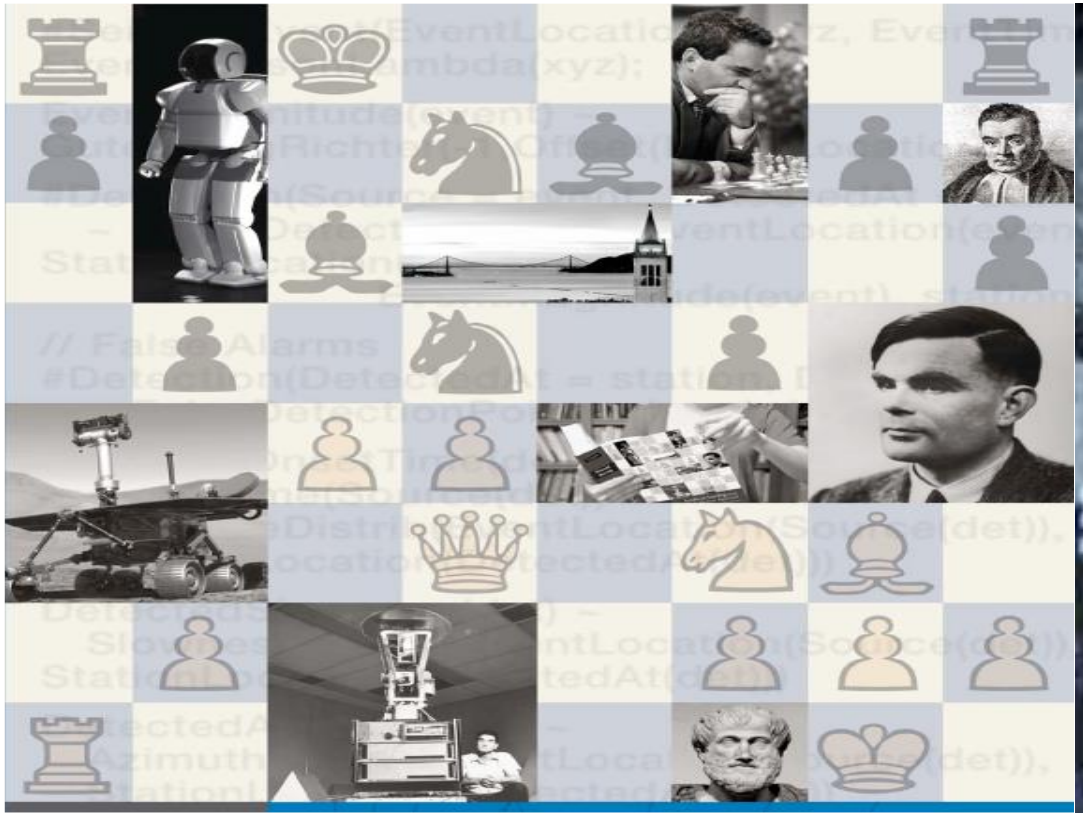
الذكاء الإصطناعي



ARTIFICIAL INTELLIGENCE

3rd Year – Bachelor's Degree in Computer Systems

About the Subject

- Coefficient : 3 Credit : 5
- Evaluation :
  - Interrogation/10 pts
  - Mini-Project/8 pts,
  - Lab attendance/2 pts (Attendance is not mandatory),
  - Final Examination/20pts

- Links:
  - Blog: https://ia-dz.blogspot.com
  - E-mail: mistudents14@gmail.com
  - Course: moodle.univ-dbkm.dz

References

- Artificial intelligence: a modern approach. Stuart Russel and Peter Norvig (1151 p)
  - 2010. 3rd PEARSON ed. https://github.com/AzatAI/cs_books/blob/master/Artificial Intelligence A Modern Approach.pdf
  - 2022. 4th US ed. https://aima.cs.berkeley.edu/

- Intelligence artificielle pour les développeurs. Concepts et implémentations en C# Virginie Mathivet (512 p)
  - 2014. 3rd ENI ed. http://livre21.com/LIVREF/F1/F001110.pdf

PLAN

AI

- Chapter 1 : Introduction
  - Definition. History
  - AI applications
- Chapter 2 : Problem-Solving and Search Algorithms
  - Uninformed (Breadth-First Search, Depth-First Search, Uniform-Cost)
  - Informed (Greedy-Best-First Search, A*,)
- Chapter 3 : Knowledge Reprsentation and Automatic Reasoning
  - Propositional logic, First-order logic
  - Production rules
  - Semantic networks, Ontologies…
- Chapter 4 : Expert Systems
  - Architecture
  - Inference strategies
  - Examples : Dendral, Mycin, Prospector..
- Chapter 5 : Expert Systems Development
  - Development lifecycle
  - Languages and Tools (Prolog, CLIPS, Experta, ES builder,..)

Lab plan:
- Intro to Python
- ES with PROLOG
- ES with CLIPS
- ES with EXPERTA

CHAPTER I

INTRODUCTION

- Definitions
- Birth of AI
- History
- AI Applications

AI: DEFINITION

Objective

Designing systems capable of reproducing human behavior (Reasoning and Action activities)

Two approaches

- Thinking and acting like humans (Imitation)
- Thinking and acting correctly (Rationality).

AI: DEFINITION

"Construction of computer programs that engage in tasks that are currently performed more satisfactorily by human beings because they require high-level mental processes such as perceptual learning, memory organization, and critical reasoning."

Marvin Lee Minsky, John McCarthy (1956)

Example : Chess Game

Two methods

1.Building an efficient program:

- The machine performs calculations inaccessible to humans.
- Example: Exploring several hundred million positions per second.

2.Understanding how humans play chess:

- Interviewing masters.
- Extracting the rules followed by players (occupying the center, dominating a color of squares, etc.).

AI History

Machine translation. 1945

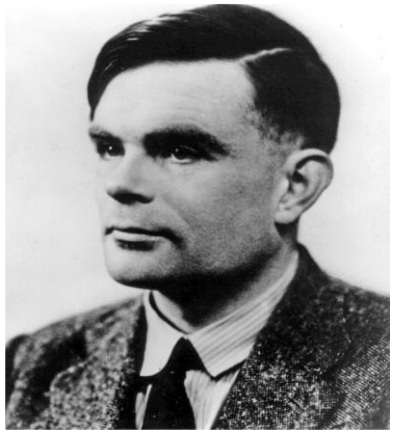
- Representation and extraction of knowledge
- Text generation

Robotics (Science fiction), 1950. Isaac Asimov

Three laws of robotics:

- A robot must not harm a human being
- A robot must obey the orders given by humans (unless it conflicts with the First Law)
- A robot must protect its own existence (as long as it doesn't conflict with the First or Second Laws)

AI History

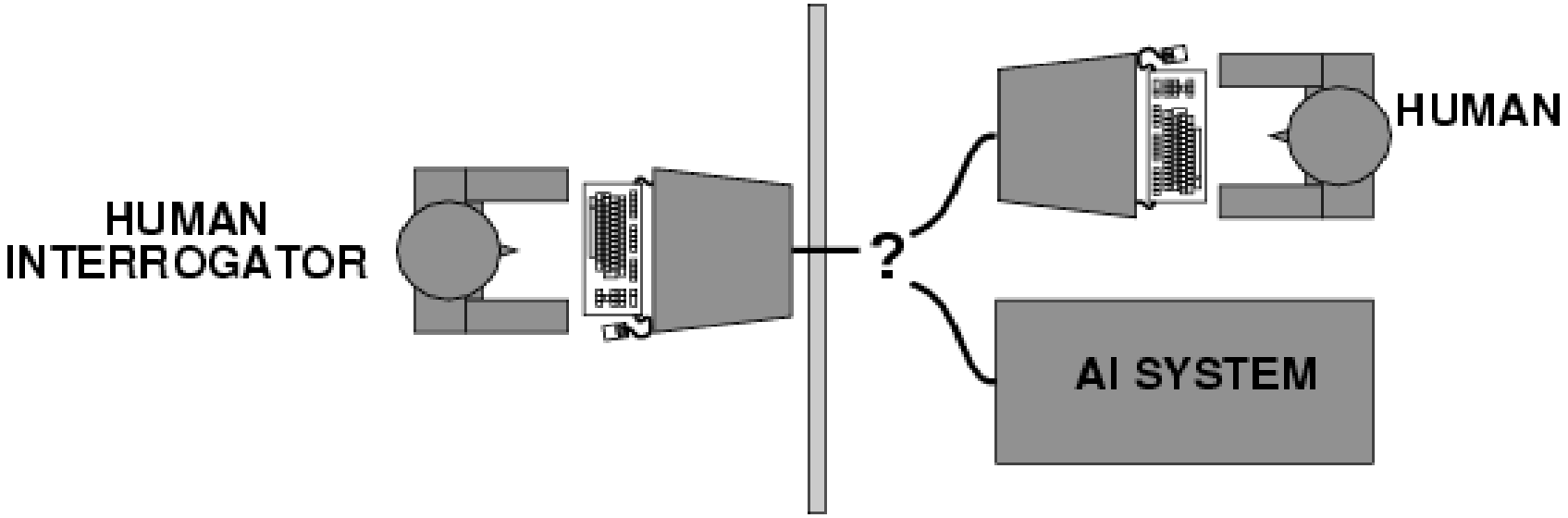


- Alan Turing (1950) "*Computing machinery and intelligence*":

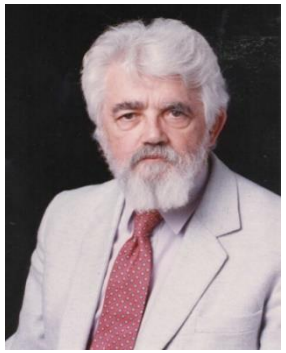
  Can machines think?

  Or: Can machines behave 'intelligently'?

- Turing Test (Imitation game)



AI History



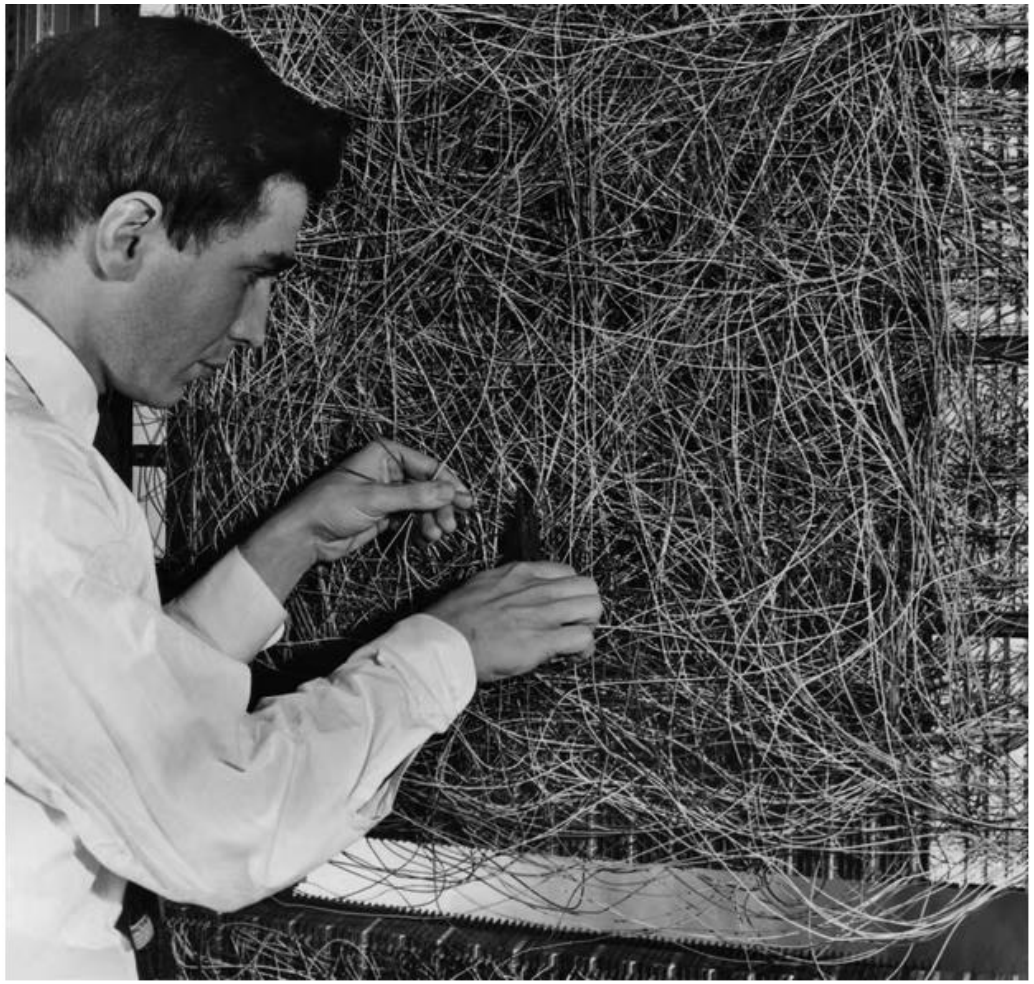
- **Birth of AI**
  - Conference at Dartmouth College (NH, USA) 1956.
  - The term «Artificial intelligence» (John McCarthy)

- **Definition of AI**

  Computer programs that solve problems typically solved by high-level mental processes in humans.

AI History

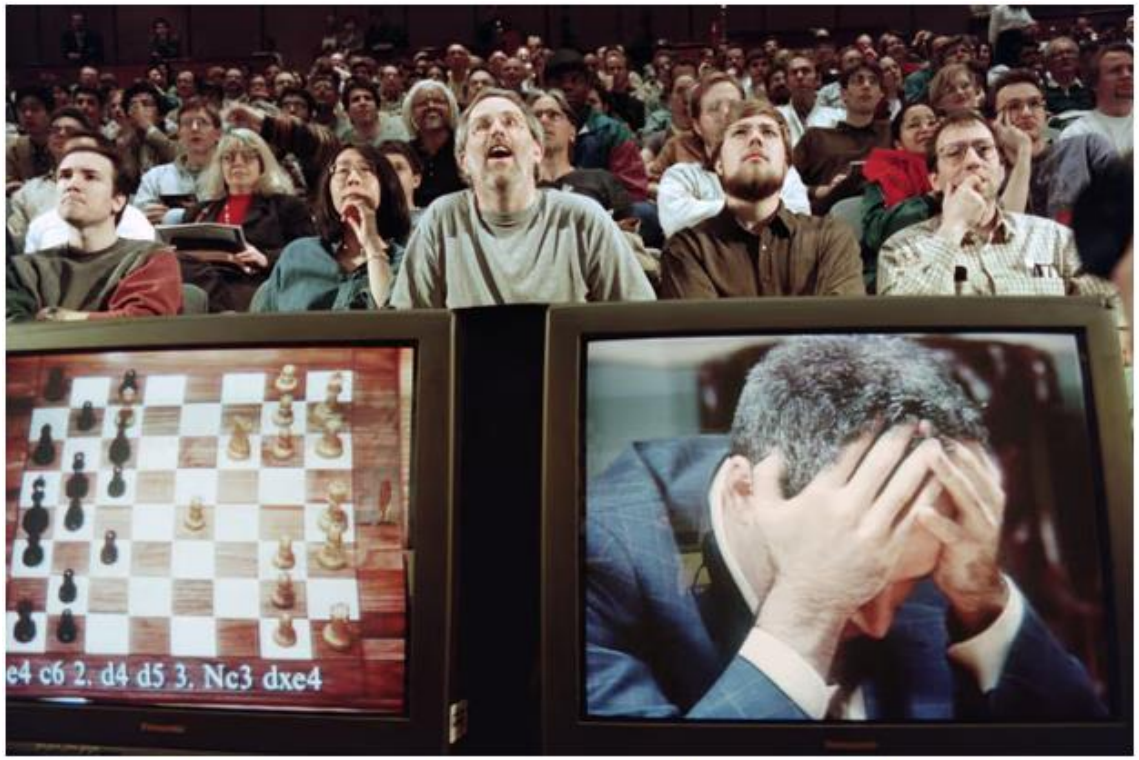
- Perceptron (Rosenblatt,1958)
  - First neural network



Frank Rosenblatt with his Mark-1 single-layer perceptron

AI History

- Chess game (Simon,1958)
  - Intelligent chess program
  - Kasparov wasn't defeated by the Deep Blue machine until 1997!



The last game of Garry Kasparov's 1997 rematch against Deep Blue, which he lost. Photograph: Stan Honda/AFP/Getty Images

AI History

- Automatic theorem proving
  - First program : LOGIC THEORIST (1956)

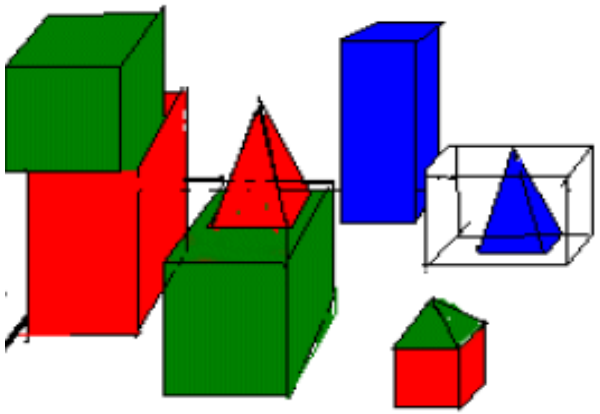
- Appearance of AI languages
  - IPL1 (1956) , Lisp (1960, McCarthy), Prolog (1971, A. Calmerauer)

AI History

- Intelligent dialogue systems
  - ELIZA (J. Weizenbaum at MIT 1965)
    - Dialogue system that imitate a psychotherapist

Demo

  - SHRDLU (T. Winograd, 1970)
    - Manipulation of geometric blocks placed on a table



Example of dialogue

SHRDLU in Action (vidéo)

AI History

Expert Systems:

- DENDRAL, 1969: Analysis of mass spectrometry results (identifying the chemical constituents of materials)
- MYCIN, 1977: Infectious diseases
- HEARSAY-II, 1980: Speech understanding
- PROSPECTOR, 1983: Geology

Specific techniques in computer science (1980)

- **Renaissance of Neural Networks:** Architecture inspired by the human brain (Backpropagation 1986).
- **Genetic Algorithms:** Mimicking natural selection.
- **Inductive Logic Programming.**
- **Bayesian Networks:** Probability theory for selecting the most satisfactory hypotheses.

AI History

Emergence of the Internet (1990-2000)

- Information Retrieval (Search Engines)
- Data Mining

Computer Vision (1997)

- ALVINN System: First autonomous car (Vavlab 5)

Robotics (1997)

- Robot Championship (RoboCup): Soccer-playing robots (Nagoya, Japan)

Automatic satellite control (1999)

AI History

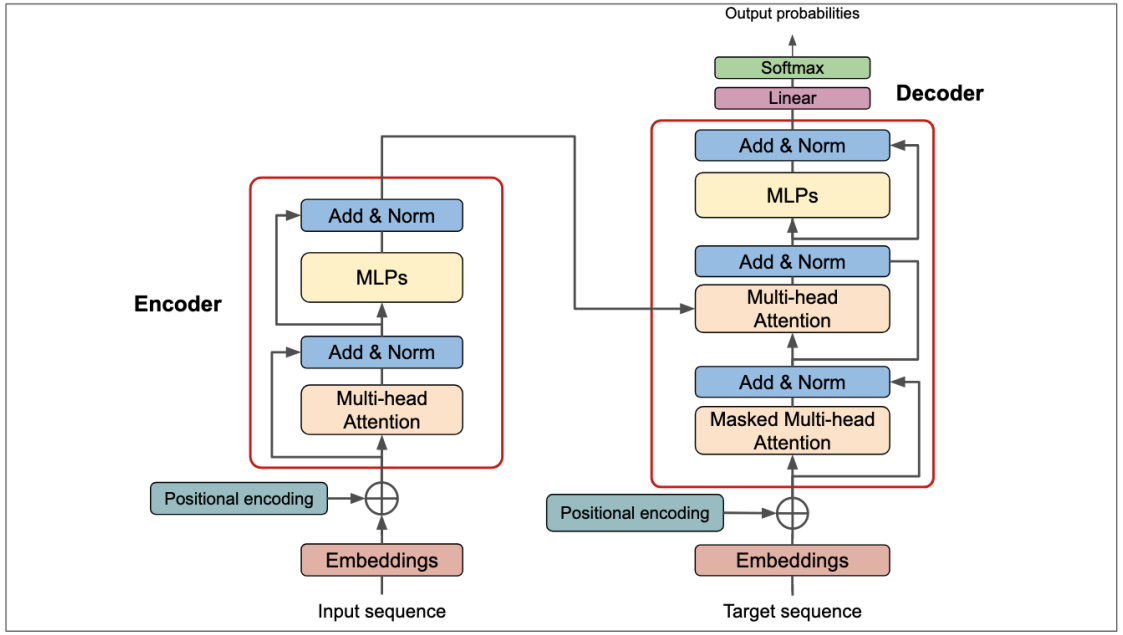
New techniques for knowledge representation and acquisition (2000)

- Ontologies (exp. Unified Medical Language System)
- NLP and lexical databases (Wordnet, OpenCyc)
- E-Learning (Elearning)
- CAPTCHA (Carnegie Mellon University) : Differentiating humans from machines

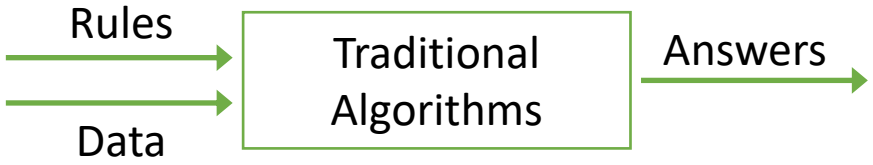
AI History

Generative AI models

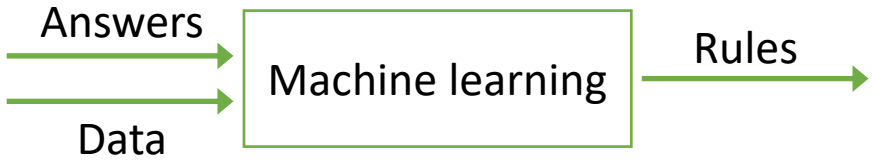
- Birth of Transformer architecture (2017)
- BERT (2019)
- ChatGPT (2022), GPT4 (2023)
- Gemini (2023)
- SORA (2024)



AI: Classical vs Modern



Training

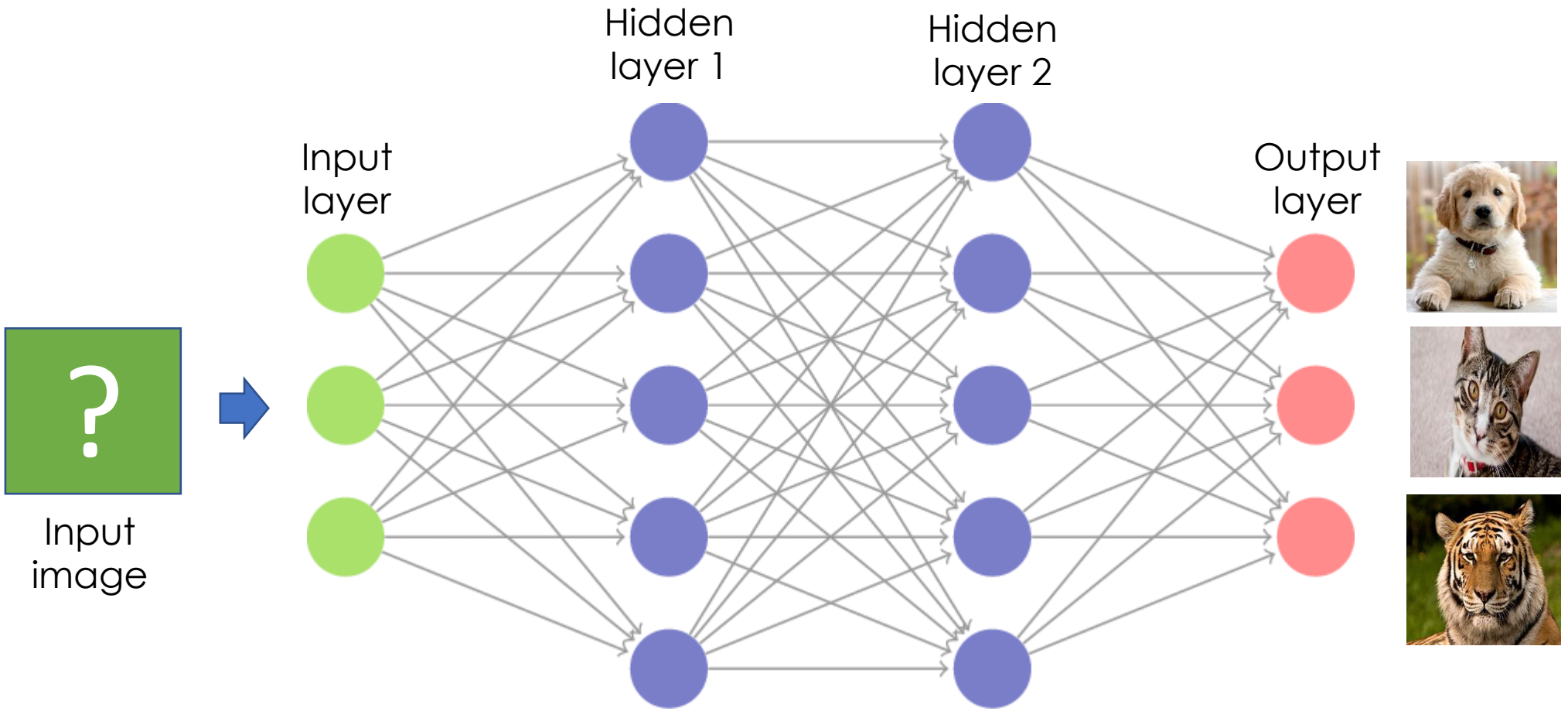


Inference

AI Research Fields

- Machine learning & Deep Learning
- Augmented Reality (AR) & Virtual Reality (VR)
- Pattern Recognition
- Artificial life
- Robotics
- Multimedia Indexation
- Datamining
- NLP, NLU and NLG
- Multimodal AI

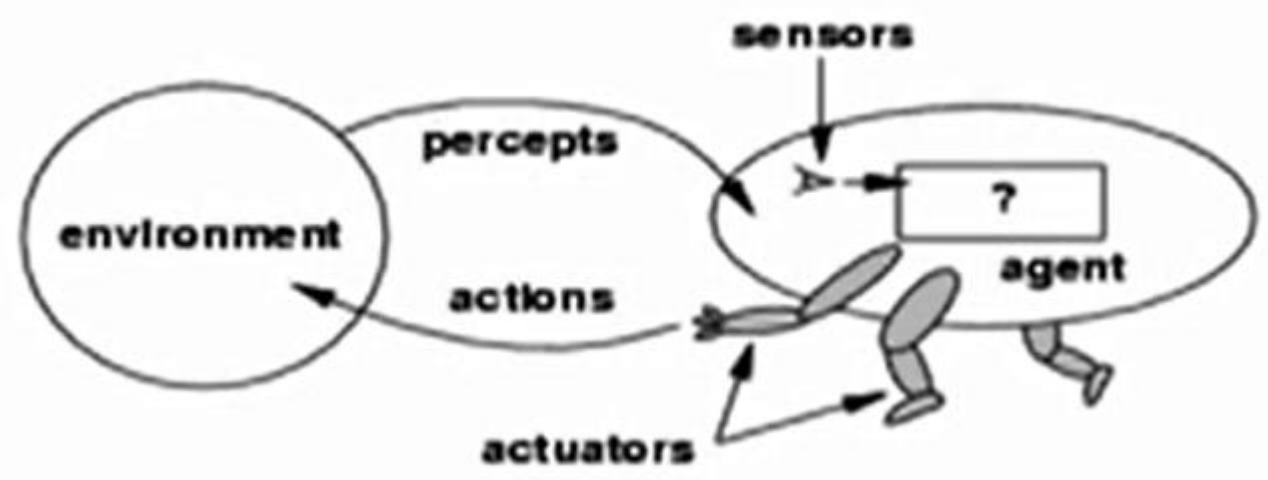
Deep learning



ROBOTICS

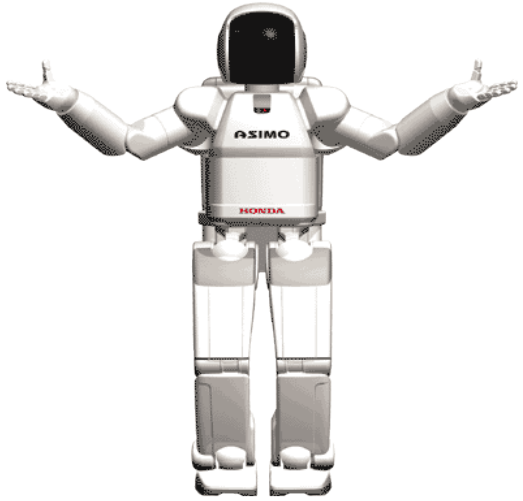
Objective: Creating physical agents that can act in the real world.

- Intelligent interconnection of perception, action, and robot operation.
- A robot must be capable of sensing, moving, reasoning, and communicating in natural language.



ROBOTICS

Examples



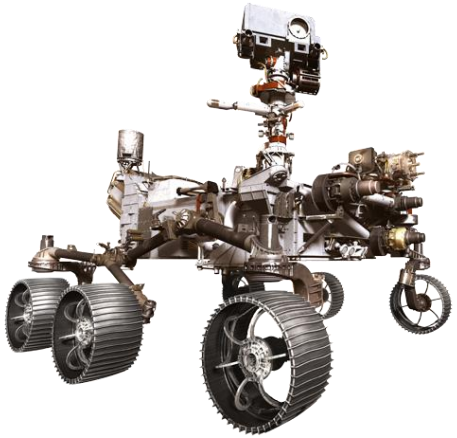
ASIMO

Quicktron

ANYmal

Ingenuity

Kiva system



Perseverance