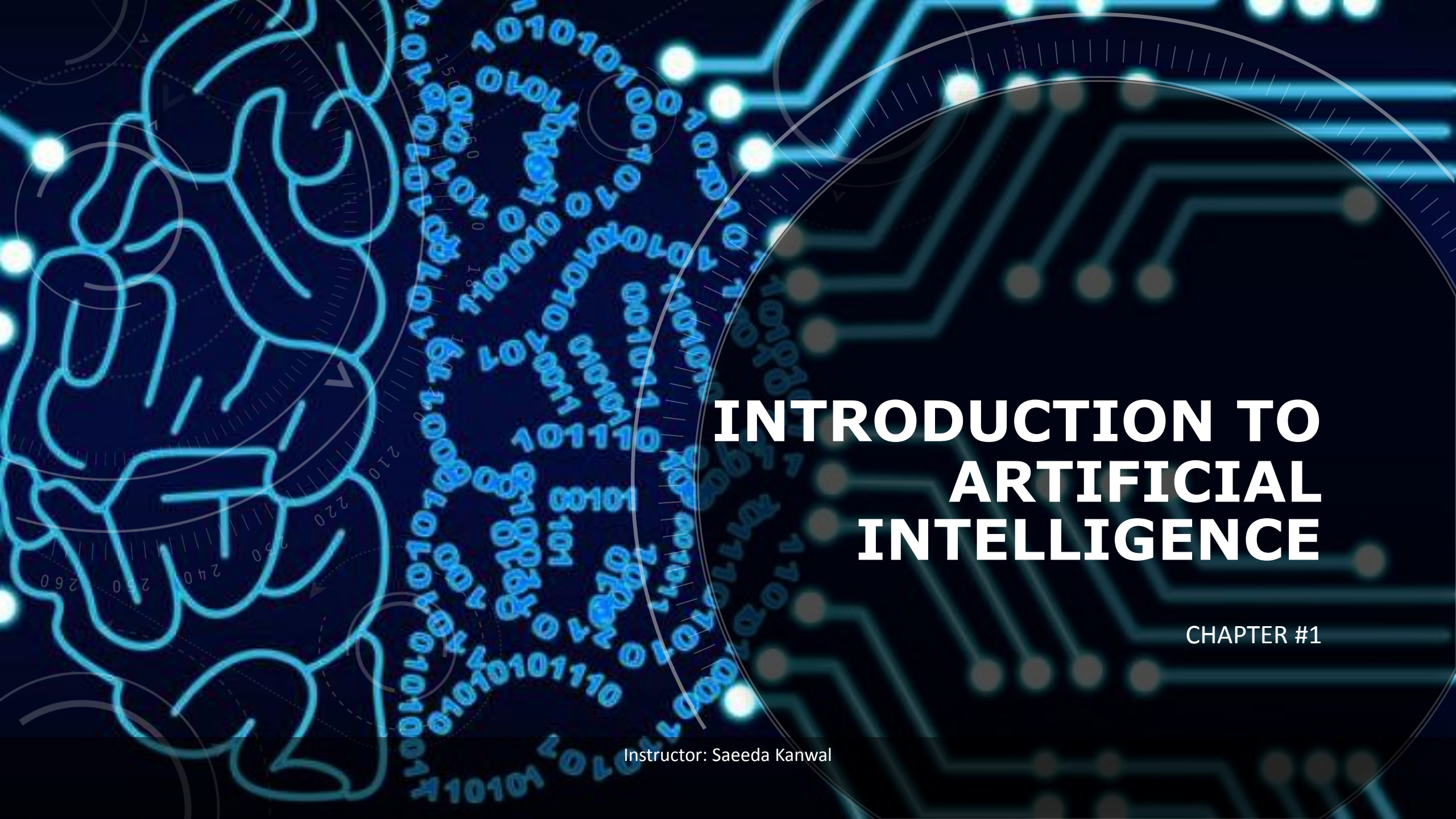
GOOGLE CLASSROOM



INTRODUCTION TO ARTIFICIAL INTELLIGENCE

CHAPTER #1

Instructor: Saeeda Kanwal

COURSE CATALOG

1: Introduction (Agents)

2: Uninformed Search

3: Informed Search

4: CSPs

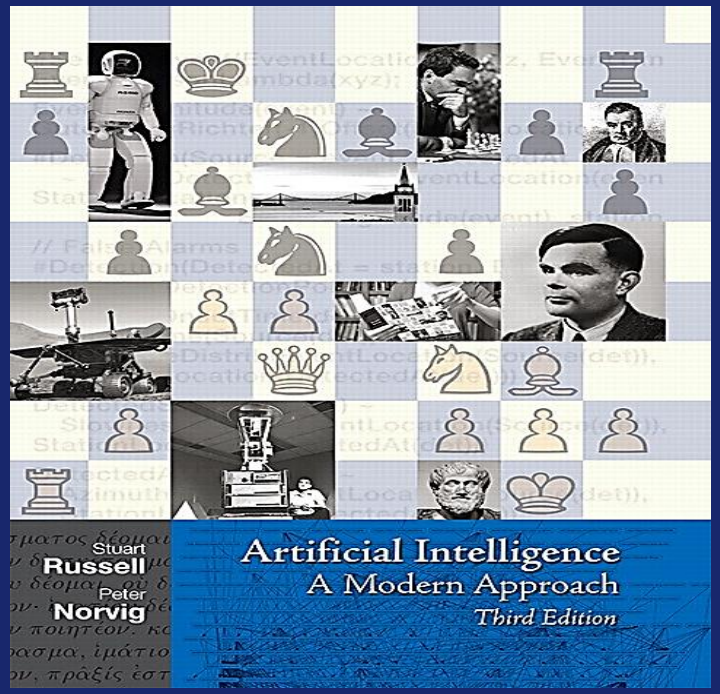
5: Adversarial Search

6: Knowledge based agents

7: Uncertainty

8: Learning

TEXTBOOK



Artificial intelligence: A modern approach (3rd edition), Stuart Russell and Peter Norvig

MARKS DISTRIBUTION

- **Assignments 5**
- **Mid exams 15+15**
- **Project 10**
- **Class Participation 5**
- **Final 50**

AGENDA

- Introduction to artificial intelligence?
- A very brief history of AI
- Foundations of AI
- AI state of Art
  - How much progress has been made in different aspects of AI

WHAT MAKES HUMAN INTELLIGENT?

Learn

Learning and Adapting by Experiences from Surroundings

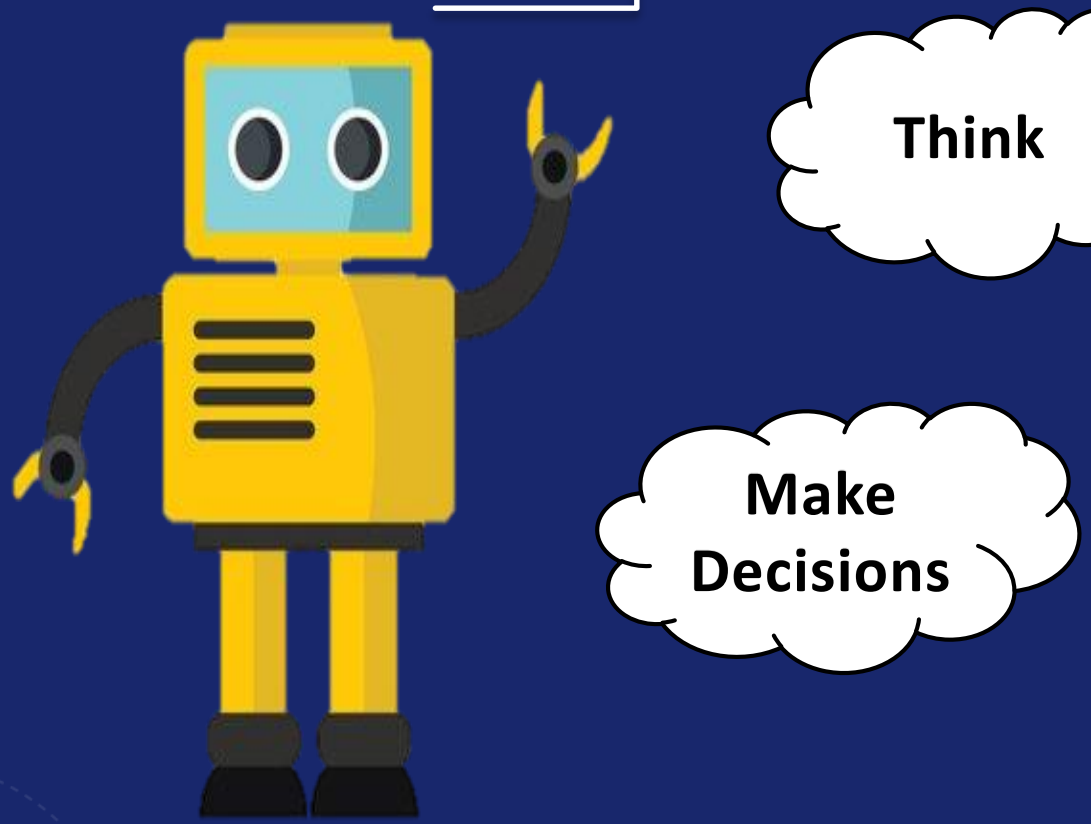
Think

Problem solving (Game theory)

Make Decisions

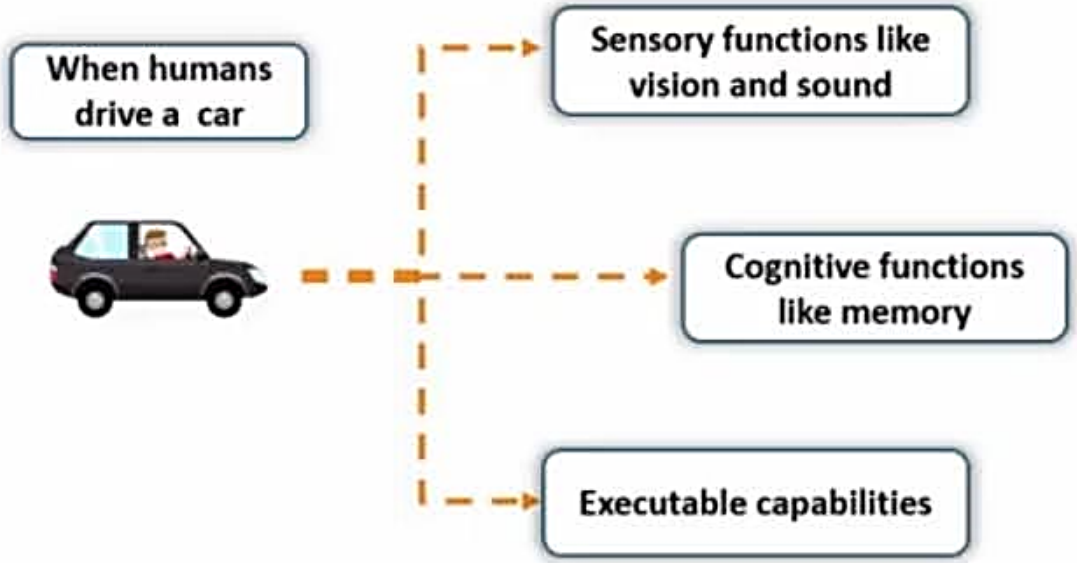
YES/NO

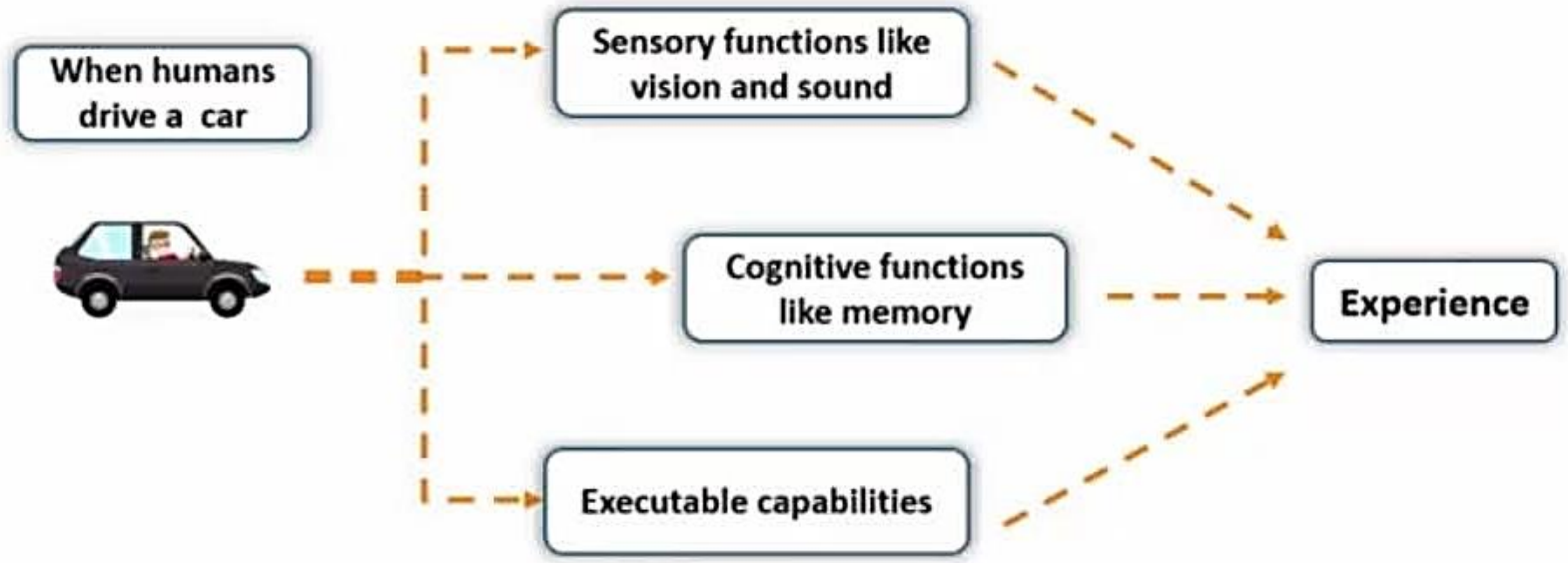
I can show human like intelligence

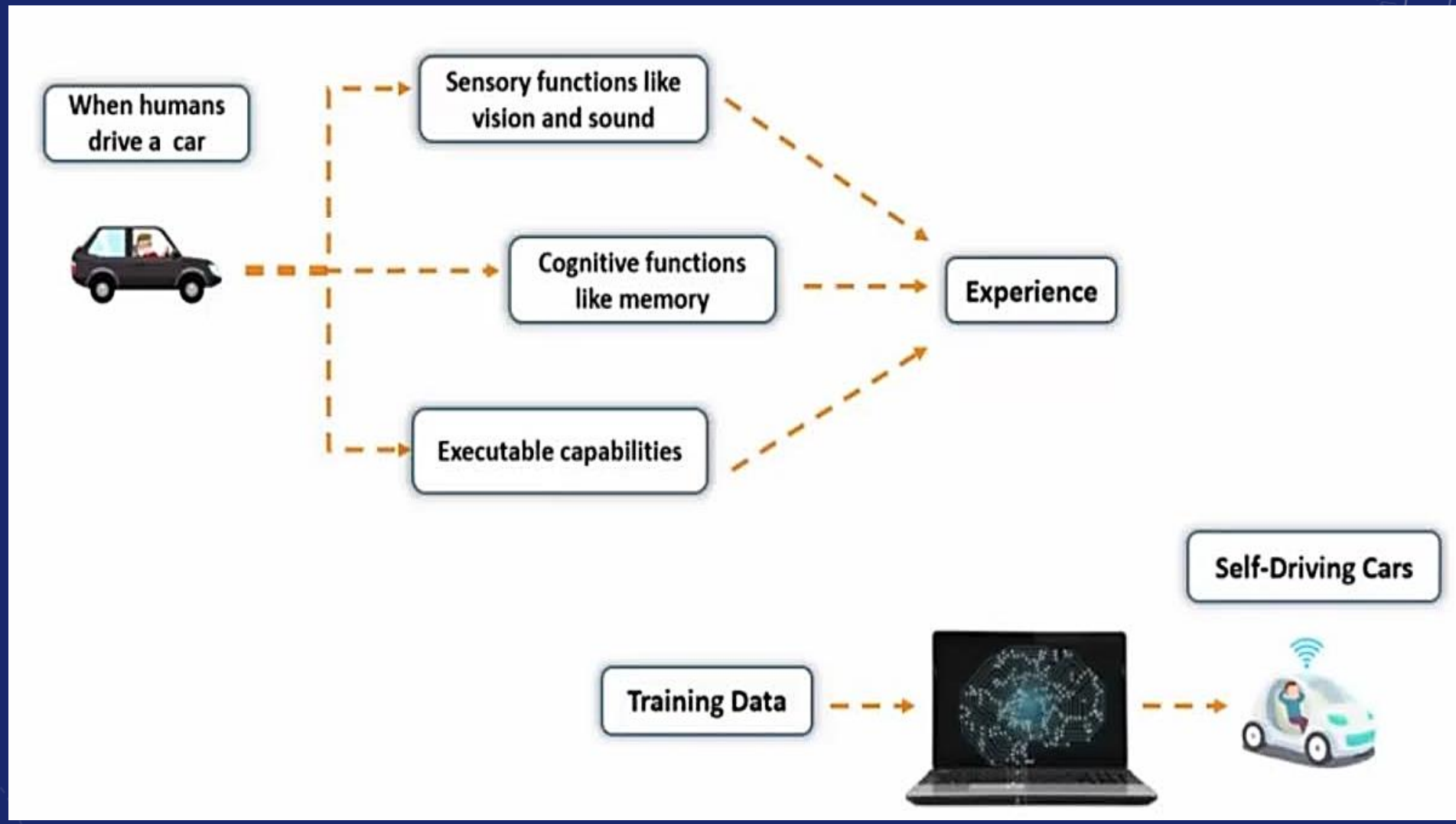


Human intelligence

When humans drive a car


When humans drive a car
Sensory functions like vision and sound
Cognitive functions like memory
Executable capabilities


When humans drive a car
Sensory functions like vision and sound
Cognitive functions like memory
Executable capabilities
Experience


When humans drive a car
Sensory functions like vision and sound
Cognitive functions like memory
Executable capabilities
Experience
Self-Driving Cars
Training Data

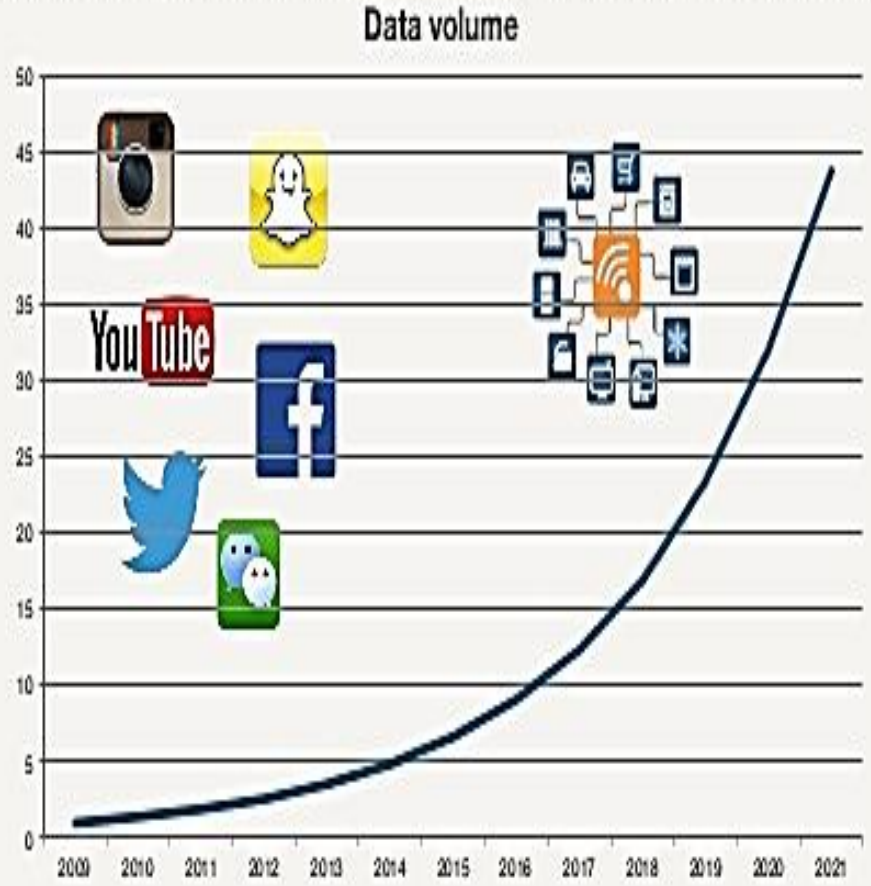

LEFT REARWARD VEHICLE CAMERA
MEDIUM RANGE VEHICLE CAMERA
RIGHT REARWARD VEHICLE CAMERA
MOTION FLOW
LANE LINES
LANE LINES
ROAD FLOW
IN-PATH OBJECTS
ROAD LIGHTS
OBJECTS
ROAD SIGNS

HISTORY OF AI

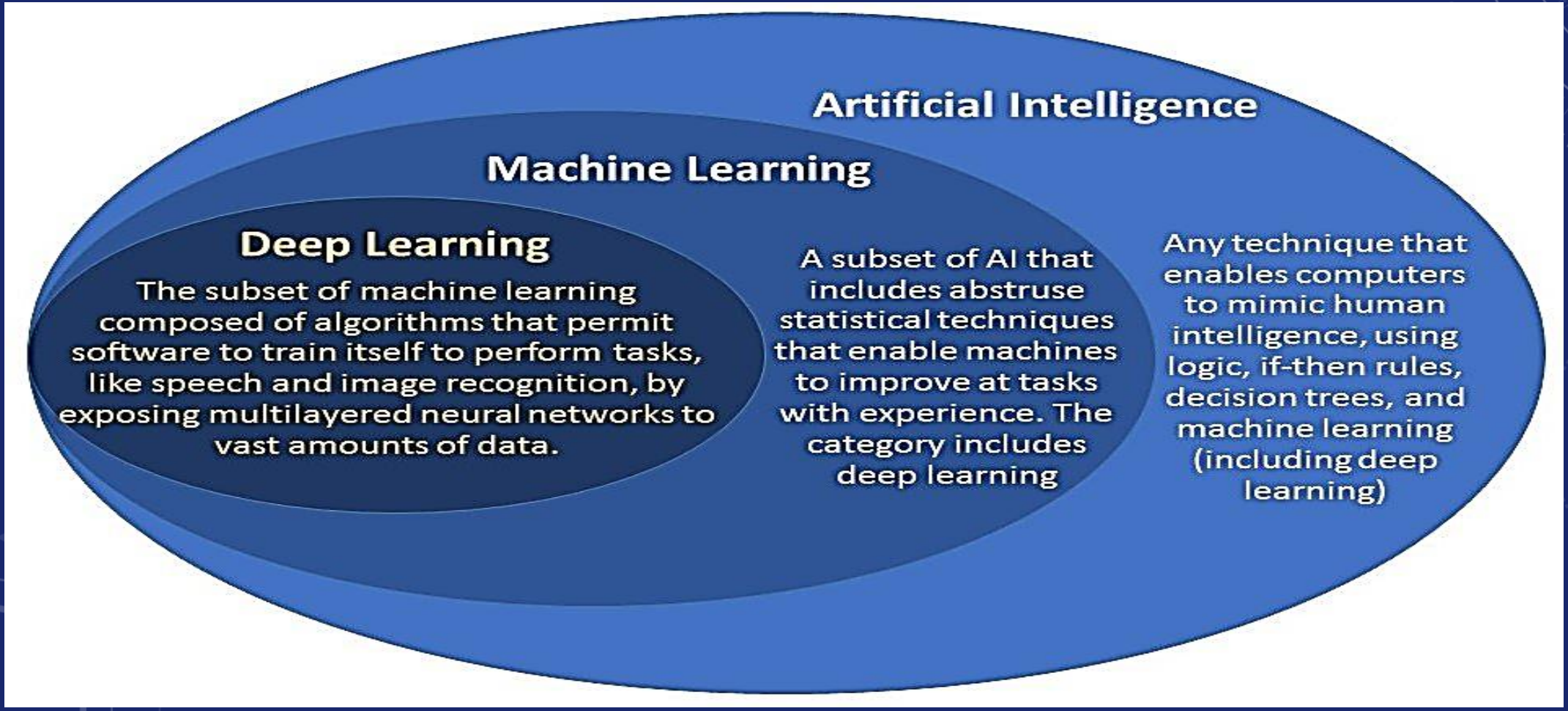
- 1950: Turing
  - Turing's "Computing Machinery and Intelligence"
- 1956: birth of AI
  - Dartmouth meeting: "Artificial Intelligence" name adopted
- 1950s: initial promise
  - Early AI programs, including
  - Samuel's checkers program
  - Newell & Simon's Logic Theory
- 1986-- Rise of machine learning
  - Neural networks return to popularity
  - Major advances in machine learning algorithms and applications
- 1990-- Role of uncertainty
  - Bayesian networks as a knowledge representation framework
- 1995-- AI as Science
  - Integration of learning, reasoning, knowledge representation
  - AI methods used in vision, language, data mining, etc

WHY AI???

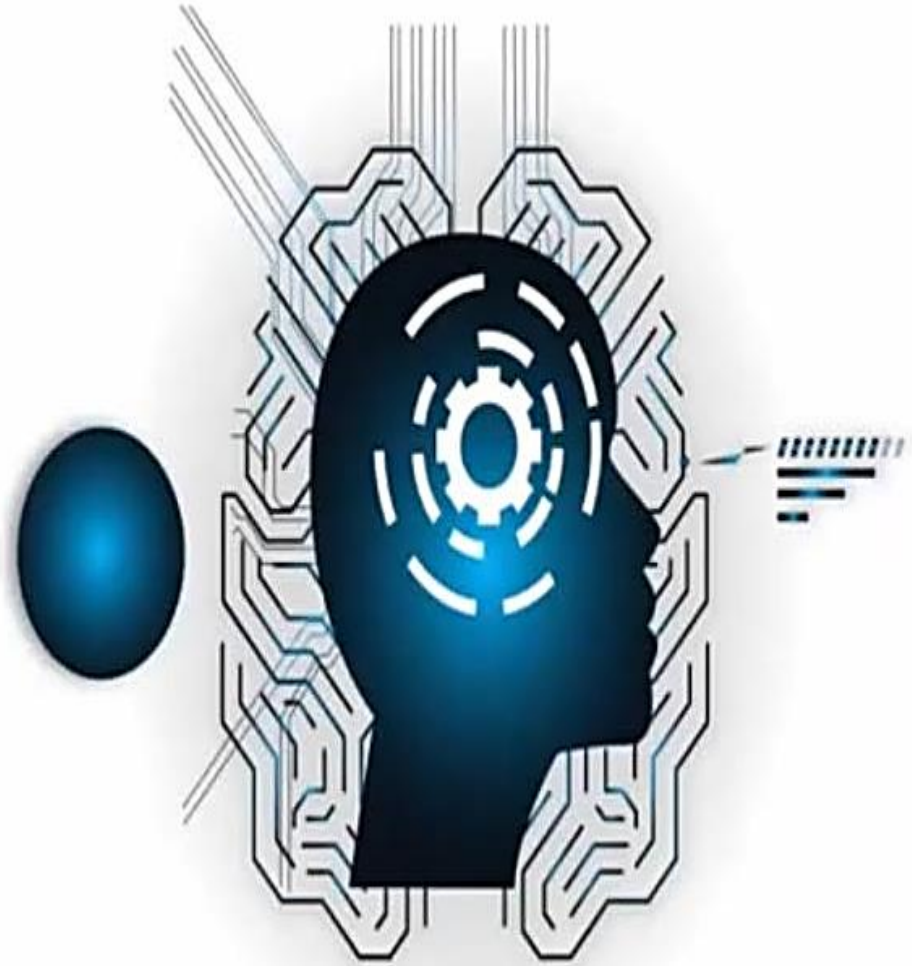
44ZB OF DATA BY 2020, 44X IN 11 YEARS



DIFFERENCE


Artificial Intelligence
Any technique that enables computers to mimic human intelligence, using logic, if-then rules, decision trees, and machine learning (including deep learning)
Machine Learning
A subset of AI that includes abstruse statistical techniques that enable machines to improve at tasks with experience. The category includes deep learning
Deep Learning
The subset of machine learning composed of algorithms that permit software to train itself to perform tasks, like speech and image recognition, by exposing multilayered neural networks to vast amounts of data.

Artificial Intelligence



Intelligence displayed by machines

OR

The capacity of a machine to imitate intelligent human behaviour

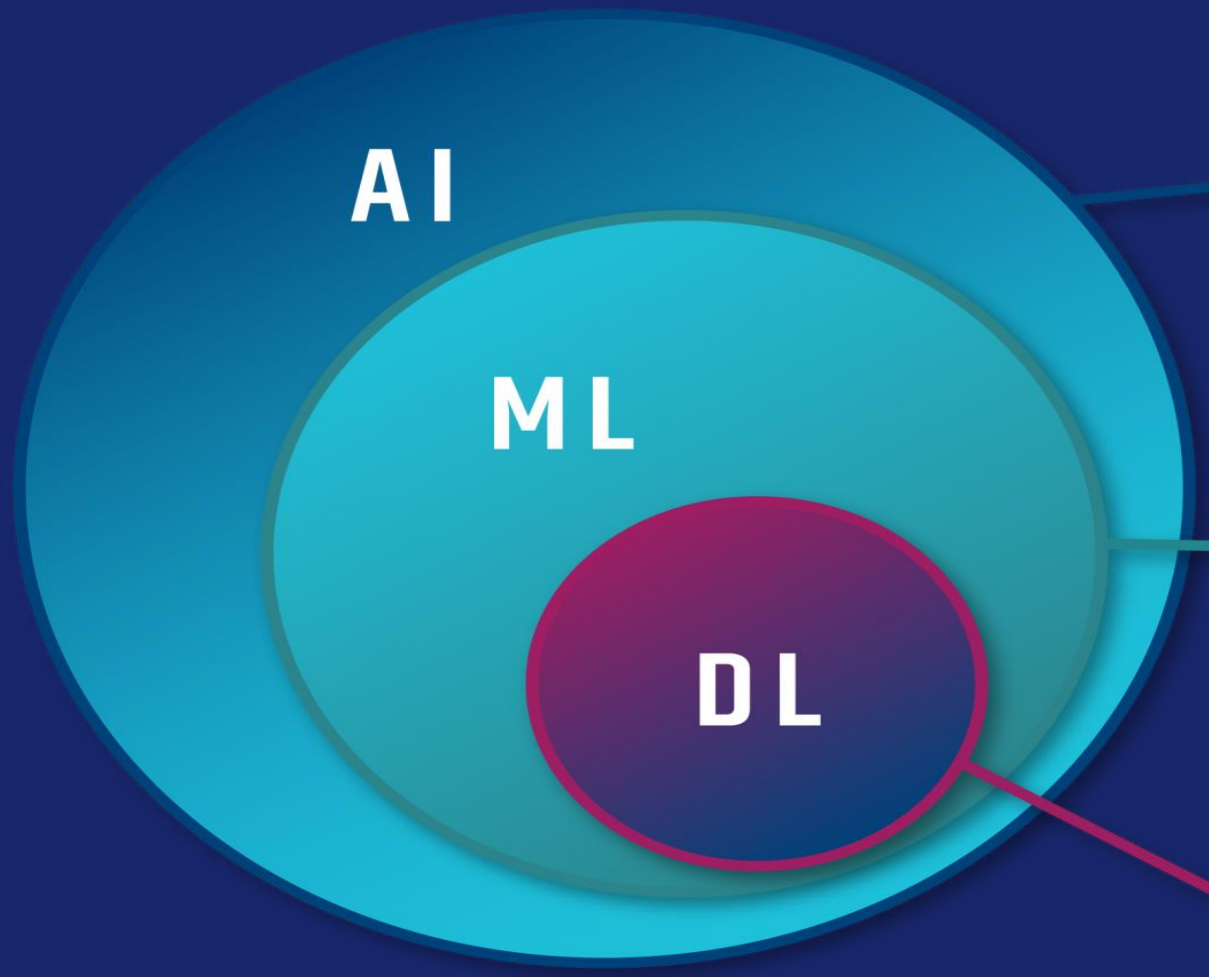
ML and DL

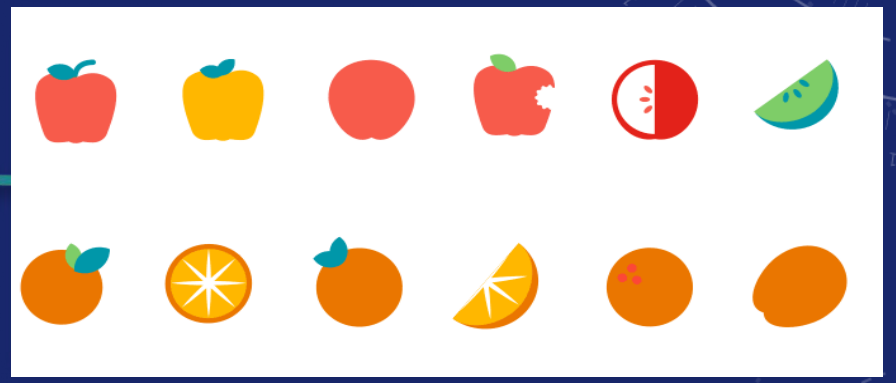
ML

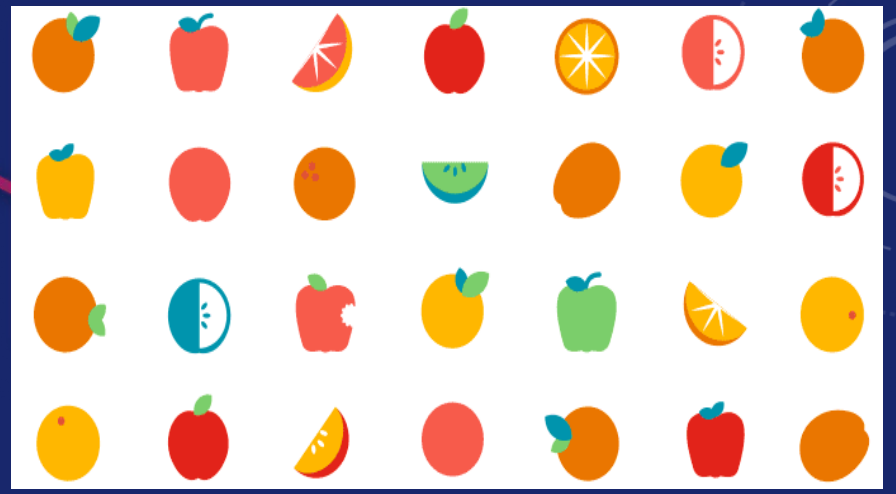
A bunch of statistical algorithms and tools to learn from the data

DL

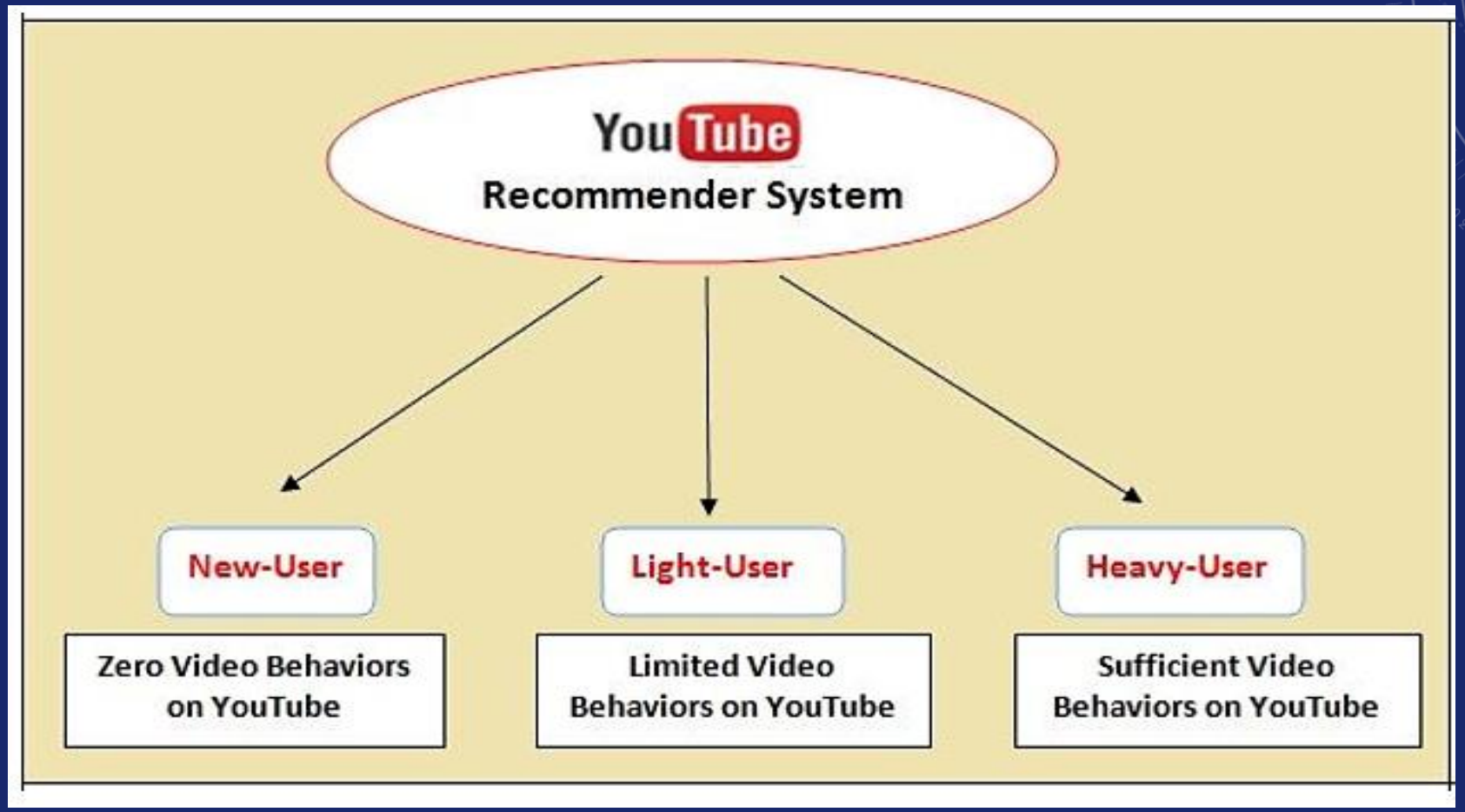
Connected with algorithms inspired by the structure and function of the brain called "Artificial Neural Networks"


AI
ML
DL

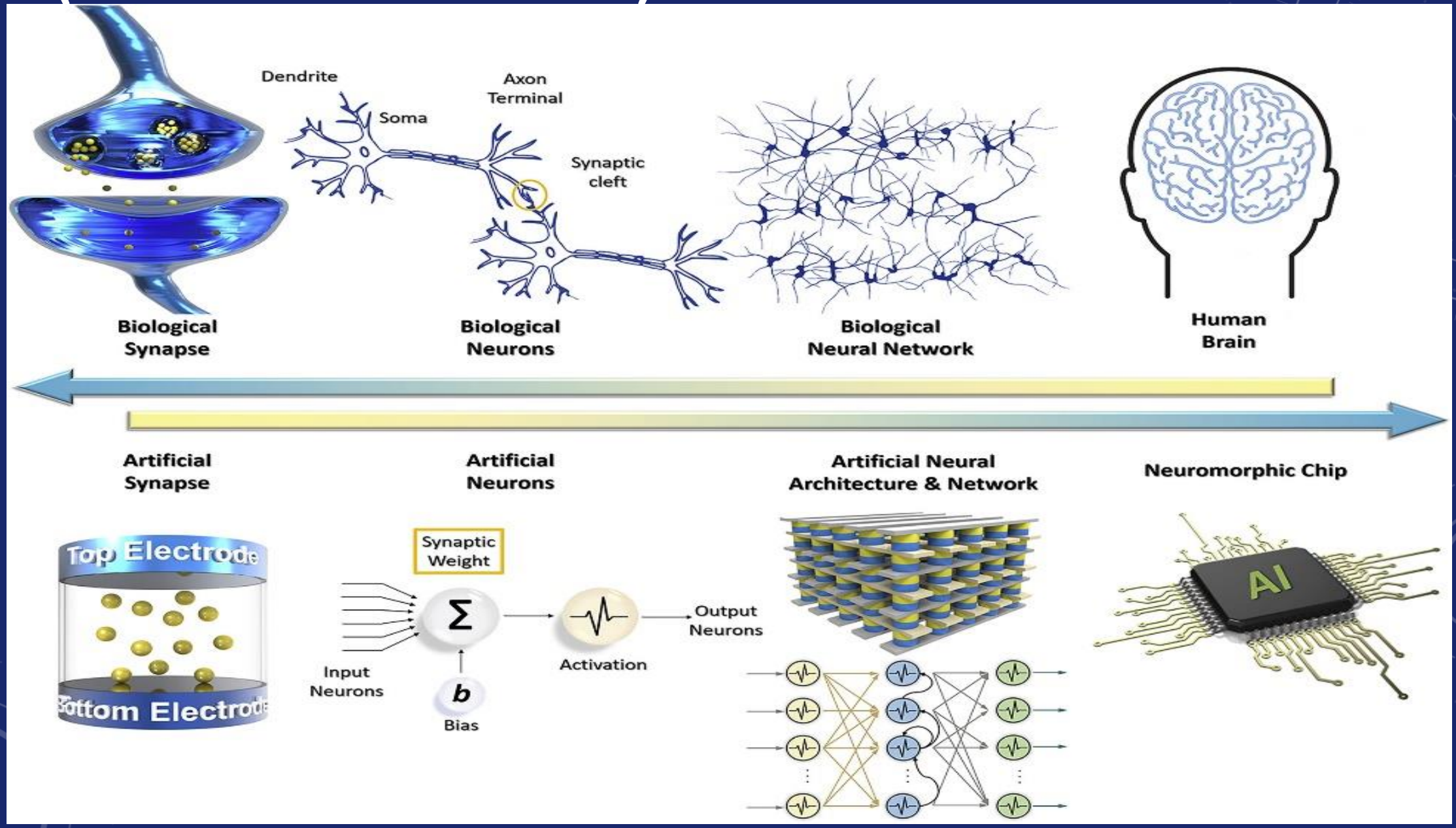




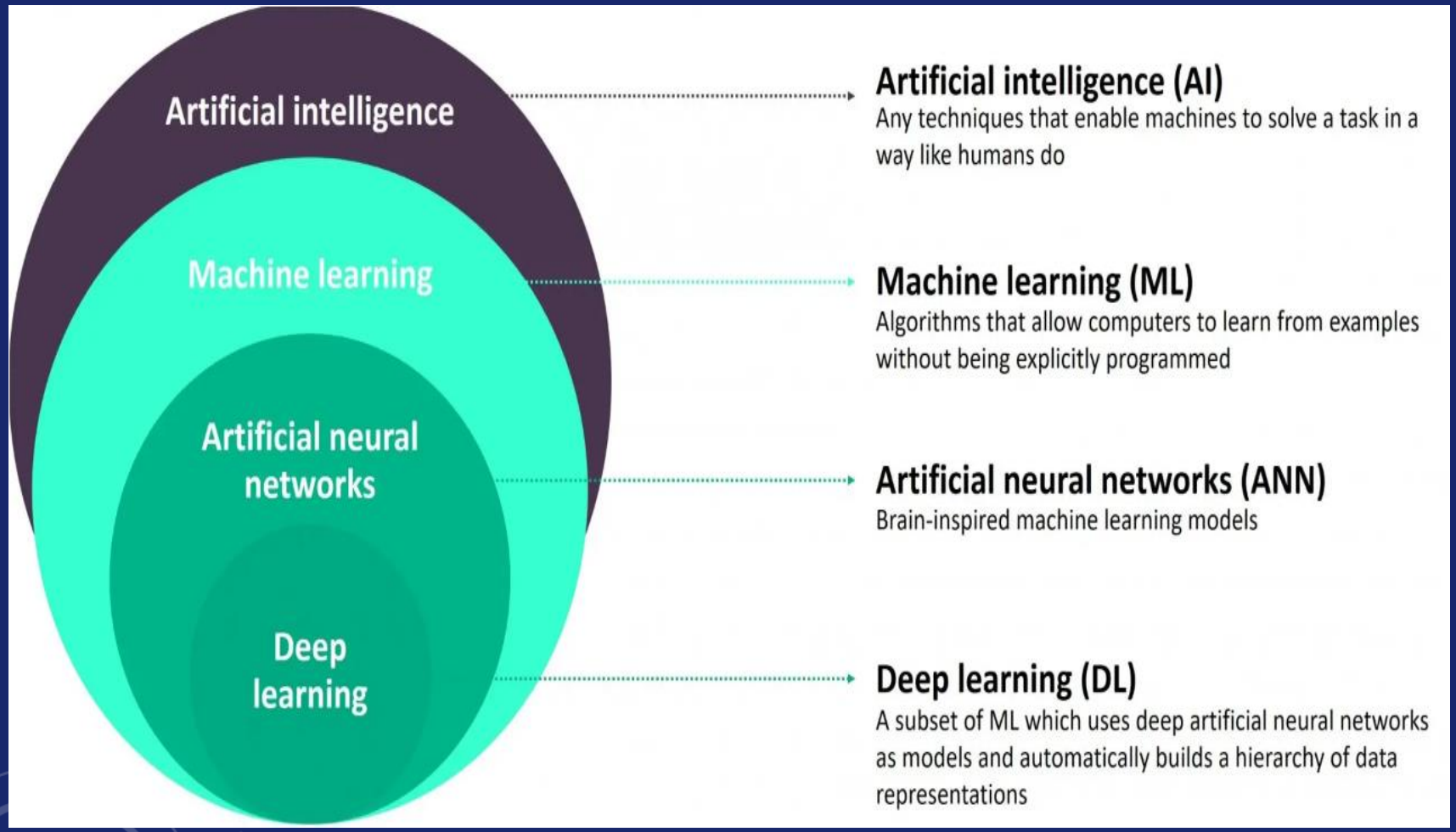
ML Application



DL (BIOLOGICAL NEURON)

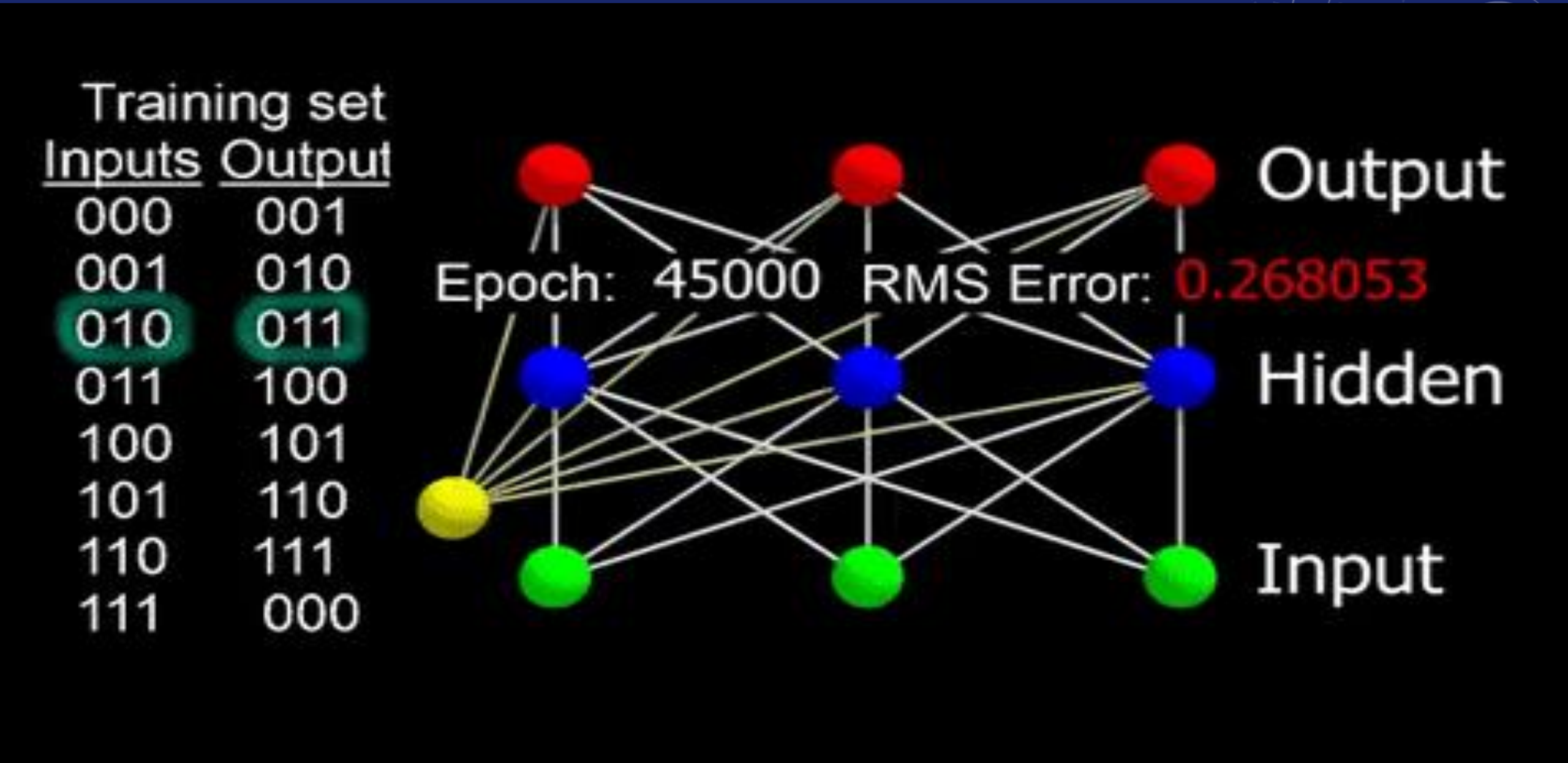


(BIOLOGICAL NEURON)



Biological Neuron	Artificial Neuron
Dendrites	Input
Cell Nucleus(Soma)	Node
Axon	Output
Synapse	Interconnections

ARTIFICIAL NEURON



DL Application

AlphaGo, created by *DeepMind and* acquired by Google

Lee Sedol, the world champion for the game called "Go"

Lee Lost to AlphaGo

Day in and day out, AlphaGo has been rocketing towards superiority, and the results are staggering

	Artificial Intelligence	Machine Learning
How does it work?	AI Combines large amounts of data through interative processing and intelligent algorithms to help computers learn automatically.	ML uses efficient programs that can use data to self learn without having to be instucted explicitly.
Popular Tools	• TensorFlow • Scikit-learn • Keras	• Amazon Lex • Scikit-learn • IBM Watson Studio • Microsoft Azure Machine Learning Studio
Top Applications	• Chatbots • Google Maps • Voice Assistant • Healthcare Industry	• Recommendation Engines • E-mail Spam Detection • Self-driving Vehicles

STATE OF THE ART

- Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997
- AI program proved a mathematical conjecture (Robbins conjecture) unsolved for decades

- NASA's on-board autonomous planning program controlled the scheduling of operations for a spacecraft

- Speech recognition: A traveler calling United Airlines to book a flight can have the entire conversation guided by an automated speech recognition and dialog management system.
- Face recognition software available in consumer cameras

WHAT IS ARTIFICIAL INTELLIGENCE?

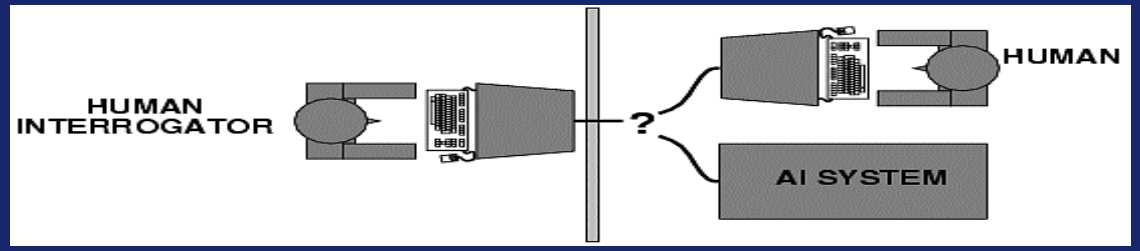
It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.

Views of AI fall into four categories:

- Thinking Humanly
- Acting Humanly
- Thinking Rationally
- Acting Rationally

ACTING HUMANLY: TURING TEST

- Alan Turing (1950) "Computing machinery and intelligence"
- "Can machines think?" → "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game



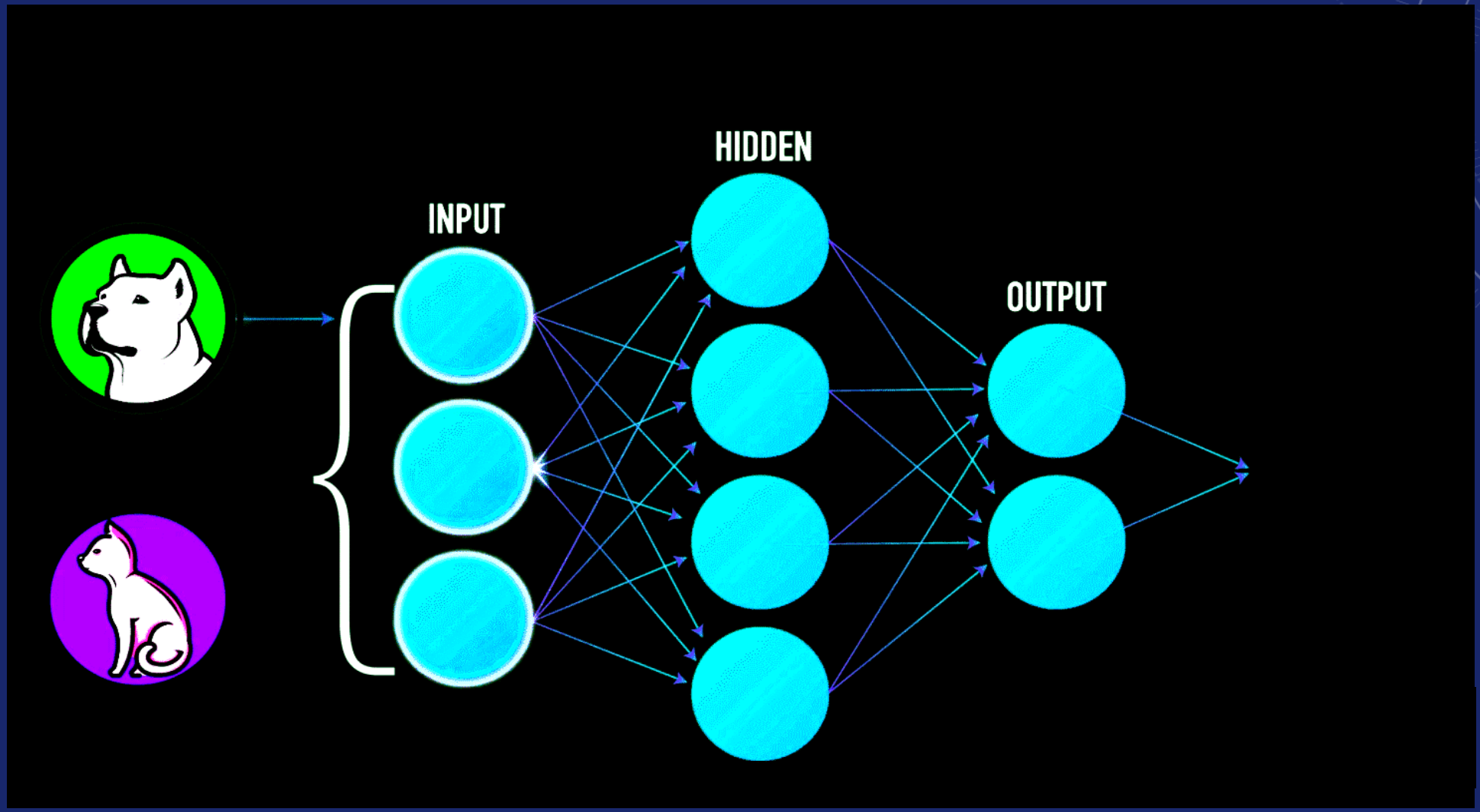
It was designed to provide a satisfactory operational definition of intelligence. A computer passes the test if a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or from a computer.

THINKING HUMANLY: THE COGNITIVE MODELING APPROACH

- **Requires detailed matching of computer behavior and timing to detailed measurements of human subjects gathered in psychological experiments.**

- **Cognitive Science approach**
  - **Try to get "inside" our minds**
  - **E.g., conduct experiments with people to try to "reverse-engineer" how we reason, learning, remember, predict**

- **So, we need to get *inside* the actual workings of human minds.**
- **There are three ways to do this:**
- **through introspection—trying to catch our own thoughts as they go by;**
- **through psychological experiments—observing a person in action;**
- **and through brain imaging—observing the brain in action.**


HIDDEN
INPUT
OUTPUT

THINKING RATIONALLY: LAWS OF THOUGHT

- Formalize “correct” reasoning using a mathematical model (e.g. of deductive reasoning/logical conclusion).

- Logics Program: Encode knowledge in formal logical statements and use mathematical deduction to perform reasoning:
- Problems:
- -Formalizing common sense knowledge is difficult.
- -General deductive inference is computationally intractable.

the pigeon experiment classic box-and-banana problem

https://www.youtube.com/watch?v=mDntbGRPeEU

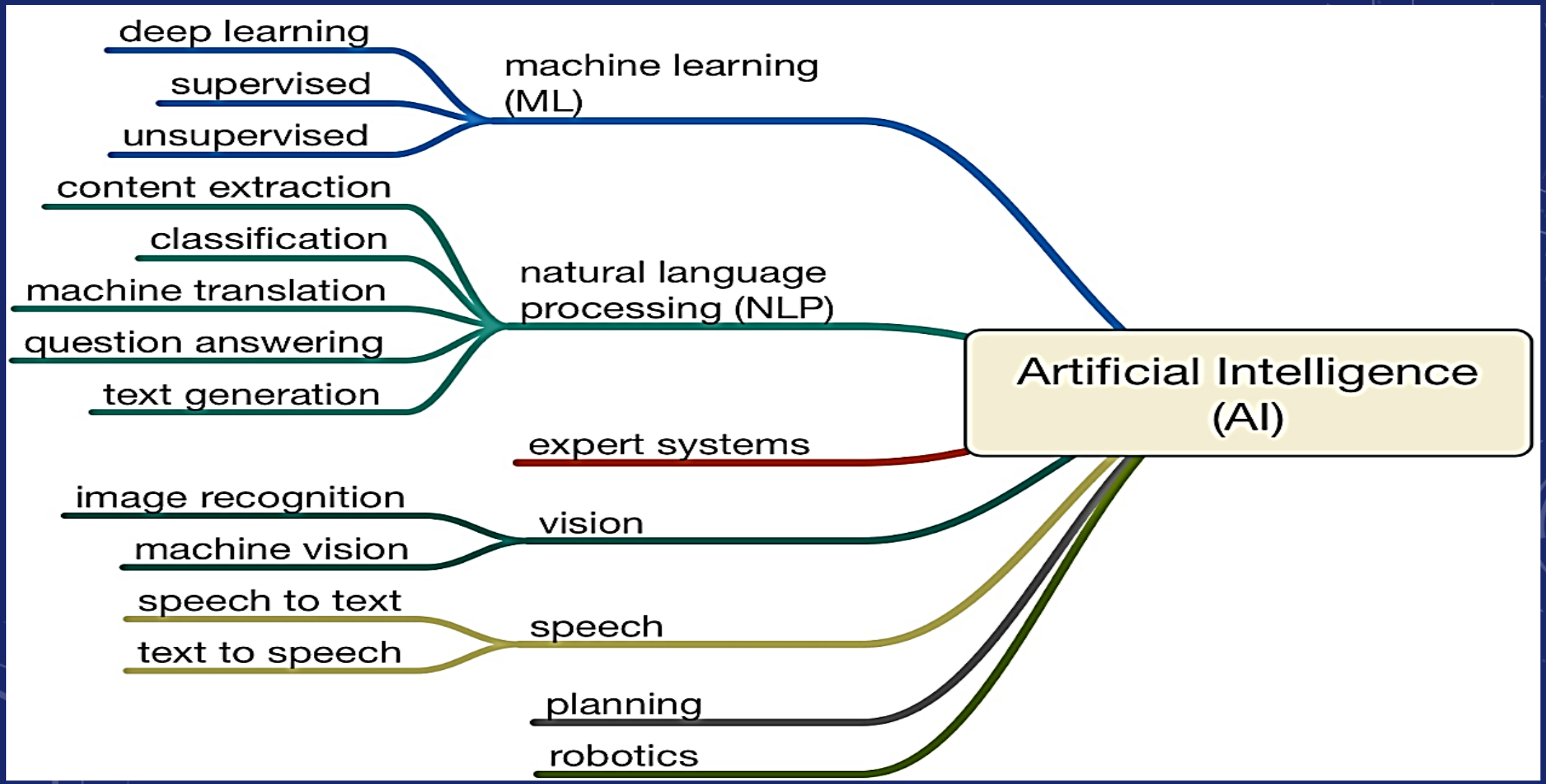
ACTING RATIONALLY: THE RATIONAL AGENT

- An agent is an entity that perceives its environment and is able to execute actions to change it.
- Agents have inherent goals that they want to achieve (e.g. survive, reproduce).
- A rational agent acts in a way to maximize the achievement of its goals.
- True maximization of goals requires omniscience and unlimited computational abilities.
- Limited rationality involves maximizing goals within the computational and other resources available.

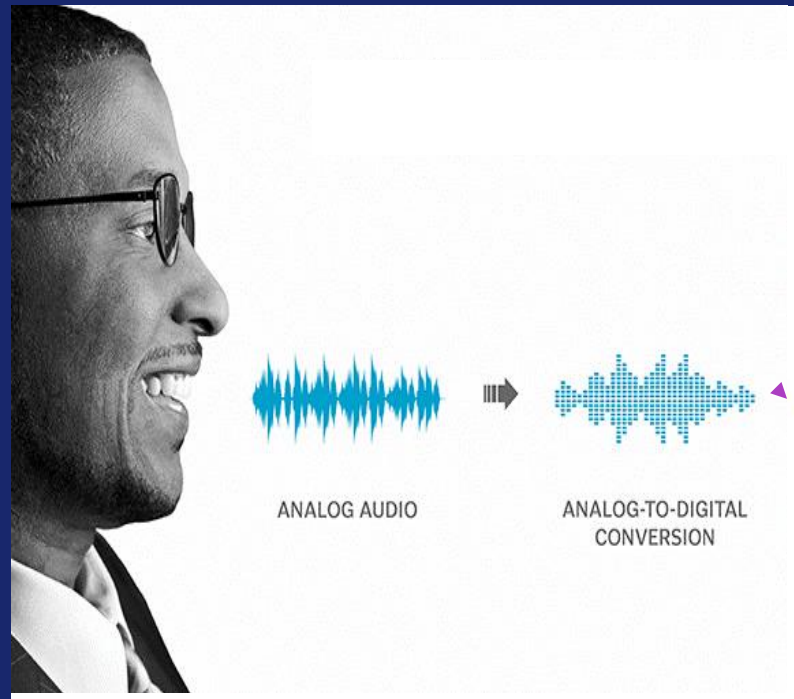
FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

- **Philosophy** Logic, methods of reasoning, mind as physical system, foundations of learning, language , rationality.
- **Mathematics** formal representation and proof, algorithms , computation.
- **Probability/statistics** modeling uncertainty, learning from data
- **Economics** utility, decision theory, rational economic agents
- **Neuroscience** neurons as information processing units.
- **Computer engineering** building fast computers
- **Psychology** how do people behave, perceive, process cognitive science information, represent knowledge.
- **Linguistics** knowledge representation, grammars

AI UMBRELLA


deep learning
supervised
unsupervised
machine learning (ML)
content extraction
classification
machine translation
question answering
text generation
natural language processing (NLP)
Artificial Intelligence (AI)
expert systems
image recognition
machine vision
vision
speech to text
text to speech
speech
planning
robotics

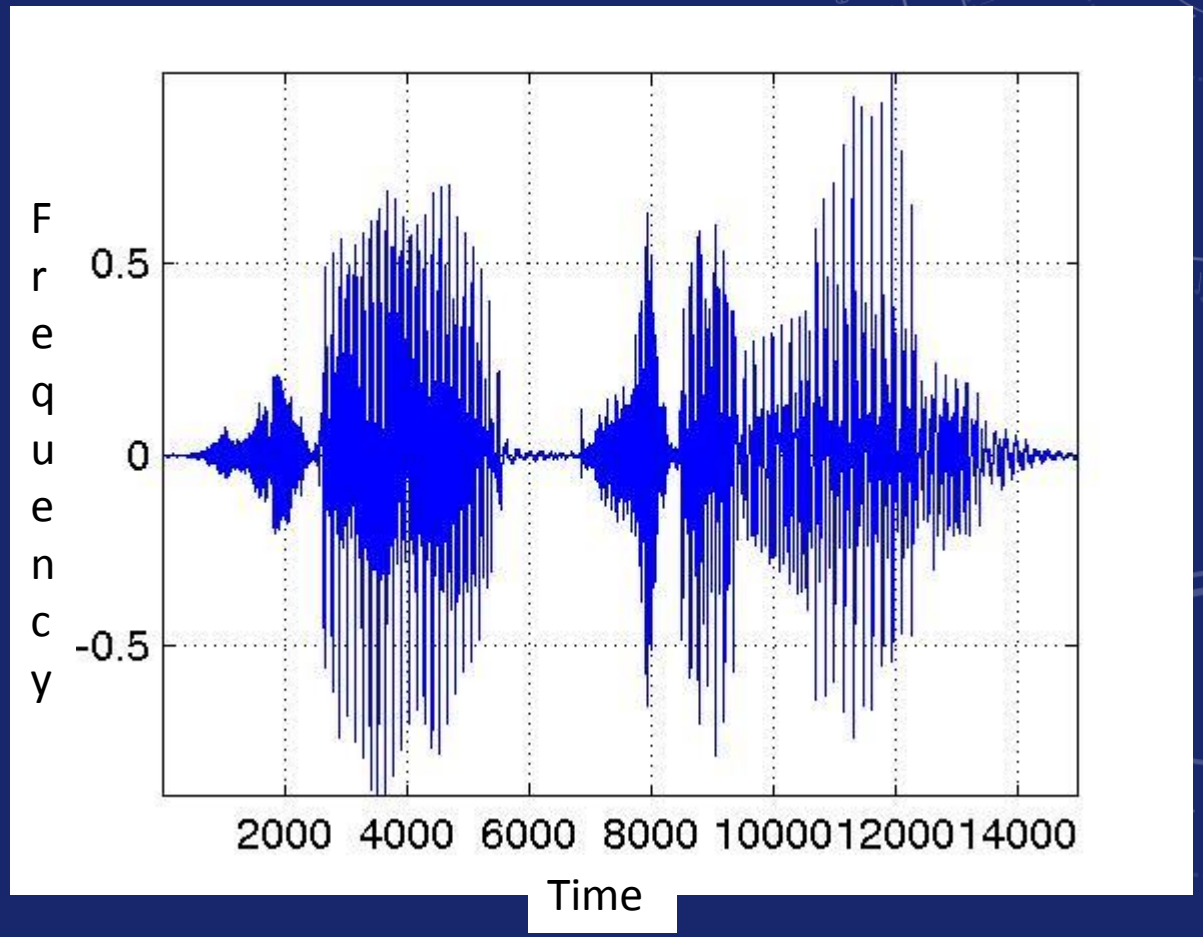
VOICE ENABLED ELEVATOR



Speech Capture → Feature Extraction → Training / Models / Pattern Matching → Process Results → ★

- Frequency(f) is inversely proportional to the time(t)

$$f=1/t$$



CAN COMPUTERS TALK?

- This is known as “speech synthesis”
  - translate text to phonetic form
    - e.g., “fictitious” -> fik-tish-es
  - use pronunciation rules to map phonemes to actual sound
    - e.g., “tish” -> sequence of basic audio sounds

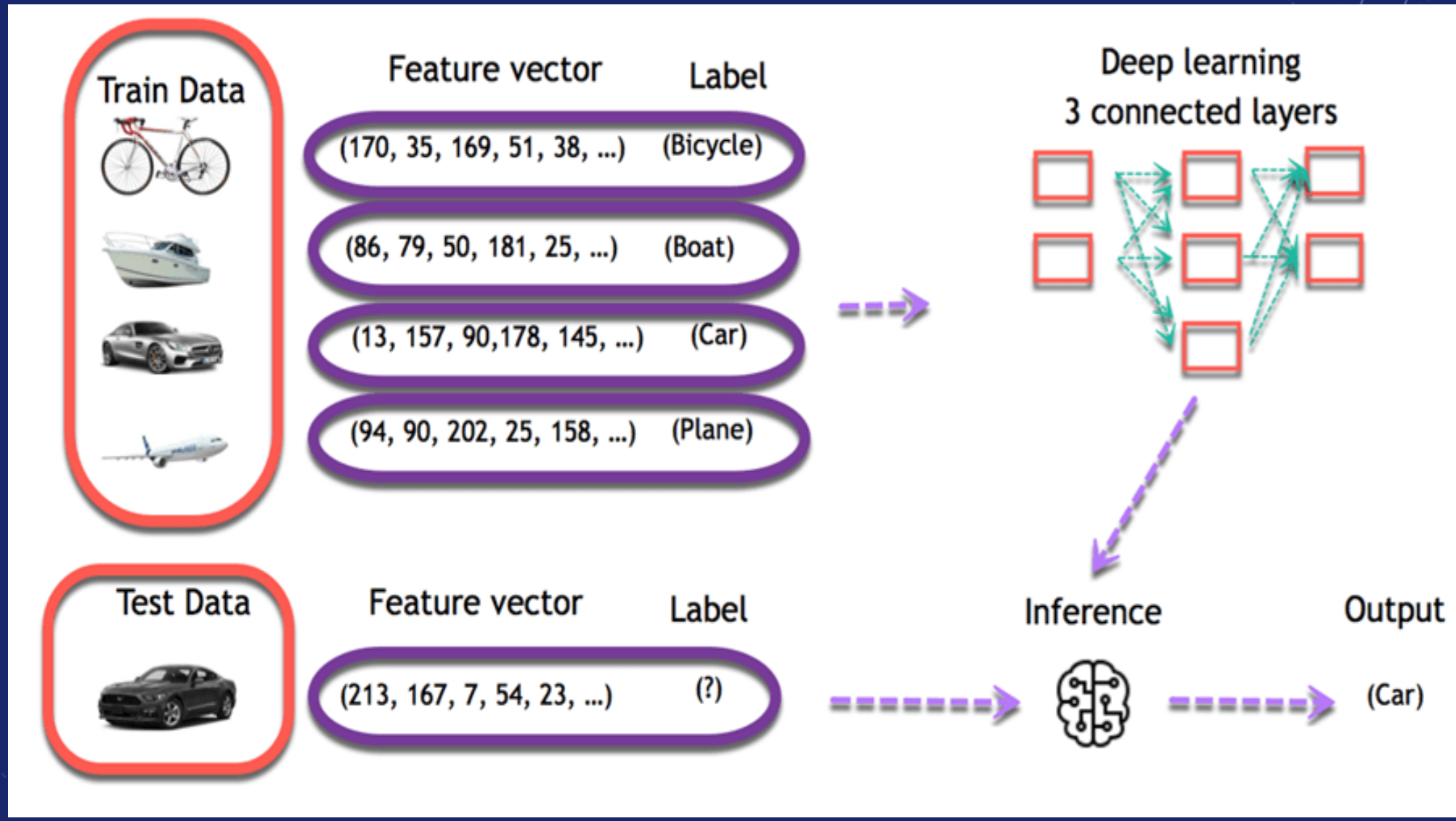
- Difficulties
  - sounds made by this “lookup” approach sound unnatural
  - sounds are not independent
    - e.g., “act” and “action”
    - modern systems (e.g., at AT&T) can handle this pretty well
  - a harder problem is emphasis, emotion, etc
    - humans understand what they are saying
    - machines don’t: so they sound unnatural

- Conclusion:
  - NO, for complete sentences
  - YES, for individual words


G CONTAINS ADULT HUMOUR

TOPICS

- **LOAN Prediction**
- **Visual Recognition**
- **Image Recognition**
- **Business (product marketing prediction)**

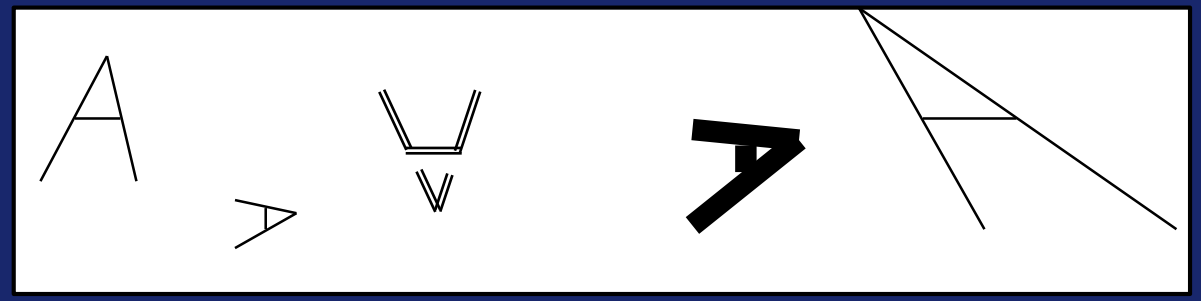

Train Data
Feature vector
Label
(170, 35, 169, 51, 38, ...)
(Bicycle)
(86, 79, 50, 181, 25, ...)
(Boat)
(13, 157, 90,178, 145, ...)
(Car)
(94, 90, 202, 25, 158, ...)
(Plane)
Deep learning
3 connected layers
Test Data
Feature vector
Label
(213, 167, 7, 54, 23, ...)
(?)
Inference
Output
(Car)

CAN COMPUTERS "SEE"?

Recognition v. Understanding (like Speech)

- Recognition and Understanding of Objects in a scene
  - look around this room
  - you can effortlessly recognize objects
  - human brain can map 2d visual image to 3d "map"

- Why is visual recognition a hard problem?



- Conclusion:
  - mostly NO: computers can only "see" certain types of objects under limited circumstances
  - YES for certain constrained problems (e.g., face recognition)