



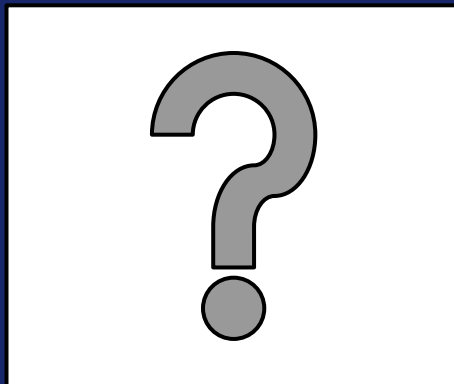
INTRODUCTION TO ARTIFICIAL INTELLIGENCE

CS-401

CHAPTER #1

Instructor: Saeeda Kanwal

What Content are you expecting from this course?

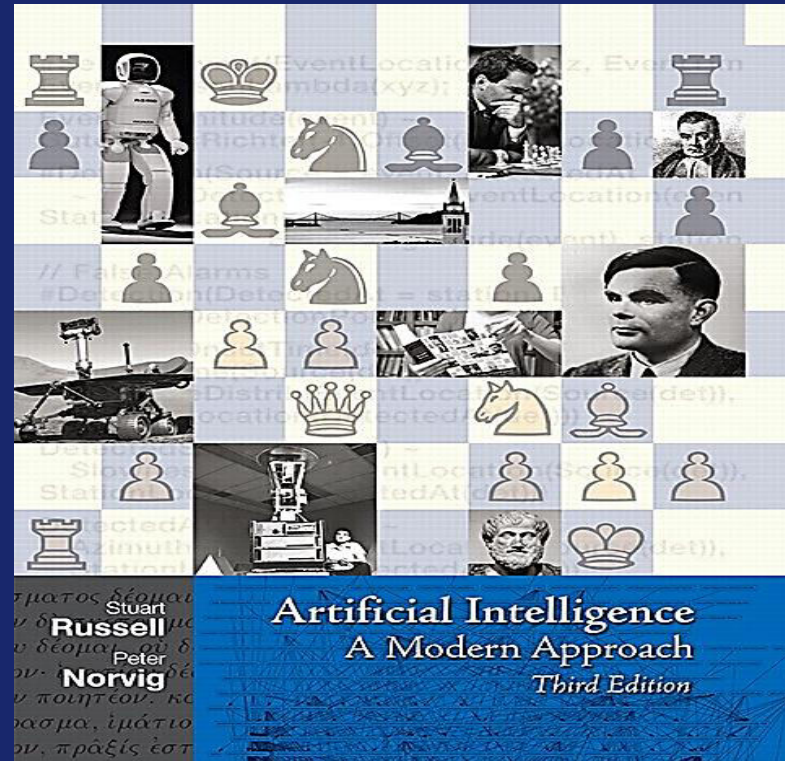


COURSE CATALOG

- 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** **20**
- **Quizzes** **10**
- **Mid exams** **15**
- **Project** **10**
- **Class Participation** **05**
- **Final** **40**



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

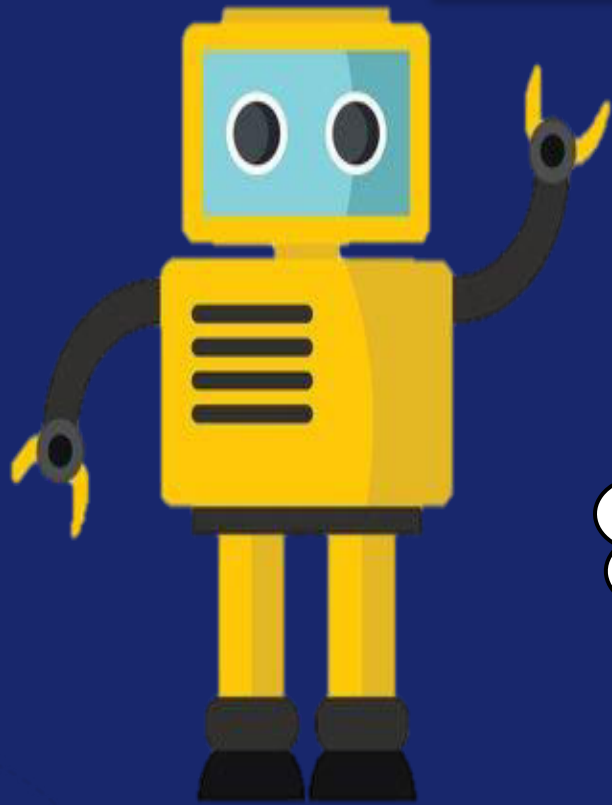
Problem
solving
(Game theory)

**Make
Decisions**

Automated
Car



I can show human like
intelligence



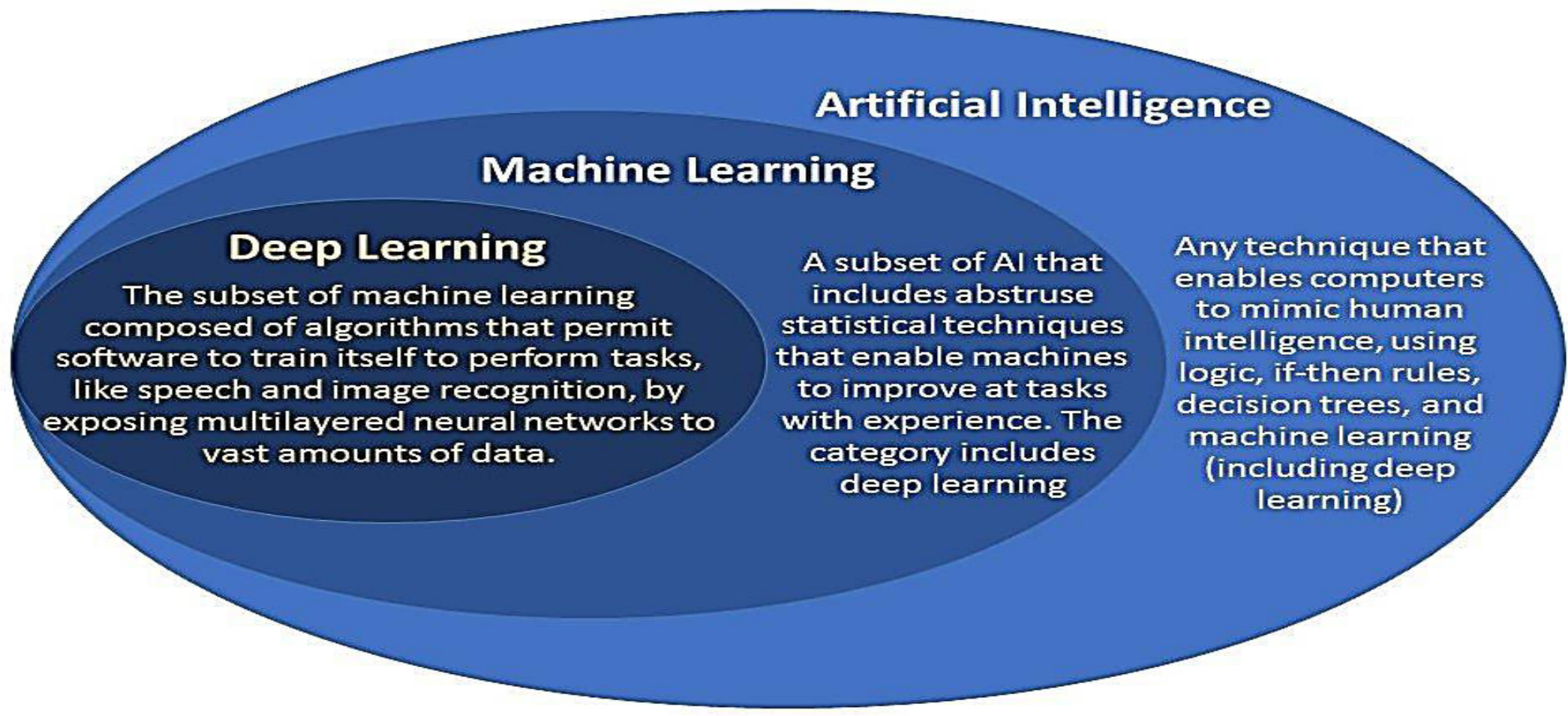
Think

**Make
Decisions**

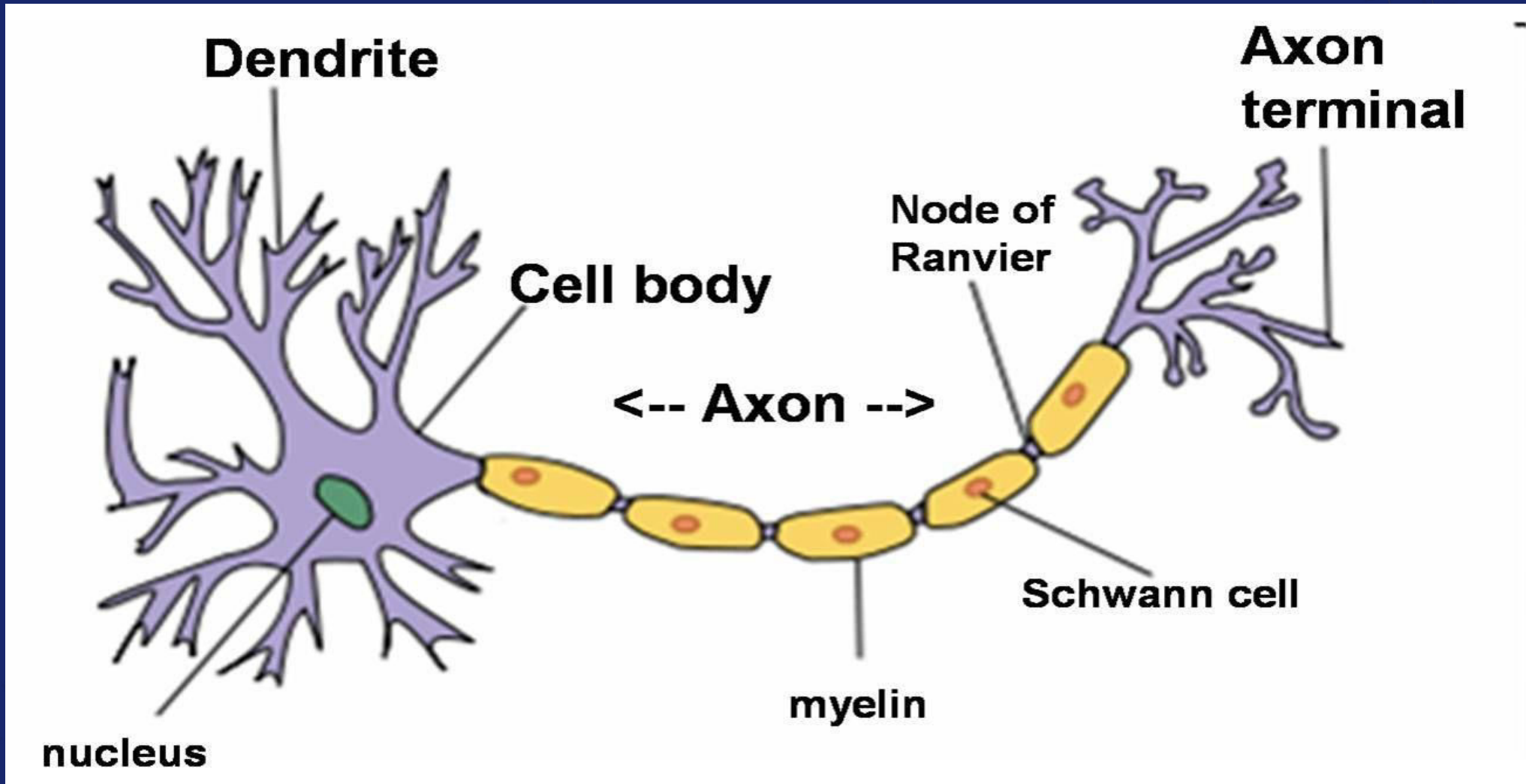
HISTORY OF AI

- 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

DIFFERENCE

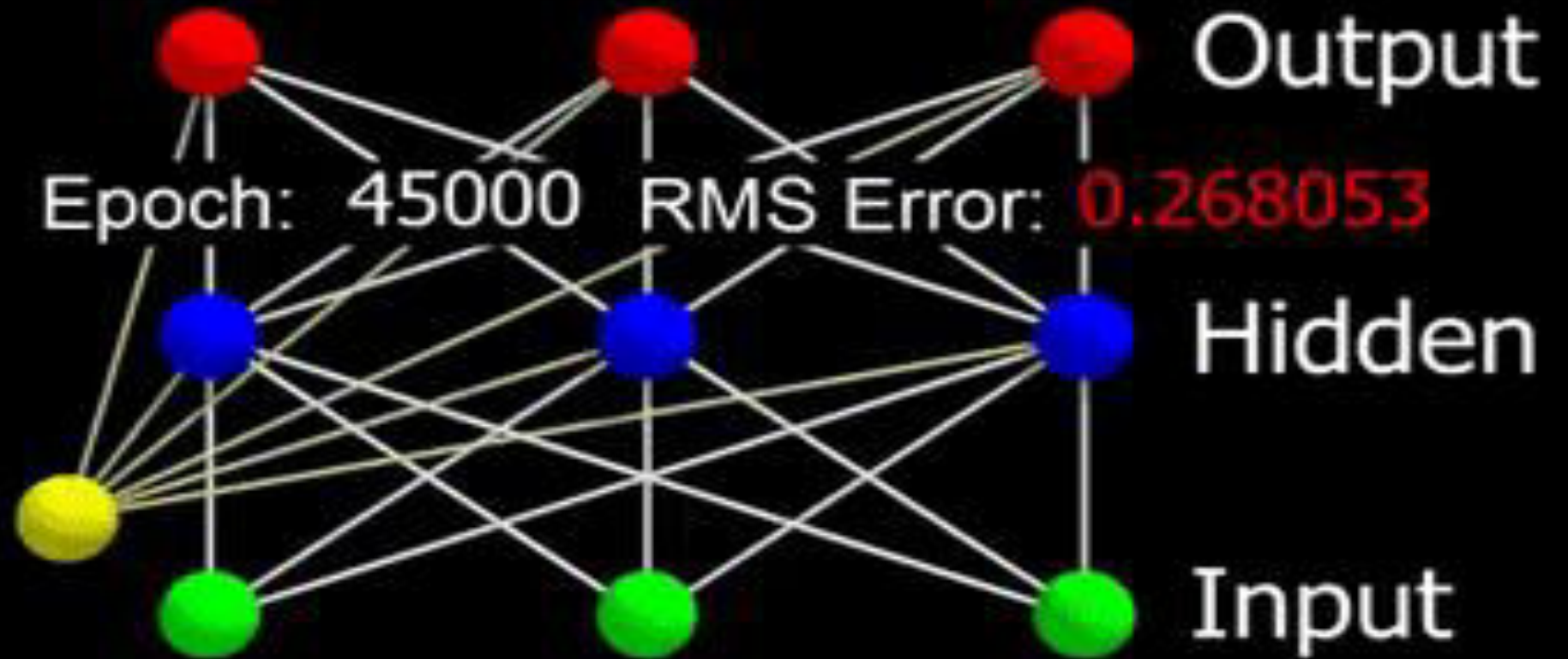


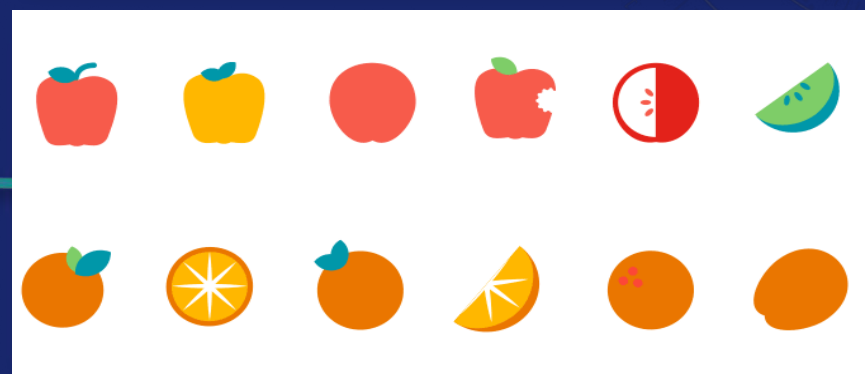
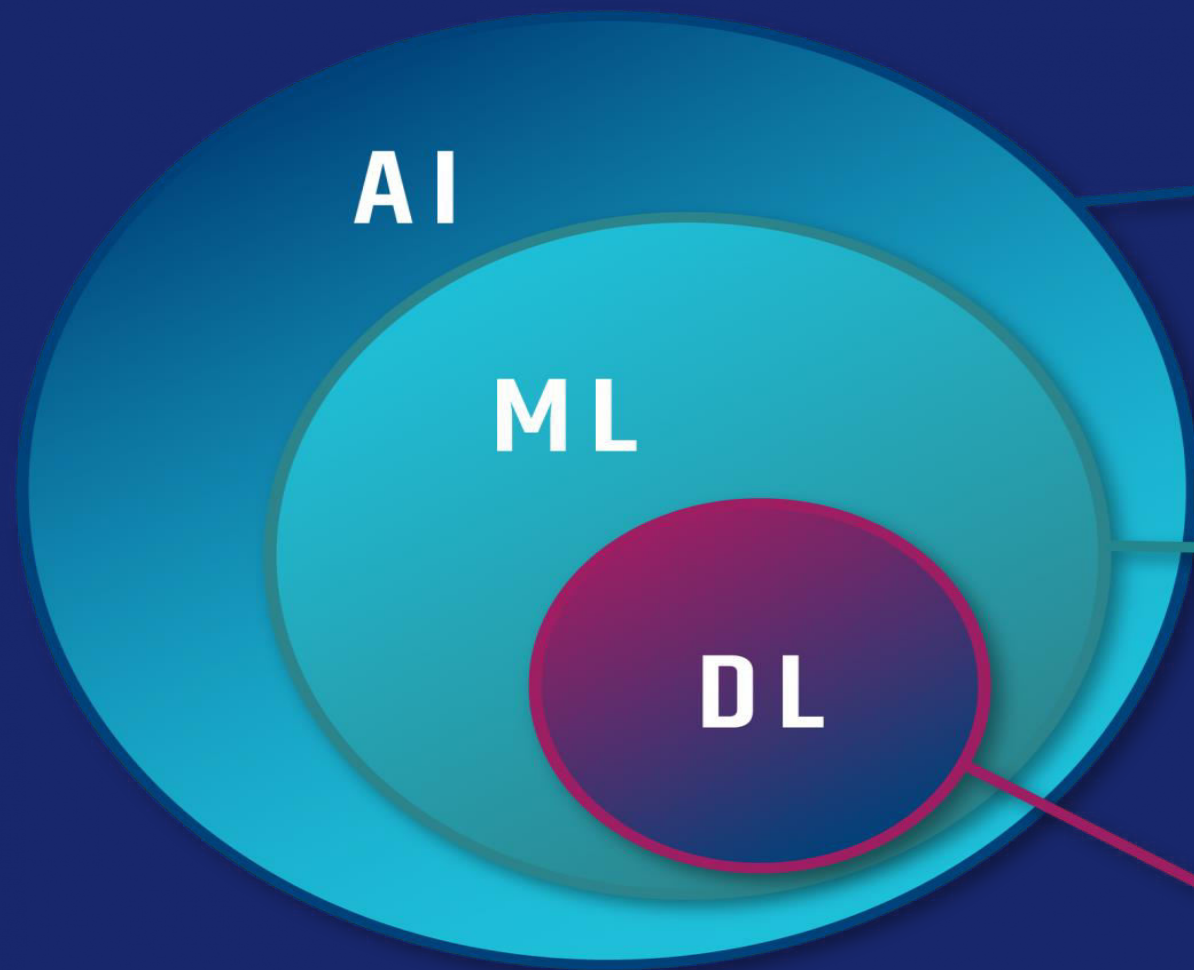
BIOLOGICAL NEURON



ARTIFICIAL NEURON

Training set	
<u>Inputs</u>	<u>Output</u>
000	001
001	010
010	011
011	100
100	101
101	110
110	111
111	000







Artificial Intelligence

How does it work?

AI Combines large amounts of data through interactive processing and intelligent algorithms to help computers learn automatically.

Popular Tools

-
- TensorFlow
 - Scikit-learn
 - Keras

Top Applications

-
- Chatbots
 - Google Maps
 - Voice Assistant
 - Healthcare Industry



Machine Learning

ML uses efficient programs that can use data to self learn without having to be instructed explicitly.

-
- Amazon Lex
 - Scikit-learn
 - IBM Watson Studio
 - Microsoft Azure Machine Learning Studio

-
- 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?

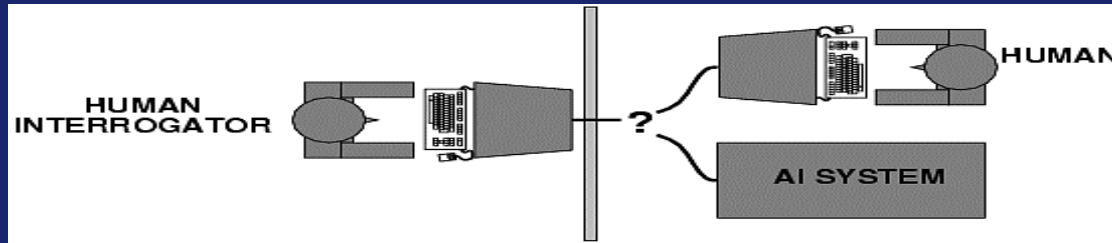
It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.

Views of AI fall into four categories:

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

ACTING HUMANLY: TURING TEST

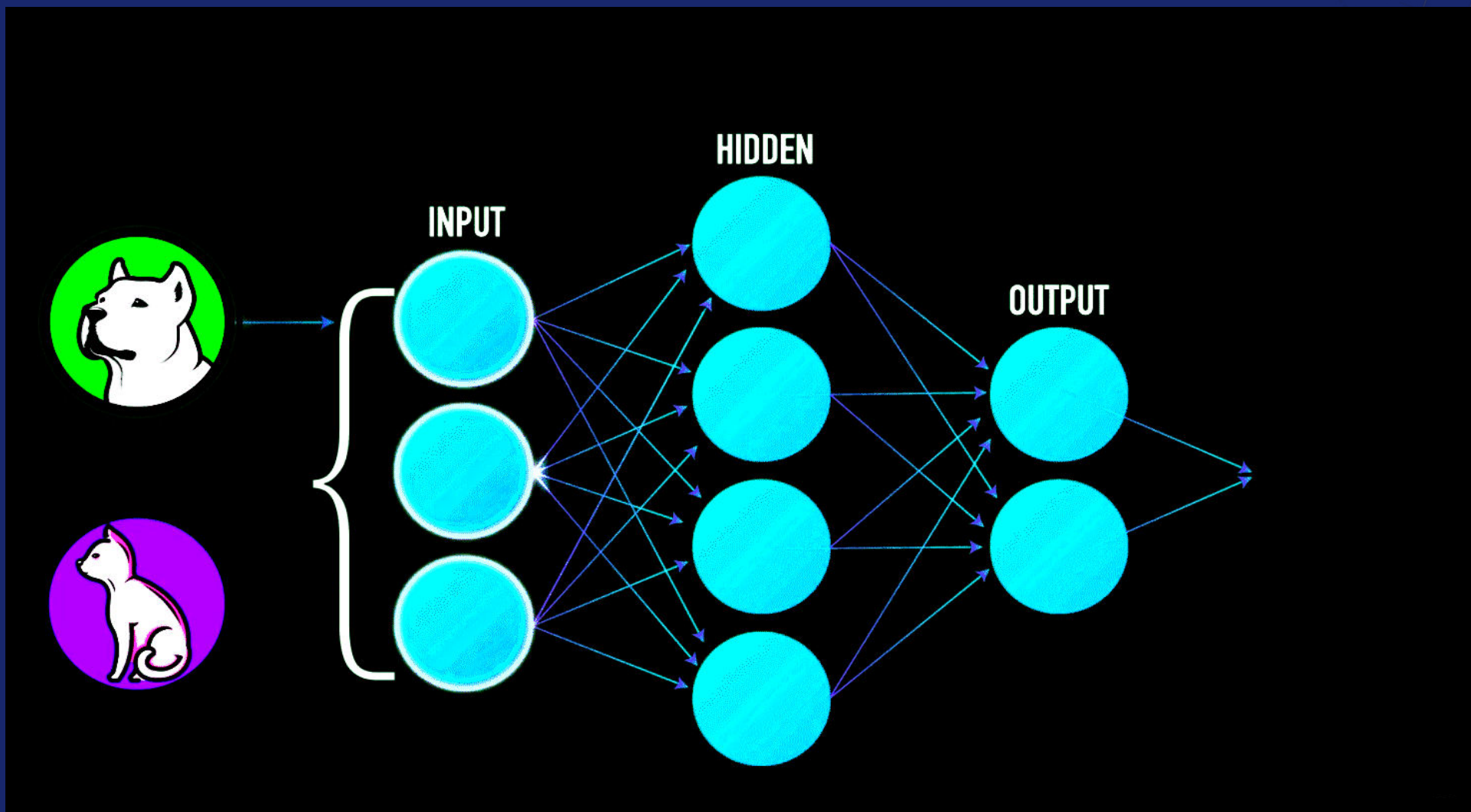
- Alan Turing (1950) "Computing machinery and intelligence"
- "Can machines think?" → "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game



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.



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.

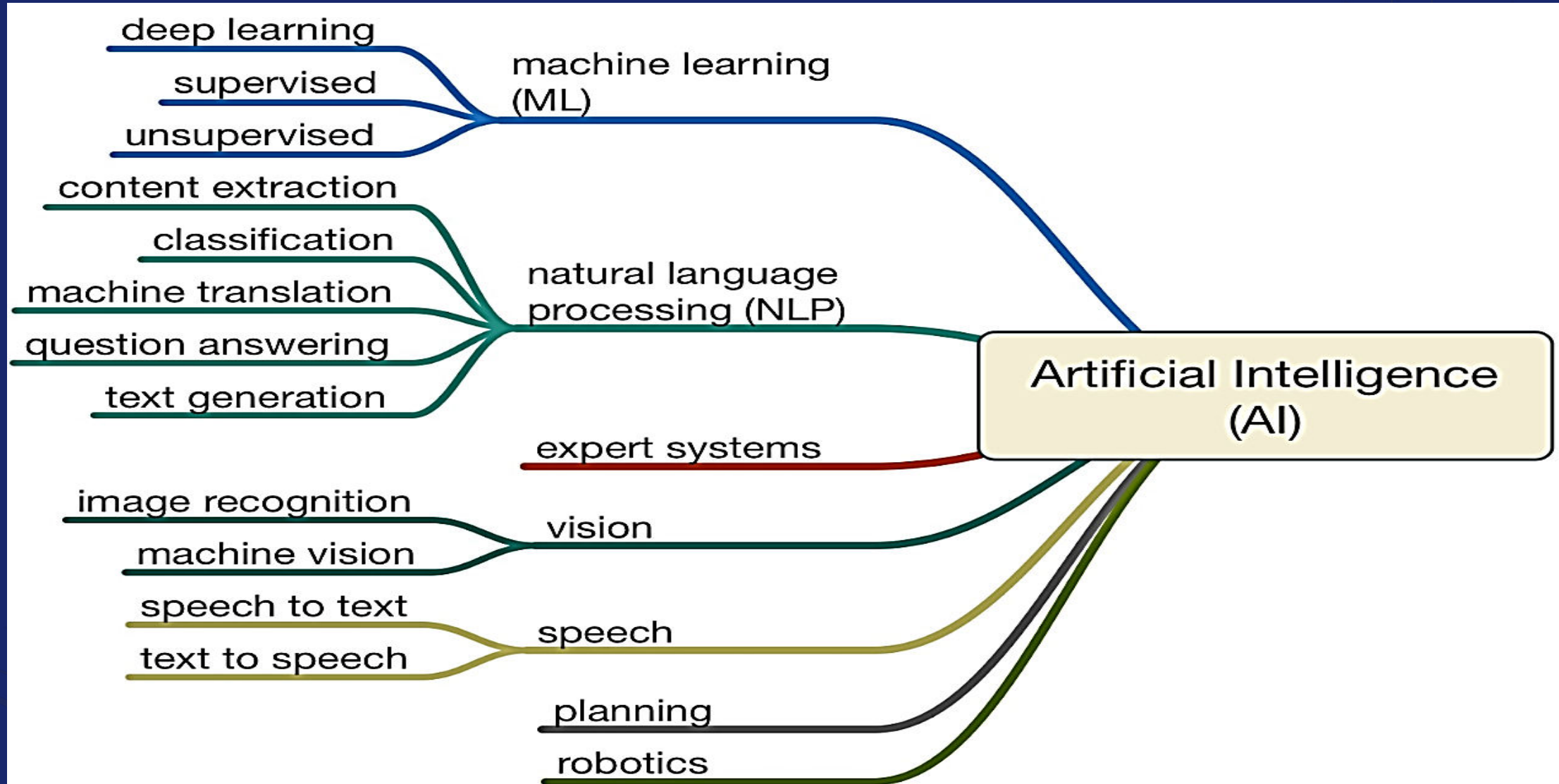
ACTING RATIONALLY: THE RATIONAL AGENT

- 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.

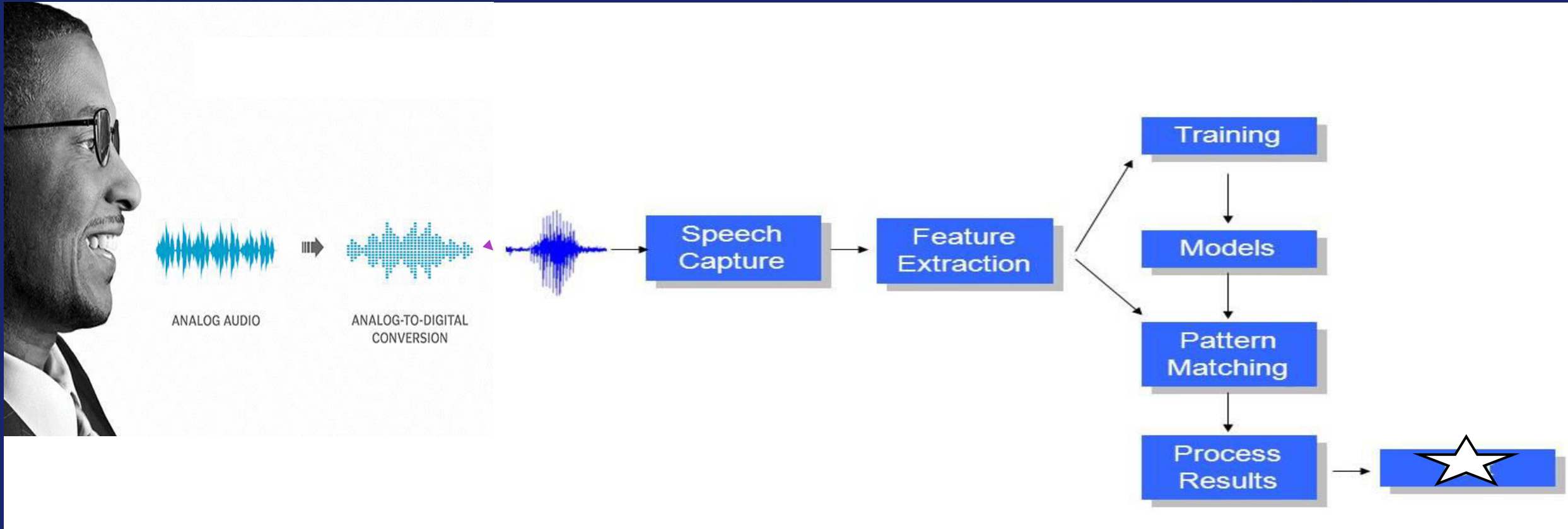
FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

- **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



VOICE ENABLED ELEVATOR



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

TOPICS

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

Train Data



Feature vector Label

(179, 45, 132, 56, 78,...) (Bike)



(98, 82, 56, 181, 35,...) (Ship)



(12, 162, 95, 143, 145,...) (Car)



(25, 48, 213, 26, 159,...) (Plane)

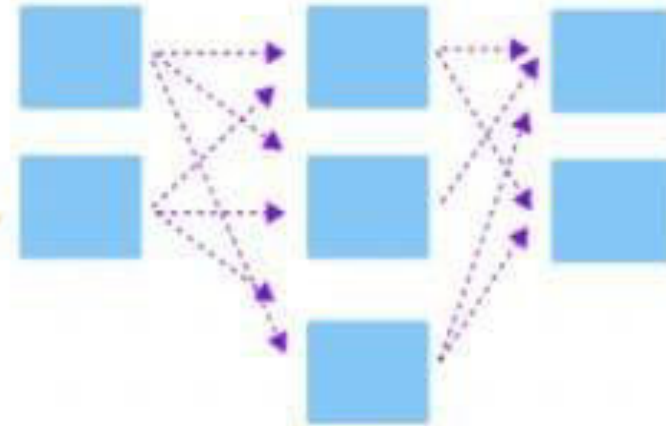
Test Data



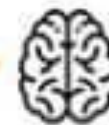
Feature vector

(12, 162, 95, 143, 23,...) (?)

Layers of Deep Neural Network



Inference



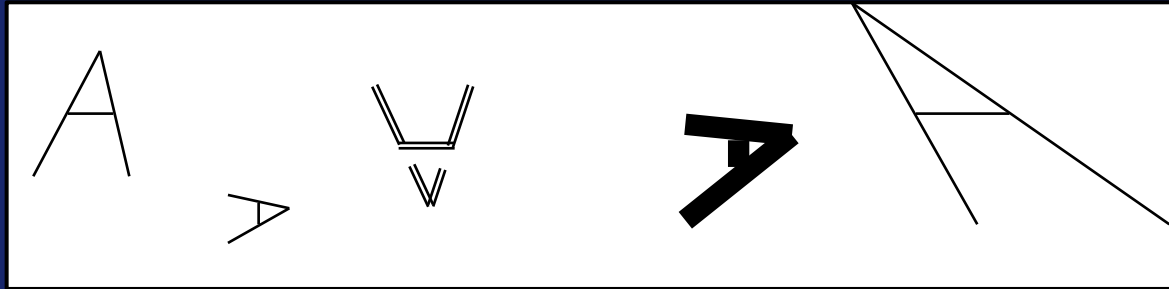
Output

(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)