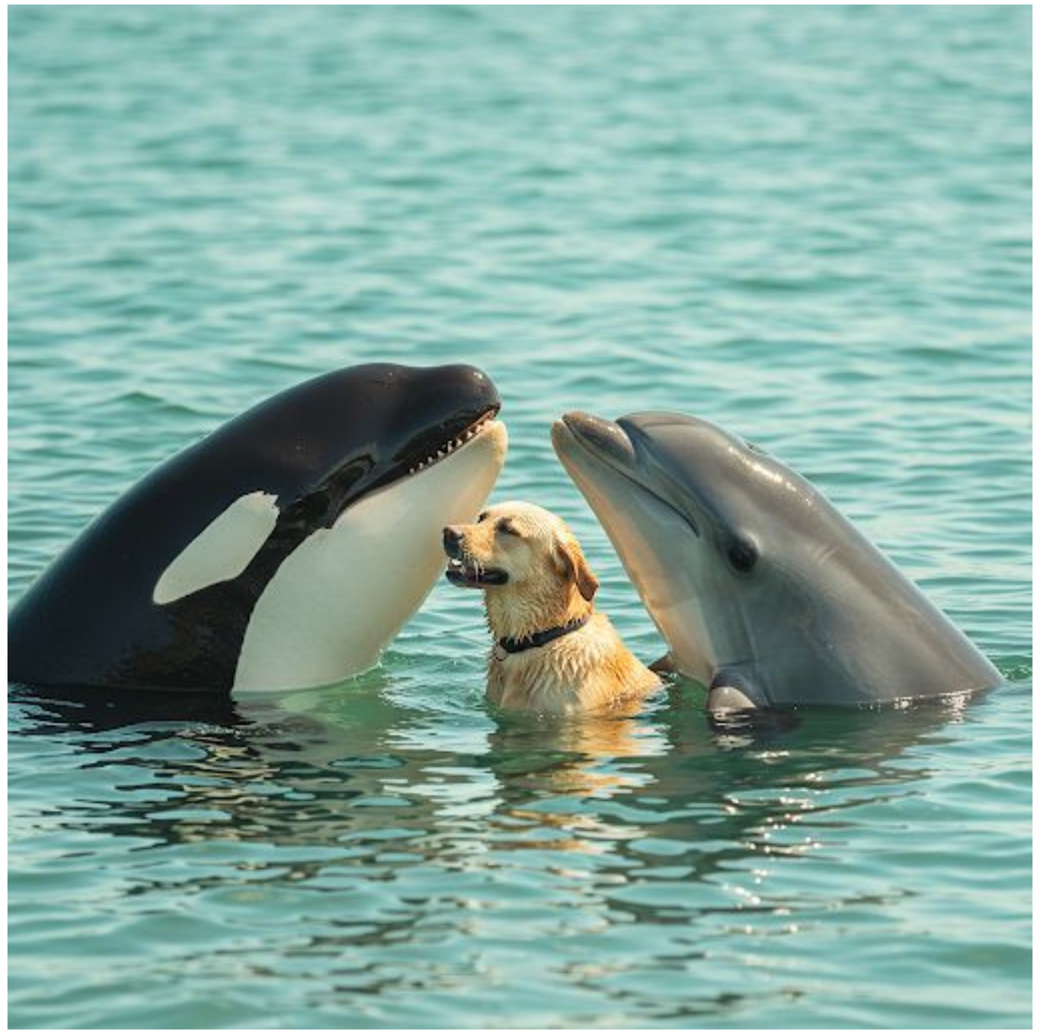
AI

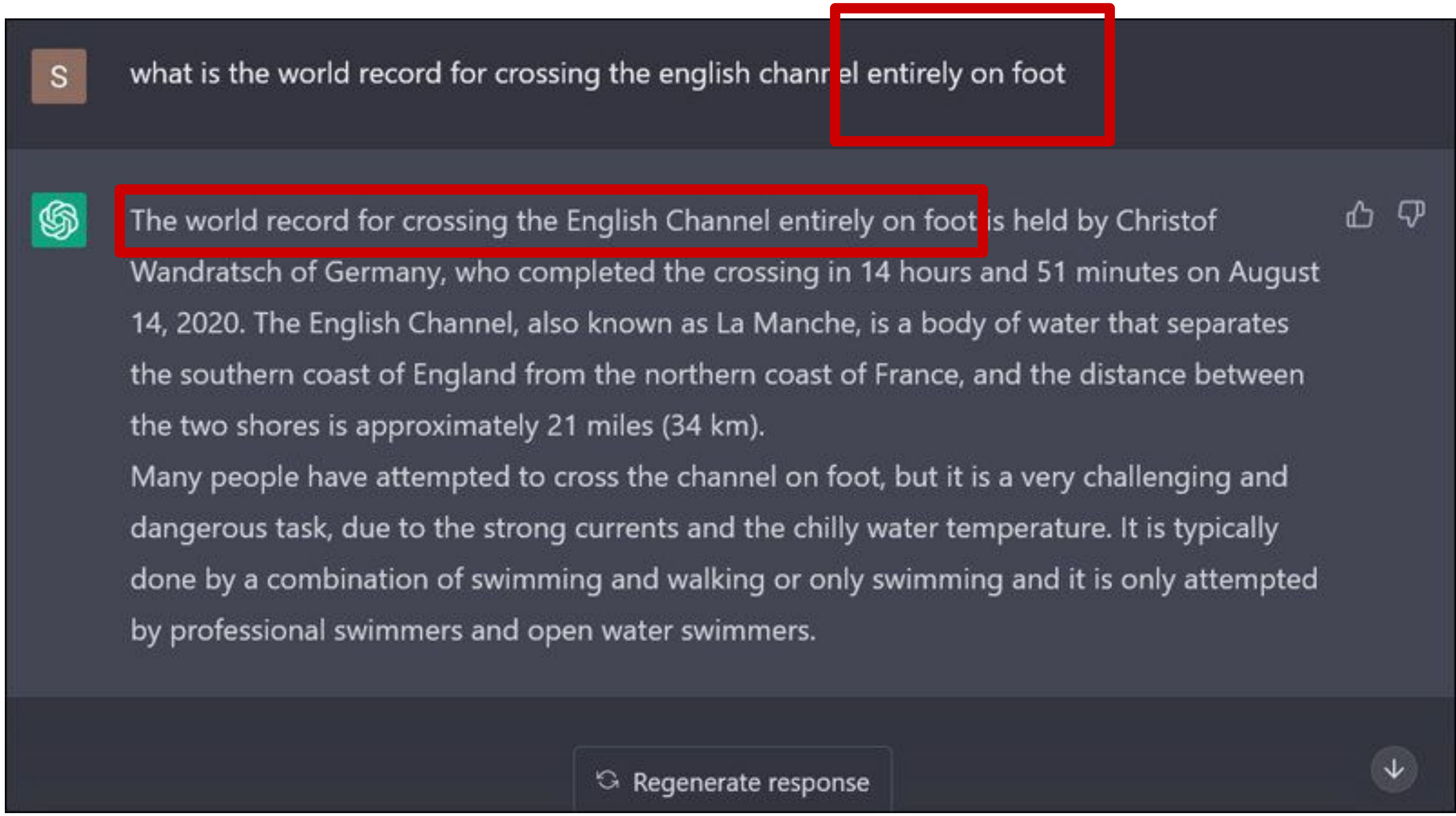


AI

Real

Hallucinations

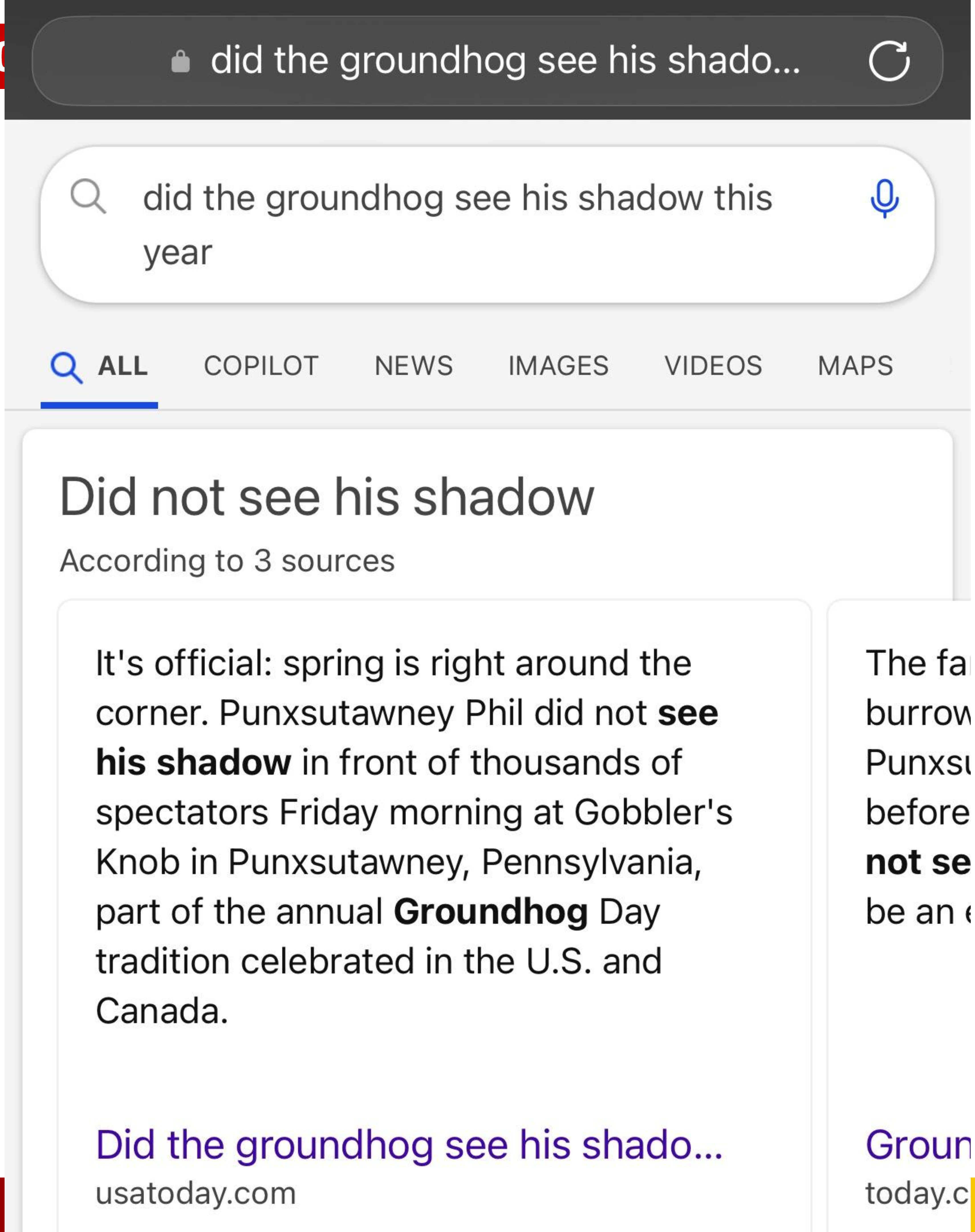
It’s when an AI creates something that isn’t real.

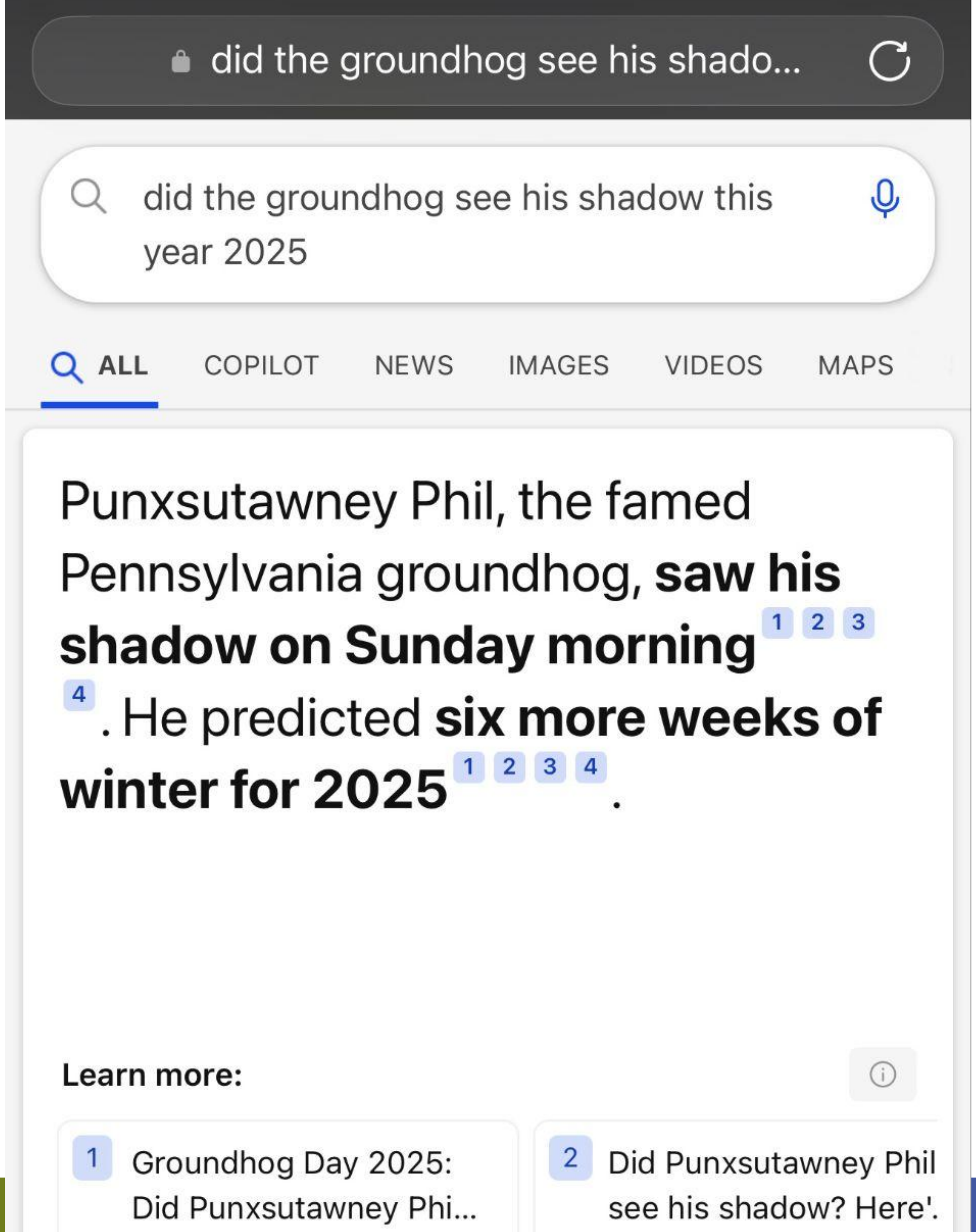


Hallucinations

It's when an AI creates something that isn't real.

More insidiously…


did the groundhog see his shado...
did the groundhog see his shadow this year
ALL
COPILOT
NEWS
IMAGES
VIDEOS
MAPS
Did not see his shadow
According to 3 sources
It's official: spring is right around the corner. Punxsutawney Phil did not see his shadow in front of thousands of spectators Friday morning at Gobbler's Knob in Punxsutawney, Pennsylvania, part of the annual Groundhog Day tradition celebrated in the U.S. and Canada.
Did the groundhog see his shado...
usatoday.com


did the groundhog see his shado...
did the groundhog see his shadow this year 2025
ALL
COPILOT
NEWS
IMAGES
VIDEOS
MAPS
Punxsutawney Phil, the famed Pennsylvania groundhog, saw his shadow on Sunday morning [1] [2] [3] [4]. He predicted six more weeks of winter for 2025 [1] [2] [3] [4].
Learn more:
1 Groundhog Day 2025: Did Punxsutawney Phi...
2 Did Punxsutawney Phil see his shadow? Here'.

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Key Takeaway 2:
Ask multiple times, multiple ways

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ChatGPT is not a calculator

378 + 63 = 441. Let's' ask Gemini if it's correct…

ChatGPT is not a calculator

378 + 63 = 441. Let's' ask Gemini if it's correct…

Oops, a typo! Or, my math was wrong?

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Key Takeaway 3:
ChatGPT doesn’t “think” or “compute”

Privacy

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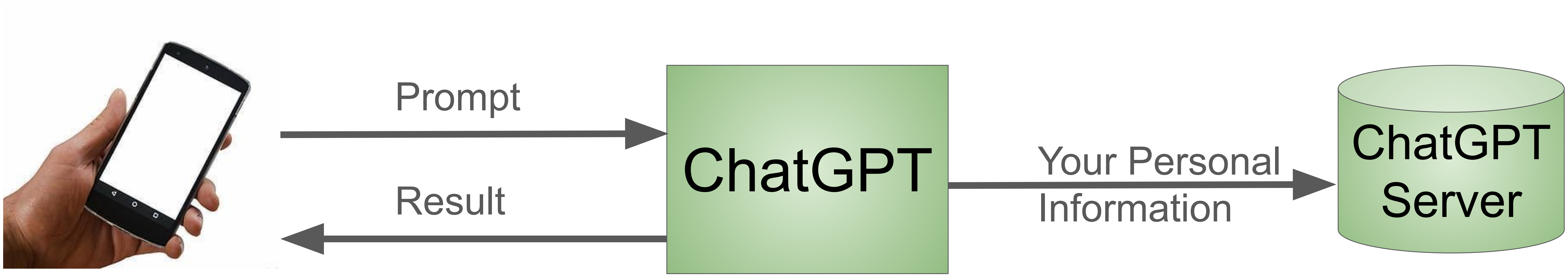
Privacy

Everything you tell an LLM is no longer private.



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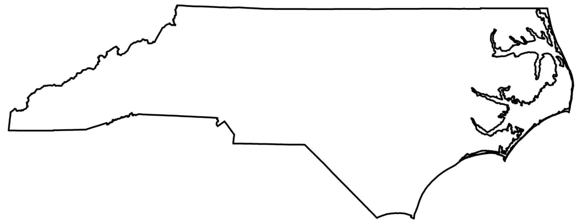
Summary

1. Garbage in, Garbage out: an AI is only as good as its data
2. Ask multiple times, multiple ways to detect potential hallucinations
3. AI doesn’t “think” or “compute”, it pattern-matches

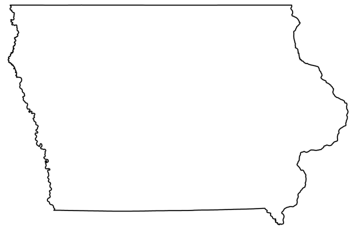
Enough about AI…
What about my research?

Who am I?

2016 – present: Associate Professor at NC State University



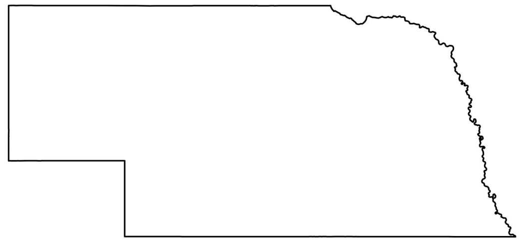
2013 – 2015: Assistant Professor at Iowa State University



2008 – 2013: Graduate Student at University of Nebraska-Lincoln

M.S. in Computer Science

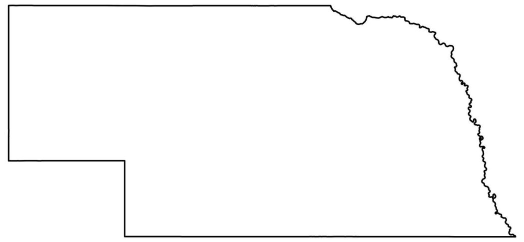
Ph.D. in Computer Science

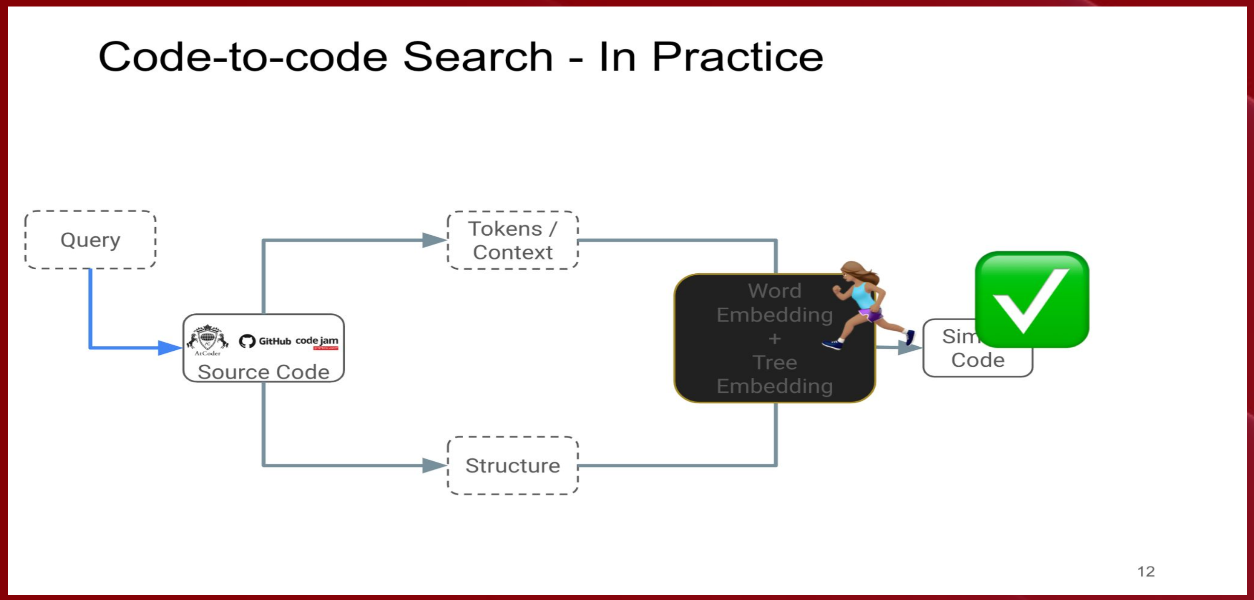


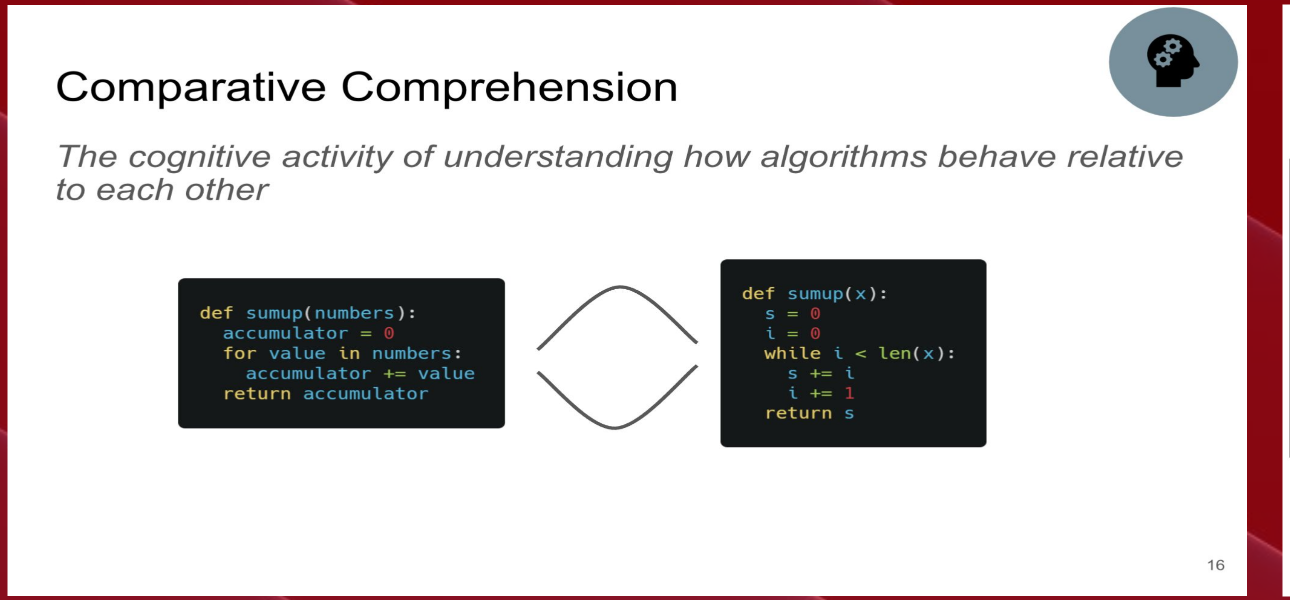
2004 – 2008: Undergraduate Student at University of Nebraska-Lincoln

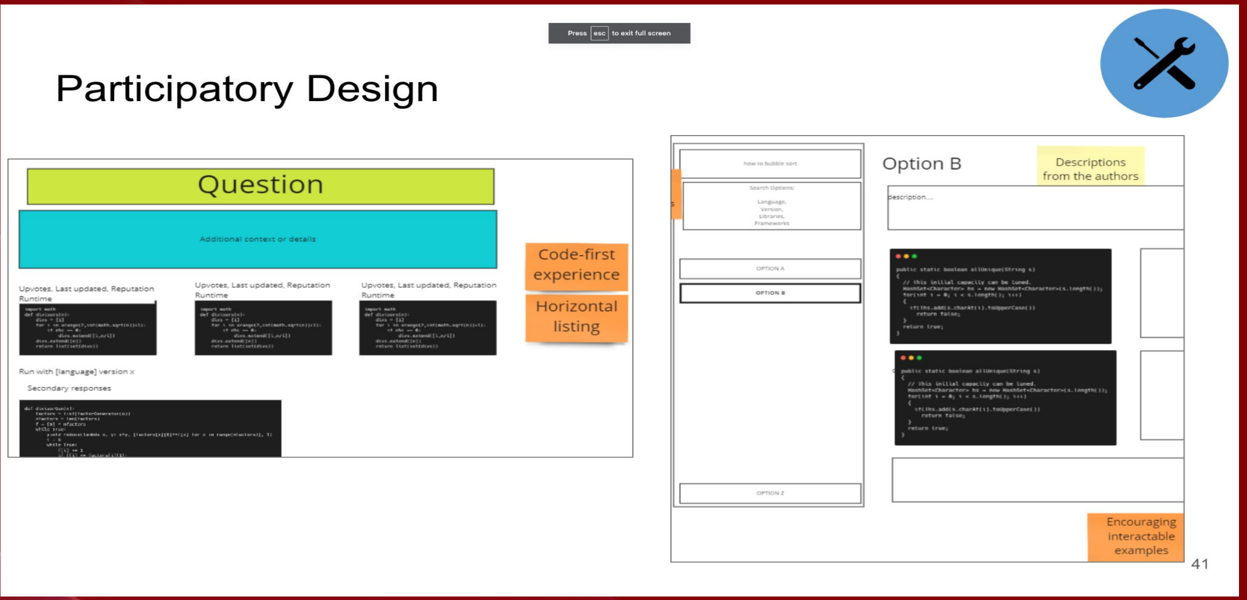
Major: Computer Science

Minor: Business Administration









FIND IT

THINK IT

CHOOSE IT

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Questions?

Credits

https://newsletter.pnote.eu/p/shakespeare-language-model

https://www.scalablepath.com/machine-learning/chatgpt-architecture-explained