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Artificial Intelligence

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Professor IIT Kharagpur**



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IN THIS BUILDING DURING THE SUMMER OF 1956

JOHN McCARTHY (DARTMOUTH COLLEGE), MARVIN L. MINSKY (MIT)
NATHANIEL ROCHESTER (IBM), AND CLAUDE SHANNON (BELL LABORATORIES)
CONDUCTED

THE DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

FIRST USE OF THE TERM "ARTIFICIAL INTELLIGENCE"

FOUNDING OF ARTIFICIAL INTELLIGENCE AS A RESEARCH DISCIPLINE

"To proceed on the basis of the conjecture
that every aspect of learning or any other feature of intelligence
can in principle be so precisely described that a machine can be made to simulate it."

IN COMMEMORATION OF THE PROJECT'S 50th ANNIVERSARY
JULY 13, 2006

1956 Dartmouth Conference: The Founding Fathers of AI



John McCarthy



Marvin Minsky



Claude Shannon



Ray Solomonoff



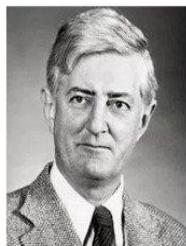
Alan Newell



Herbert Simon



Arthur Samuel



Oliver Selfridge



Nathaniel Rochester



Trenchard More





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Major Milestones in AI history

The term "Artificial Intelligence" was proposed at the Dartmouth Summer Research Project on AI

Creation of ELIZA, the first chatbox

Introduction of Transfer Learning

First CNN paper

1950

1959

1975

1979

1997

Alan Turing proposed the Turing test

The term "Machine Learning" was introduced

The first AI program applied to medicine (MYCIN) was published

Invention of "neocognitron" an artificial neural network which was an inspiration for CNNs

Launching of DALL-E 1 & AlphaFold Project

FDA clearance for cloud-based deep learning (Arterys)

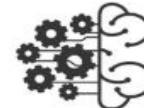
Creation of the ImageNet dataset

Kasparov Proves No Match for Computer

By Rajiv Chandrasekaran

Washington Post Staff Writer

Monday, May 12, 1997; Page A01



2022

2018

2011

2002

2021

2017

2006

Launching of ChatGPT

FDA clearance for AI software that detects diabetic retinopathy

IBM's Watson defeats "Jeopardy"

Launching of Torch library



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Turing Test

- (Human) judge communicates with a human and a machine over text-only channel.
- Both human and machine try to act like a human.
- Judge tries to tell which is which.
- Numerous variants

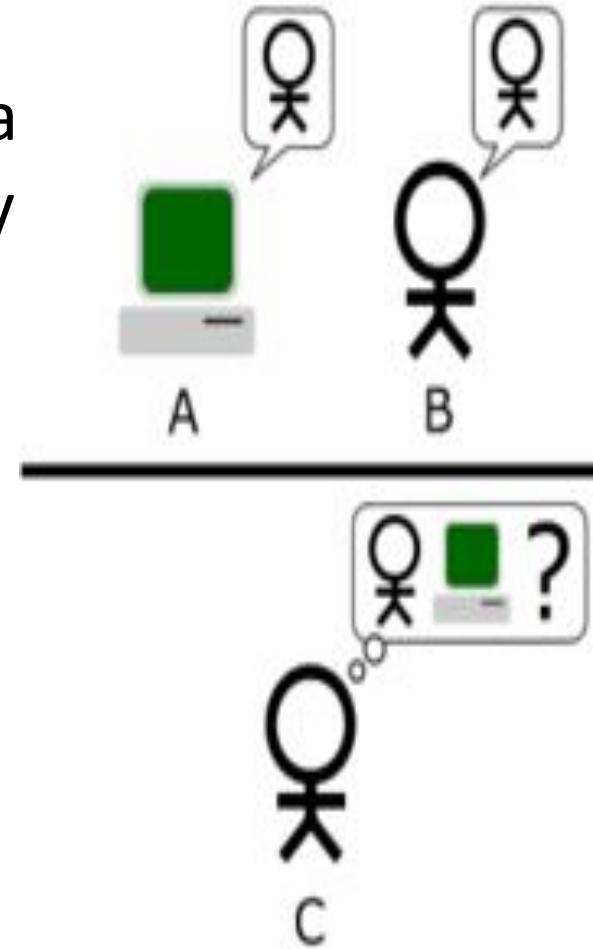


image from http://en.wikipedia.org/wiki/Turing_test



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Turing Test on Unsuspecting Judges

- It is possible to (temporarily) fool humans who do not realize they may be talking to a bot
- ELIZA program [Weizenbaum 66] rephrases partner's statements and questions (~psychotherapist)



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```
EEEEEEEEE L      IIIIIII ZZZZZZZZ      AAA
E          L      I          Z      A   A
E          L      I          Z      A   A
EEEEEE    L      I          Z      A   A
E          L      I          Z      AAAAAAAA
E          L      I          Z      A   A
EEEEEEEEE LLLLLLLL IIIIIII ZZZZZZZZ      A   A
```

ELIZA > (PLEASE TYPE IN ALL CAPS) WHAT'S YOUR NAME DEAR ?

AMIT

ELIZA > HI, I'M ELIZA. WHAT DO YOU WANT TO TALK ABOUT ?

AMIT > CAN I TALK ABOUT MY PROBLEM ?

ELIZA > SURE... !

AMIT > DUE TO ON GOING EXAMS IN COLLEGE, I HAVE A LOT OF STRESS.

ELIZA > PLEASE RELAX A LITTLE. SLEEP WELL.

AMIT > THANKS FOR YOUR ADVICE.

ELIZA > NO MENTION.

AMIT > BYE

ELIZA > BYE AND KEEP IN TOUCH...



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ELIZA: Is something troubling you ?
YOU: life is meaningless
ELIZA: Do you feel strongly about discussing such things ?
YOU: everyone is born, grows and dies
ELIZA: Who, for example?
YOU: you
ELIZA: You're not really talking about me -- are you ?
YOU: me
ELIZA: That is interesting. Please continue.
YOU: what is the purpose of sucess and happiness
ELIZA: Are such questions much on your mind ?
YOU: all the time
ELIZA: Tell me more about that.
YOU: why should i study
ELIZA: That's quite interesting.
YOU: i cant take my knowledge with me
ELIZA: Is it important to you that your knowledge with you ?
YOU: i cant take anything with me
ELIZA: Have you tried ?
YOU: i'll have to die for that
ELIZA: Can you elaborate on that ?



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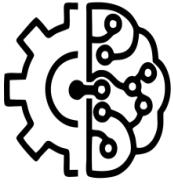
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What is Artificial Intelligence

“[The automation of] activities that we associate with human thinking, activities such as decision making, problem solving, learning” (Bellman 1978)

“The study of mental faculties through the use of computational models” (Charniak & McDermott, 1985)

Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally



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Good Old AI Days



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Representing Knowledge

- Logic
- Rules
- Semantic Graphs/Nets



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A Few Statements

- All people who are graduating are happy.
- All happy people smile.
- Someone is graduating.
- Is someone smiling? (Conclusion)



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Predicates

1. For all (x) graduating (x) \rightarrow happy (x)

2. For all (x) happy (x) \rightarrow smiling (x)

3. There exists (x) graduating (x)



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Rule Based Inference Example

(R1) if gas_in_engine and does not start, then
problem(spark_plugs).

(R2) if not (does not start) and not (lights_on), then
problem(battery).

(R3) if not(turns_over) and light_on, then problem(starter).

(R4) if gas_in_tank and gas_in_carb, then gas_in_engine

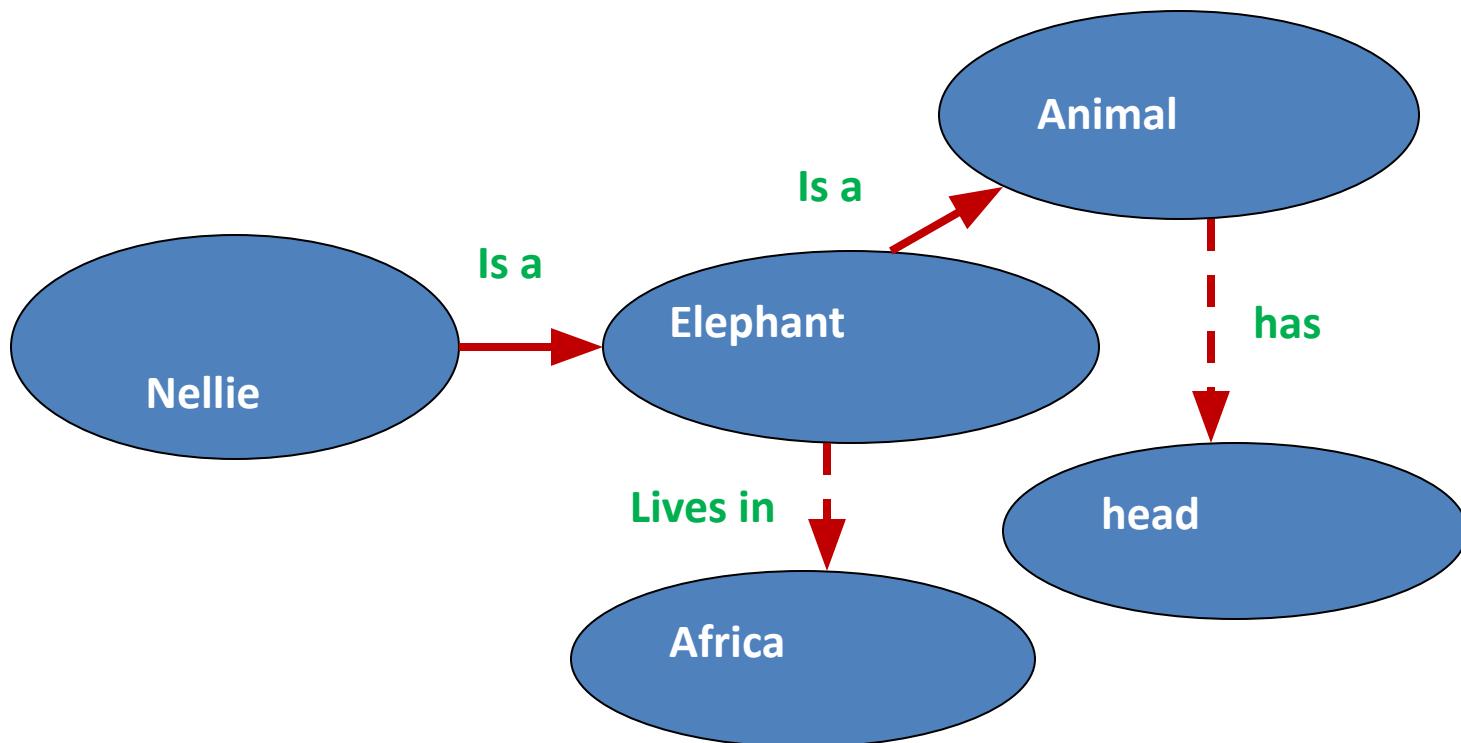


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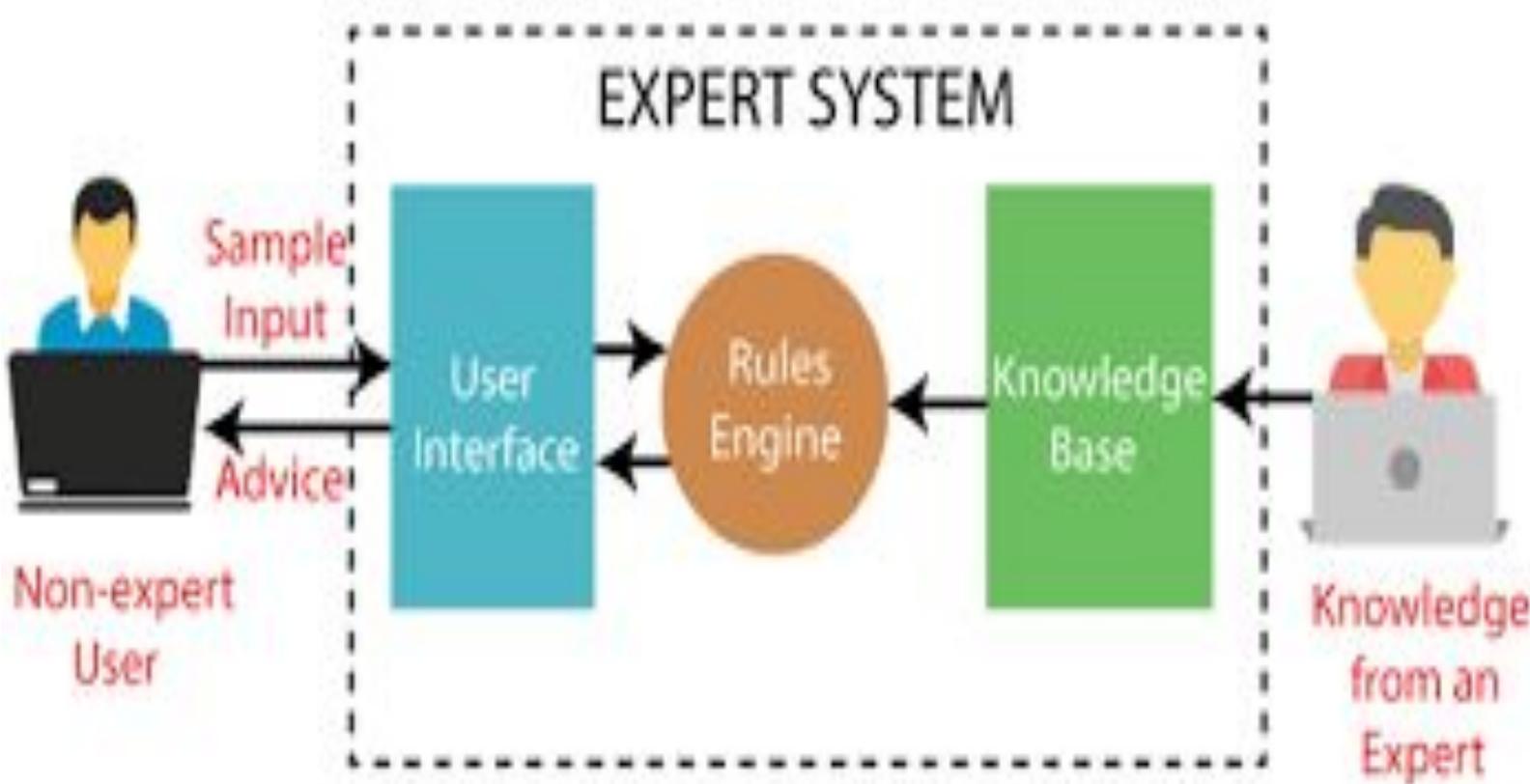
Semantic Nets





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Hit the Wall

- **Ambiguity:** highly funded translation programs (Russian to English) were good at syntactic manipulation but bad at disambiguation

“The spirit is willing but the flesh is weak” becomes
“The vodka is good but the meat is rotten”

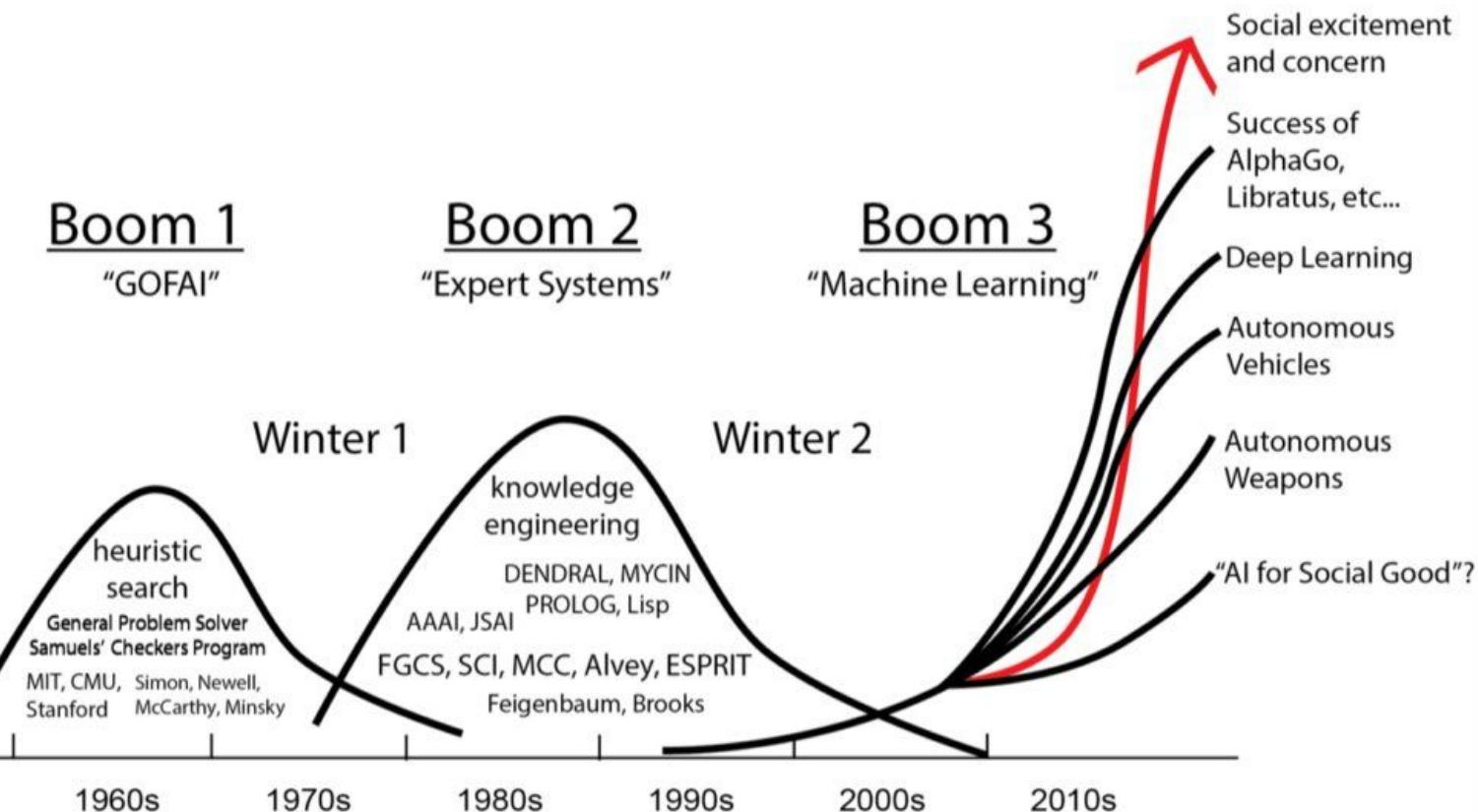
- **Scalability/complexity:** early examples were very small, programs could not scale to bigger instances
- Limitations of **representations** used



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AI Winter





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Machine Learning



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Data



Data is the New Oil



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- Collection of measurements or observations that can be used to train a model.
- Can be categorical (cats,dogs,lion,etc), ordinal (tall, medium, short), continuous (10-15,15-20,20-25,...).

Data

Type of Media	Amount per Minute	Amount per Day
Emails sent	231.4 million	333.22 billion
Crypto purchased	90.2 million	129.89 billion
Texts sent	16 million	24.04 billion
Google searches	5.9 million	8.5 billion
Snaps shared on Snapchat	2.43 million	3.5 billion
Pieces of content shared on Facebook	1.7 million	2.45 billion
Swipes on Tinder	1.1 million	1.58 billion
Hours streamed	1 million	1.44 billion
USD spent on Amazon	443,000	637.92 million
USD sent on Venmo	437,600	630.14 million
Tweets shared on Twitter	347,200	499.97 million
Hours spent in Zoom meetings	104,600	150.62 million
USD spent on DoorDash	76,400	110.02 million

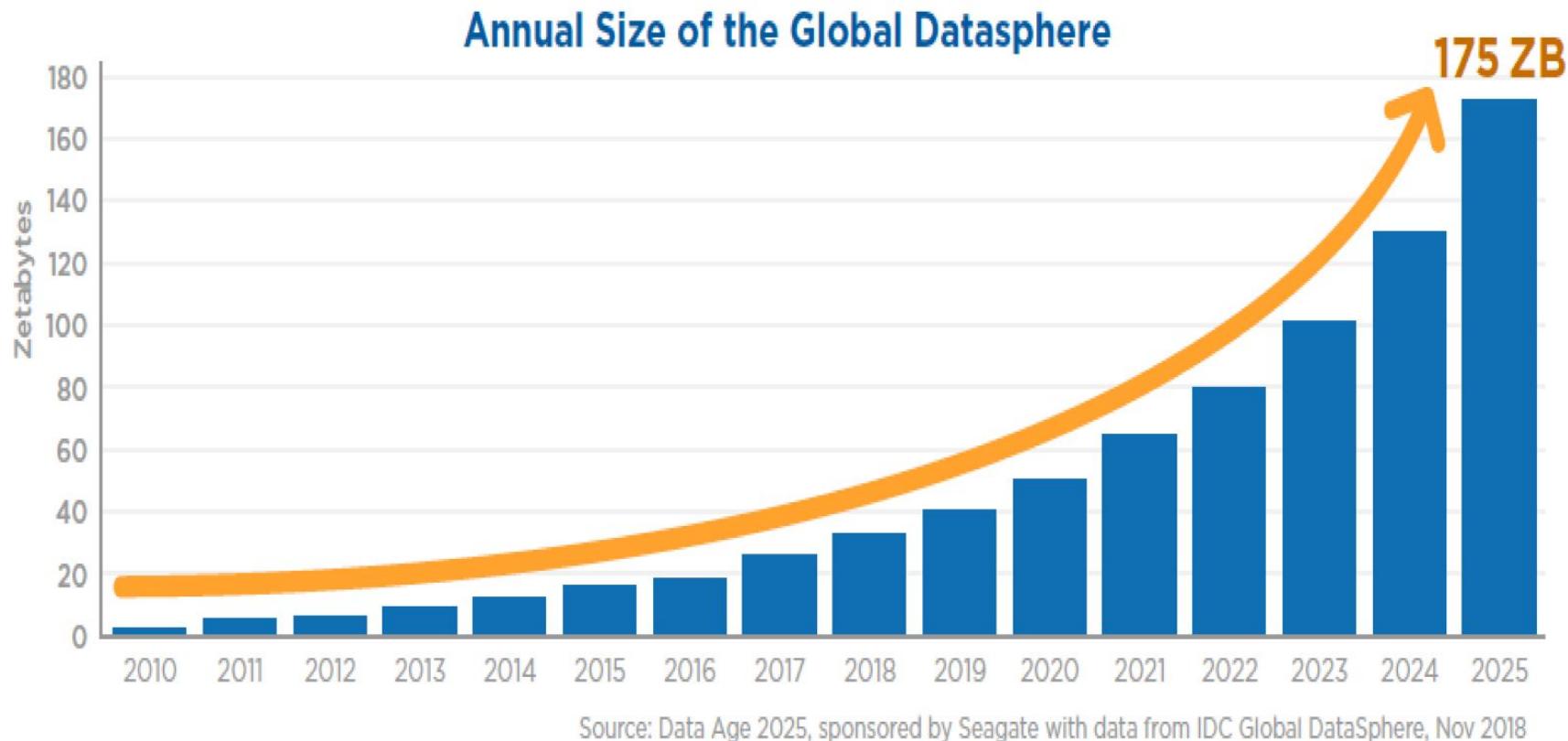


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Data





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Machine Learning

- a field of **study** in **artificial intelligence** concerned with the development and study of **statistical algorithms** that can **learn** from data (seen data) and **generalize** to unseen data and thus perform tasks without explicit instructions.
- “a computer program is said to learn from **experience E** with respect to some **task T** and some **performance measure P**, if its performance on T, as measured by P, **improves** with experience E.” - Tom Mitchell, 1997

Emergence of Supervised Learning



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Supervised Learning Human Perspective

- Scenario [How a child learns]
 - Below are the images of cats and dogs

Cats



Dogs





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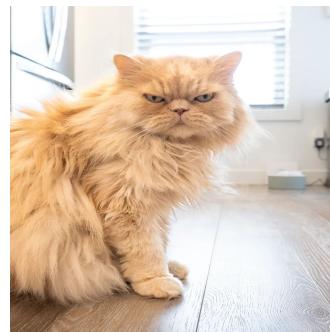
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Supervised Learning

Human Perspective

– Scenario [How a child learns]

- Now, we provide the child with some images and ask the child which is what?





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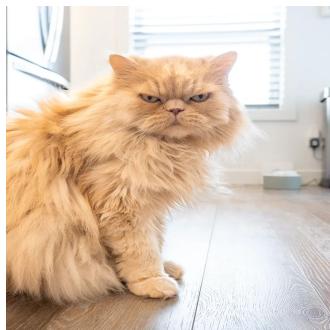
Supervised Learning

Human Perspective

– Scenario [How a child learns]

- Child guesses the images are cats and dogs as shown below.

Cats



Dogs



How did a child know?



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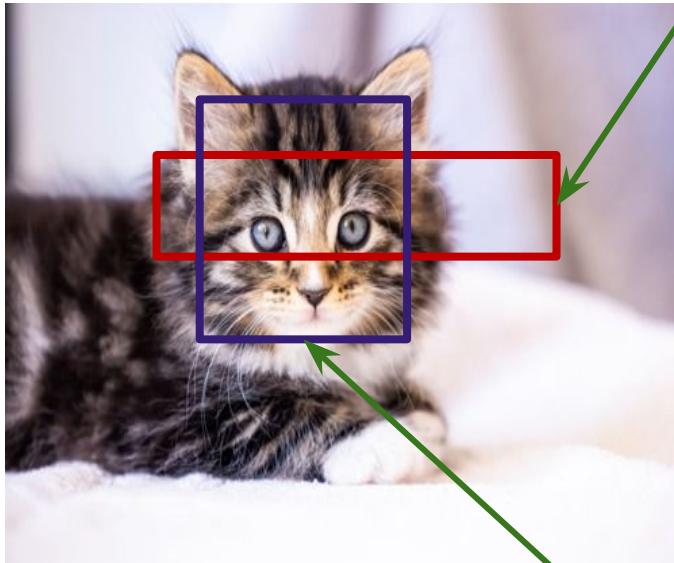
Supervised Learning

Human Perspective

– Scenario [How a child learns]

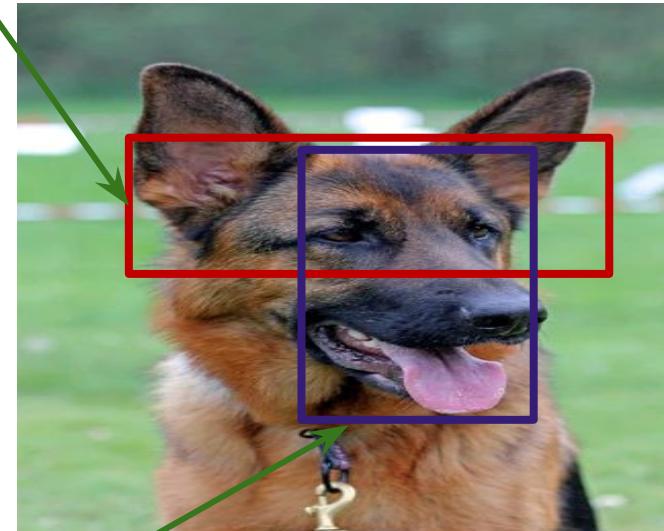
- The child understood the features which **distinguishes dogs from cats!**

Cats



Eyes

Dogs



Facial Features



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Supervised Learning Model Perspective

– Model Perspective

- If we are to use a machine learning model which tells us how to decide/classify which is a cat or dog, we train the model on the images as shown below

Cats



Dogs



Train



Machine Learning
Model



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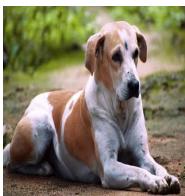
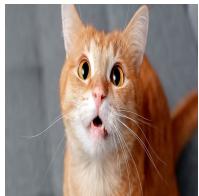
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Supervised Learning Model Perspective

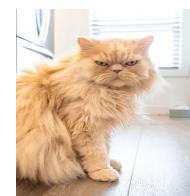
– Procedure :

- Divide Dataset into Train and Test

Training Dataset



Testing Dataset





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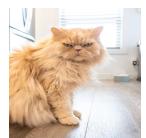


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Supervised Learning Model Perspective

– Procedure

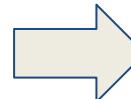
- Predict the classes from the Model on the images in the similar manner



Feature
Extractor



Feed



Machine
Learning
Model



Predict



Cats



Dogs





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Problems with Data Annotation

- Supervised Learning requires labelled data.
- Large amounts of data available (in Zettabytes).
- Almost all are unlabelled.
- Cannot label each and every data be it image, text, audio, video, molecules etc. **Labour Intensive**
- What can we **do?**





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Unsupervised Learning

When data is unlabelled



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Unsupervised Learning

– Definition :

Type of learning where data is **unlabelled/unknown** and models learn these type of data for hidden patterns or data groupings.

– Types :

- **Clustering** : Discover **groupings** from unknown data.
Example : Spam Emails
- **Association** : Find out **rules** to express your unknown data. Example : Recommendation System



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Unsupervised Learning

– Scenario [Human Behavior]

- Suppose your class is being ready for a group photograph and taking positions in order of heights.
- You do not possess any prior knowledge of the heights of your classmates.





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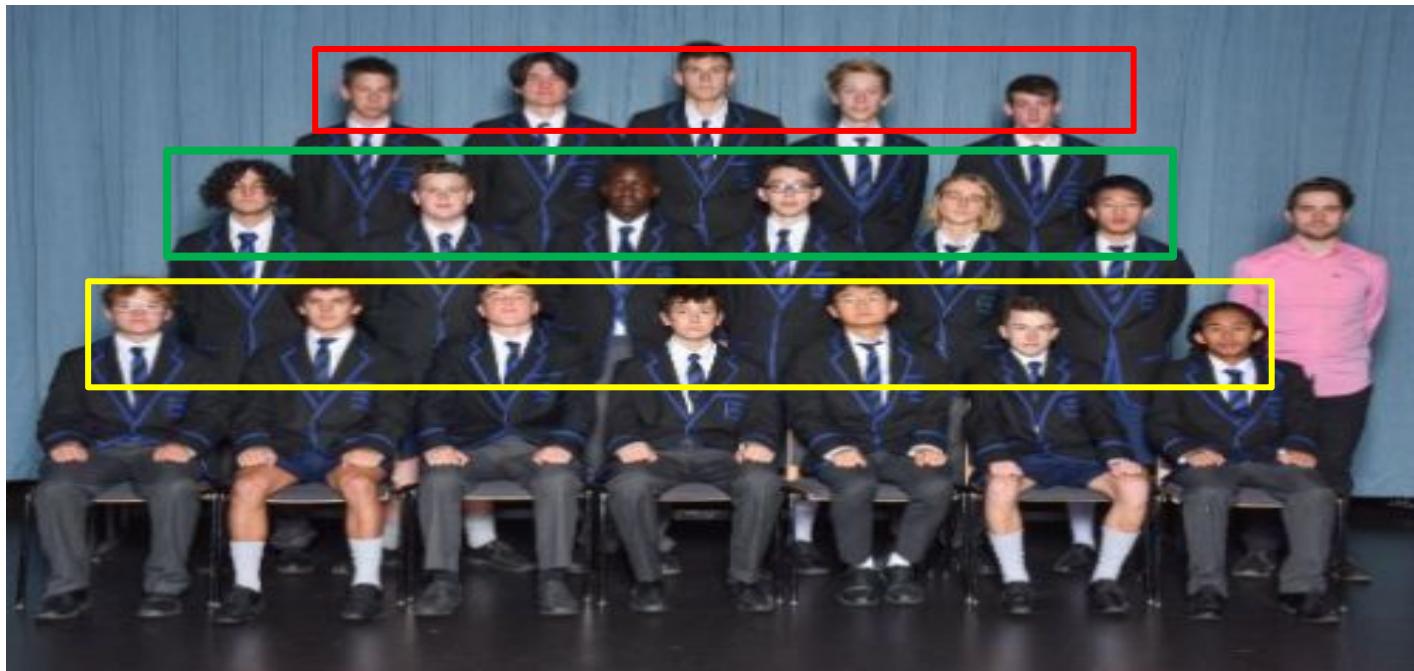


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Unsupervised Learning

– Scenario [Human Behavior]

- You try to get into a position according to the height.
- You figure it out without being told as to where to stand.





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Unsupervised Learning

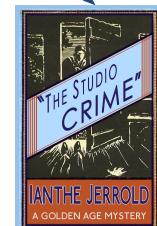
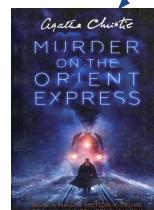


Cluster of
Detective
Novels

Those who bought
this



also bought these



Recommender Systems
Example of Unsupervised Learning



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Semi Supervised Learning

- Definition :
 - Supervised \cap Unsupervised
 - Using labelled and unlabelled data for classification and regression tasks.
 - Number of labelled data is usually much less than that of unlabelled data.
 - Primarily dealing with unlabelled data.
- One such example is pseudo labelling.

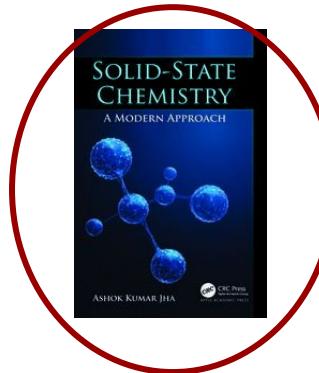
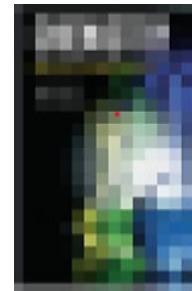
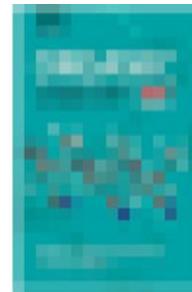
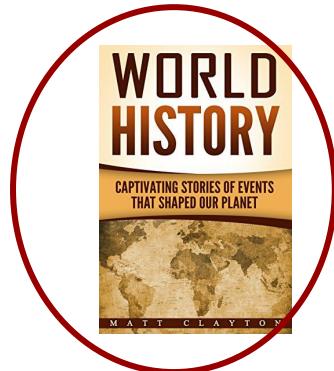


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Semi Supervised Learning



Books are present, know labels of some and not of others



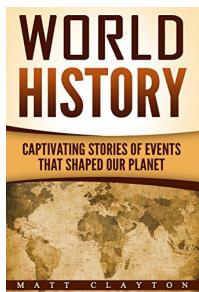
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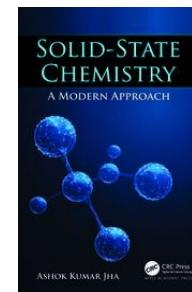
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Semi Supervised Learning

We know the labels of these 2 books among other books



History



Chemistry

How can we get to know about the class of other books?



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Semi Supervised Learning

History



Chemistry



We use Clustering Algorithm (Unsupervised Learning) to cluster similar books (based on content) and label them!



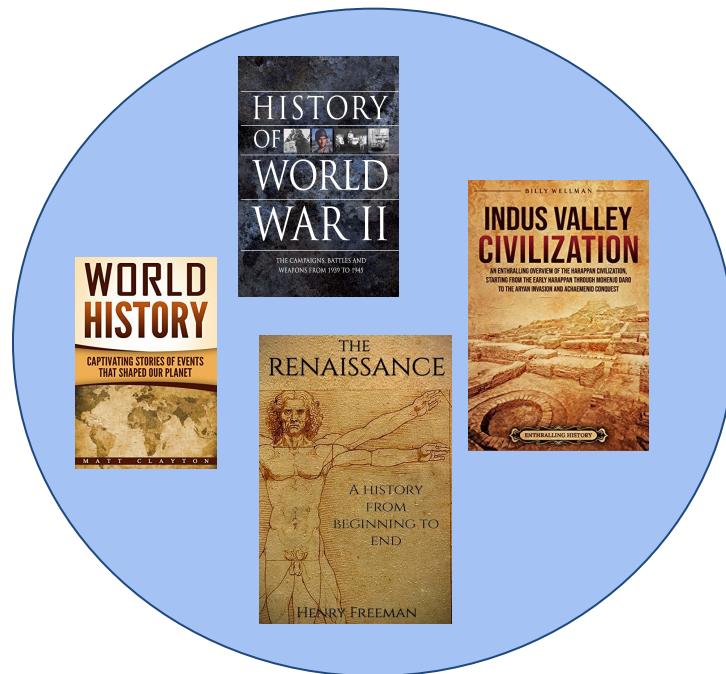
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Semi Supervised Learning

History



Chemistry



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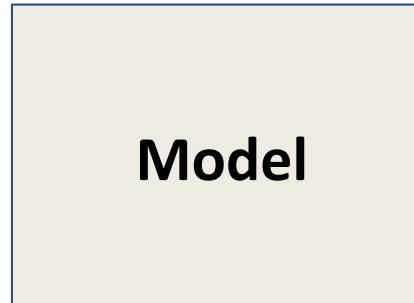
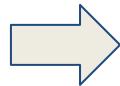
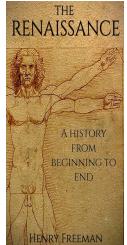
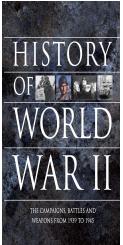
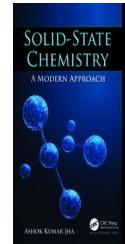
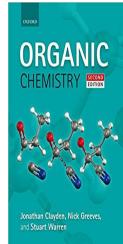
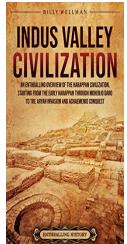
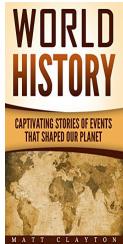


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Semi Supervised Learning



Learned
Parameters

History

Chemistry

We then use these labelled data and train our Model in a
Supervised Learning Manner!



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Types of Learning

Supervised Learning

Unsupervised Learning

Semi-Supervised Learning.

Ensemble Learning [combining models together]

Self Supervised Learning [how we learn language]

Reinforcement Learning [how robot learns]



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Discriminative And Generative Tasks

— Discriminative Tasks : Classification

- Identify whether Cat or Dog
- Identify whether the next word would be noun or pronoun.

— Generative Tasks :

- Generates sentences based on instruction.



ChatGPT



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Generative Task is a Discriminative Task!

Consider the well known sentence containing all the English Alphabets -

“The quick brown fox jumps over a lazy dog”

Suppose Given

“The quick brown

The model needs to generate the entire sentence



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Generative Task is a Discriminative Task!

Task given “The quick **brown**” classify which of the following words will be the next word.

[**fox, ox, tiger, ant, duck**] — the model I classify “**fox**” as 1 and the rest as 0.

Recursively Given “The quick **brown fox**”, classify which word will be the next word — the model classify “**jumps**”

Given .“The quick **brown fox jumps**”, classify which word will be the next word — the model will classify “**over**” and so on....

We observe that if a series of such **Prediction** (or) **Classification** task (or) **Discriminative** Task are done, and each word predicted is appended with the phrase and run again for Prediction, we get a sentence.



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Generative Task is a Discriminative Task!

Et Voila! We find that **Generative Task is a Sequence of **Discriminative** Task!**



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Outcomes of HAAI

Cohort 2

- Concepts of Machine Learning from Basics to Advanced (Supervised, Unsupervised, Semi supervised).
- Introduction to Reinforcement Learning.
- Concepts of Deep Learning from Basics to Advanced.
- Foundations of Generative AI.

- Hands on with Python Programming Language, Python ML tools, Pytorch and Mathematical Foundations.



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Happy Learning!!

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End of Slides