



INTRODUCTION TO ARTIFICIAL INTELLIGENCE

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- Over 10 years of experience in AI, Machine Learning, Data Engineering.
- Had over 90 publications in prestigious conferences/ journals and four patents filed in USA and Canada.
- Won various international and national scientific awards in Machine Learning and Artificial Intelligence.
- Help over 20 students win Ph.D. fellowships in well-known universities and research institutes in Europe, Asia, and America during the last five years.

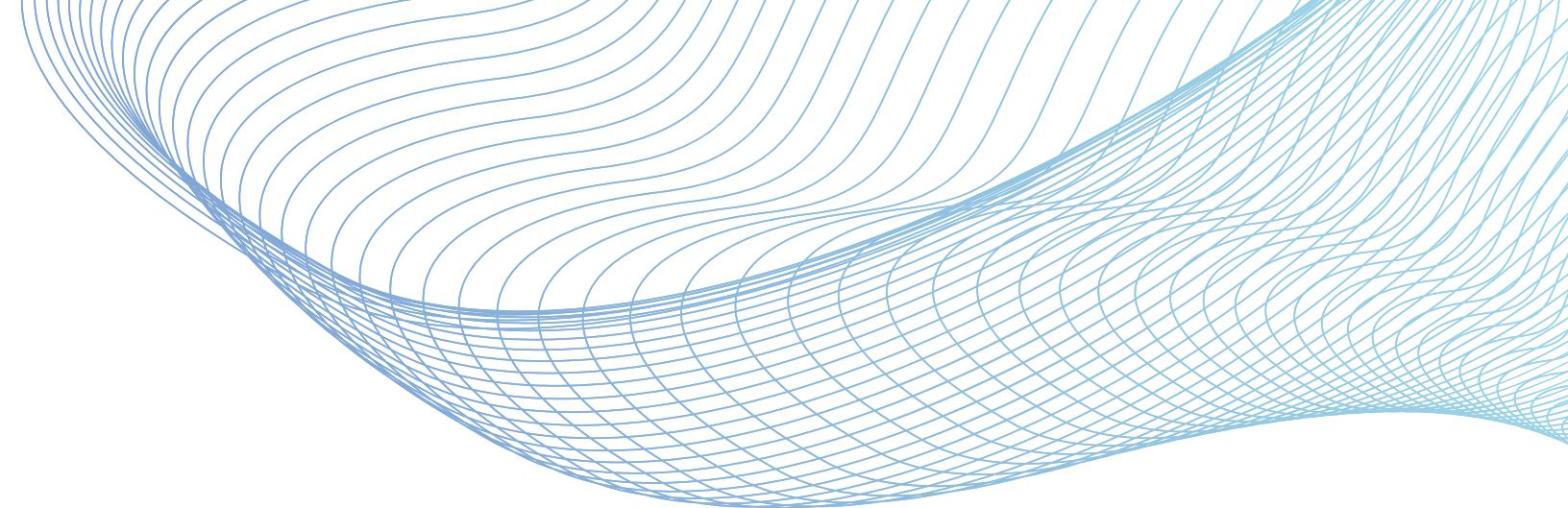


**PGS. TS. NGUYỄN
THANH BÌNH**

OBJECTIVE

- Understand basic concepts of Artificial Intelligence:
 - Heuristic Algorithms
 - Fuzzy Logic and Genetic Algorithms.
 - Neural Network and its applications.
 - Knowledge Representation
 - Data-Mining and Machine Learning
- For all undergraduates on Computer Science



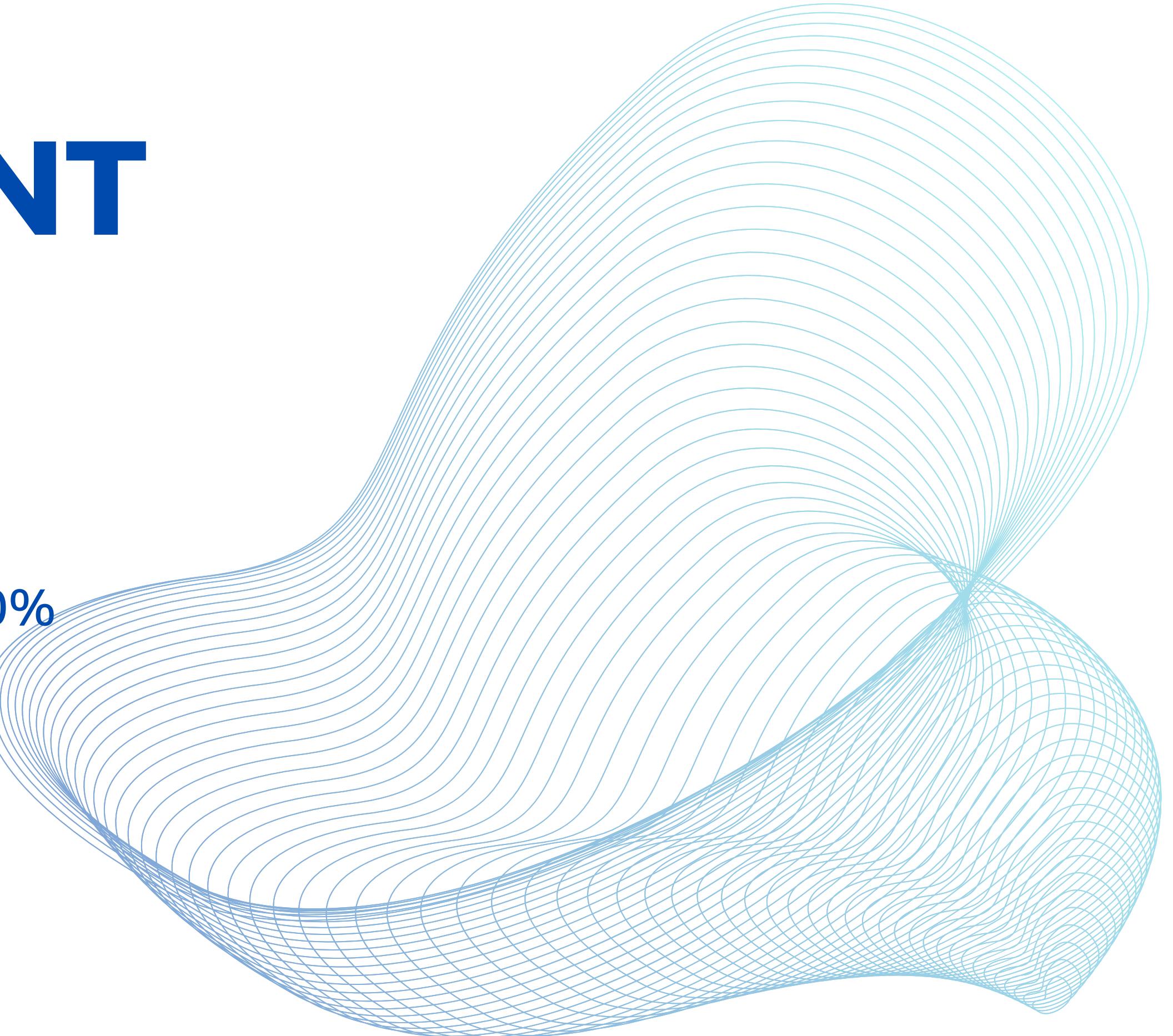


REFERENCES

- ★ Machine Learning, Nguyen Dinh Thuc, 2002.
- ★ Genetic Algorithm, Nguyen Dinh Thuc, 2001.
- ★ Artificial Intelligence: A modern approach, Russel and Norvig, 2003.
- ★ An introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 1999

ASSESSMENT OVERVIEW

- ★ Homework: 20%
- ★ Programming assignments: 20%
- ★ Final Exam: 60%
- ★ Bonus: 10%

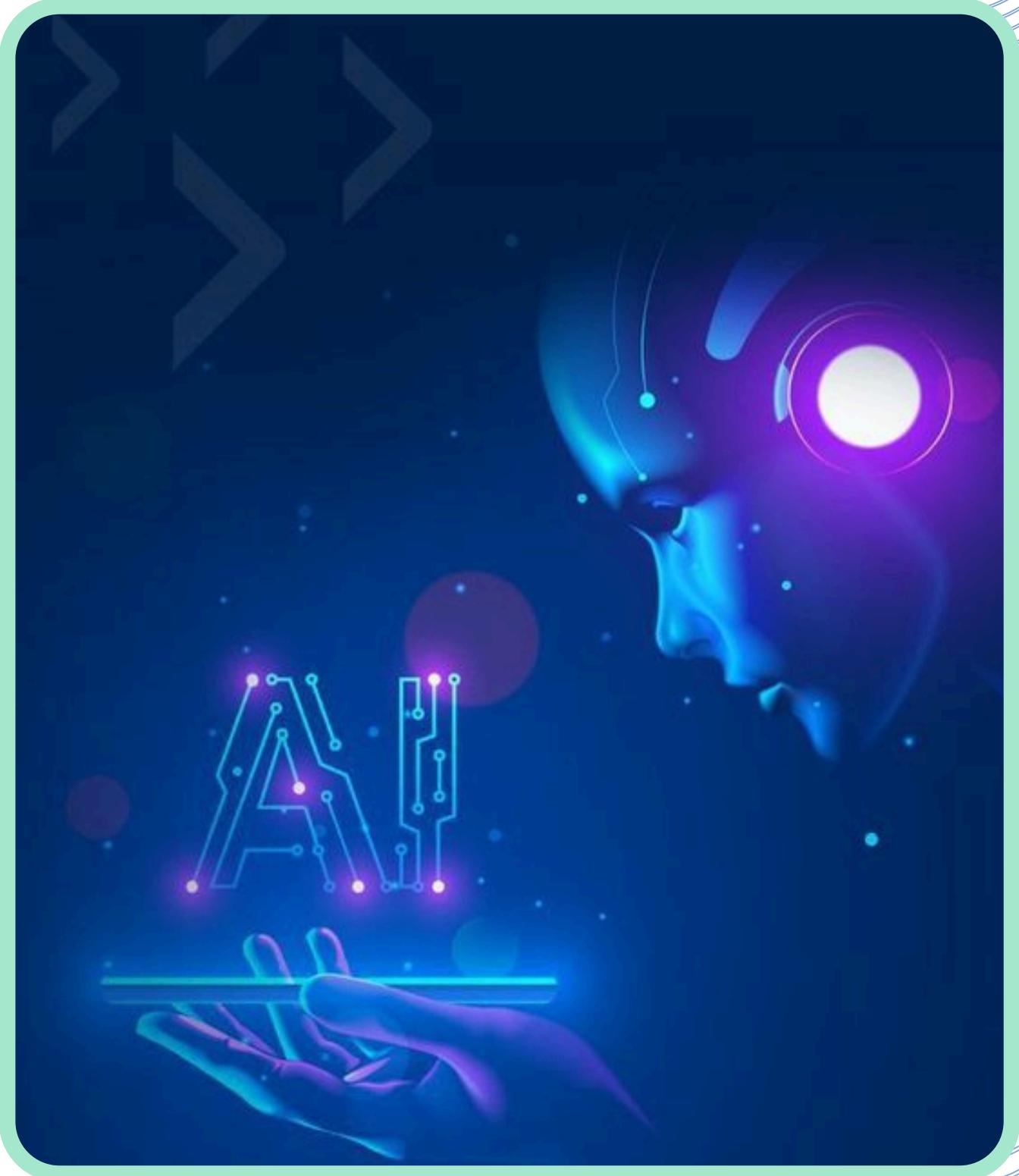


CLASSROOM RULE

- ★ Each homework and programming assignments should be done within 2 weeks.
- ★ No excuse for late cases.
- ★ You will be marked for the parts in which you claimed for your own contribution

WHAT IS ARTIFICIAL INTELLIGENCE ?

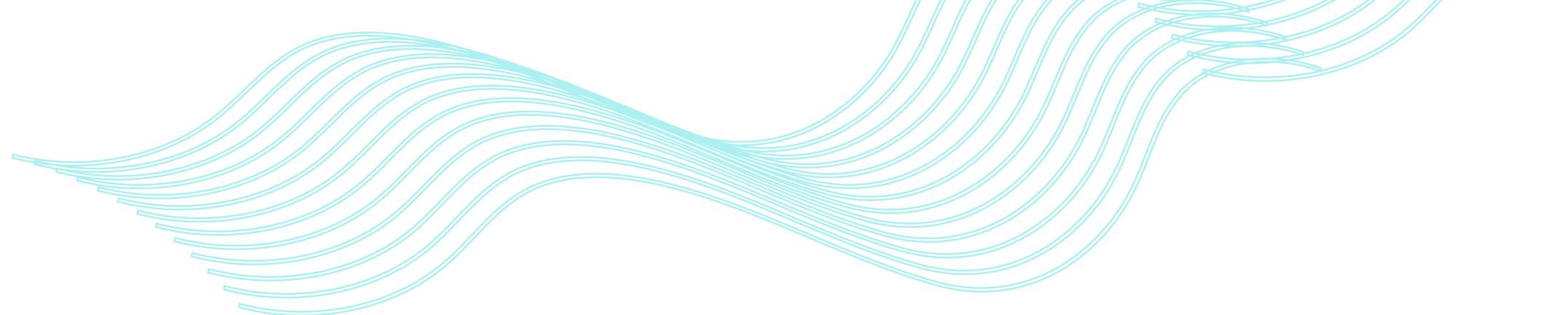
- Course Overview
- What is AI?
- The History of AI
- What can AI do?



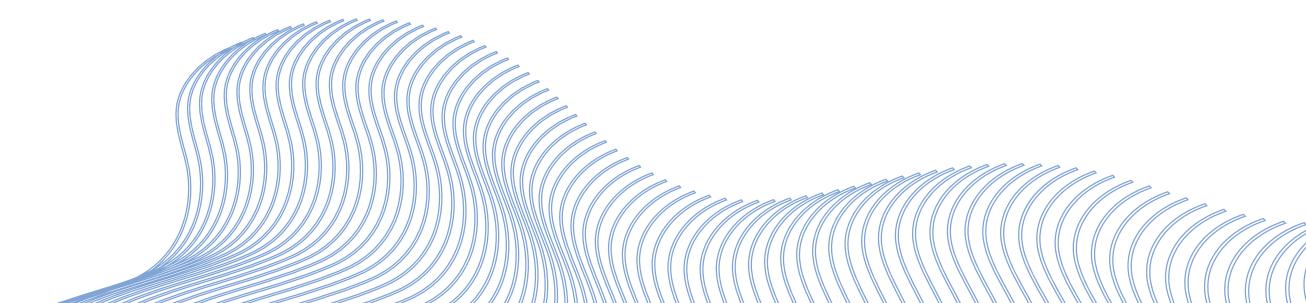
COURSE OVERVIEW

- Introductions and agents
- Heuristic Algorithms and its applications
- Knowledge Representation
- Machine Learning and Data-Mining.
- Genetic Algorithms
- Fuzzy Logics and Neural Networks.



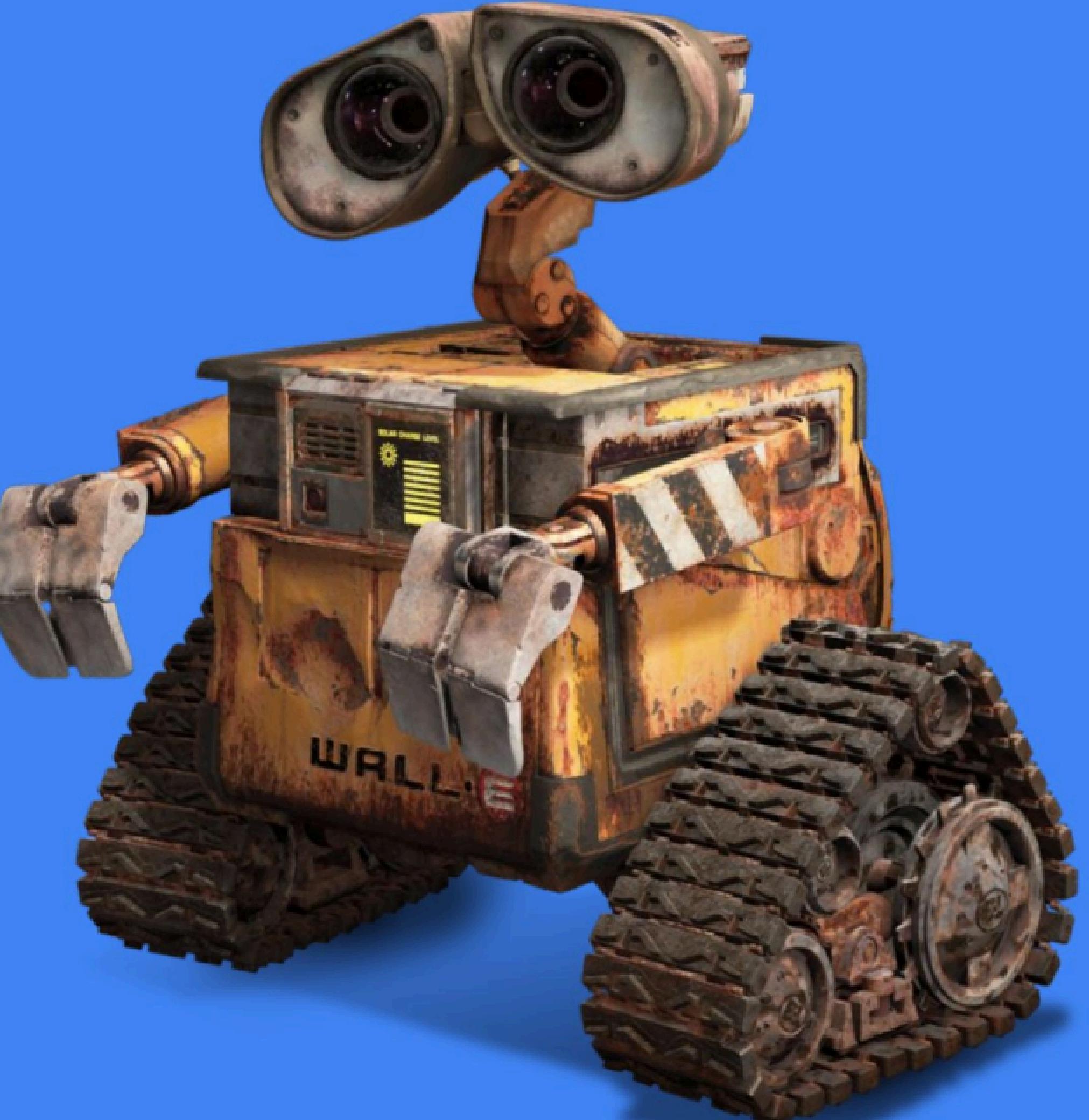


WHAT IS AISIA?



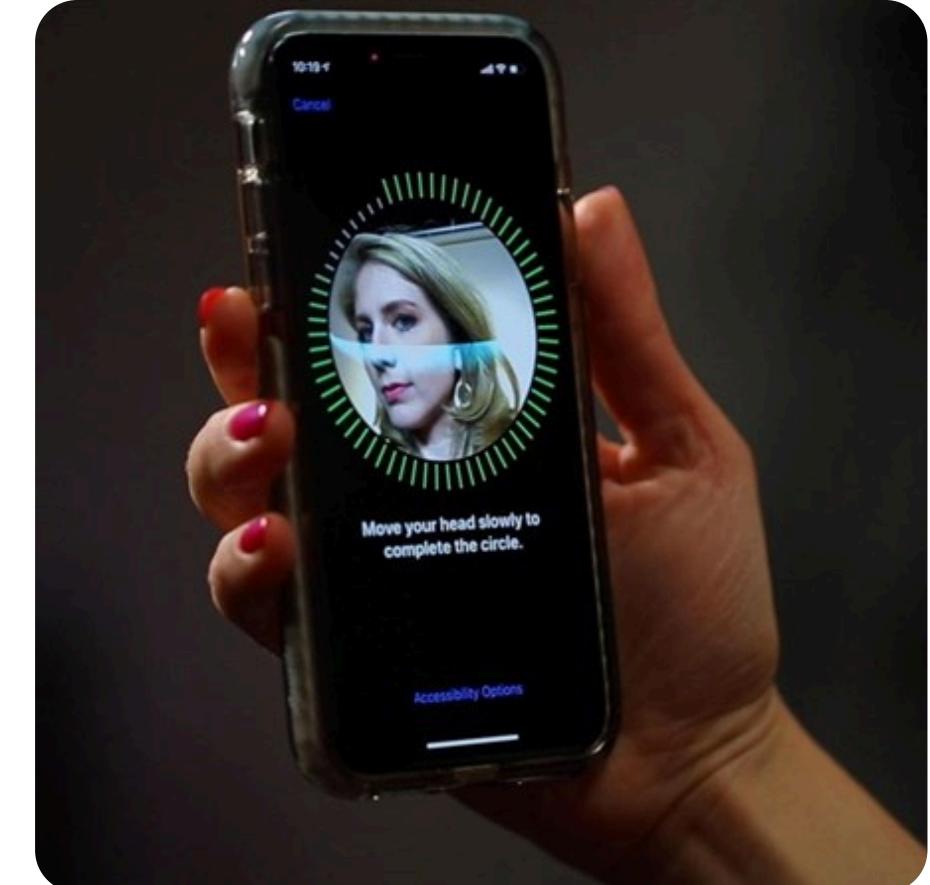
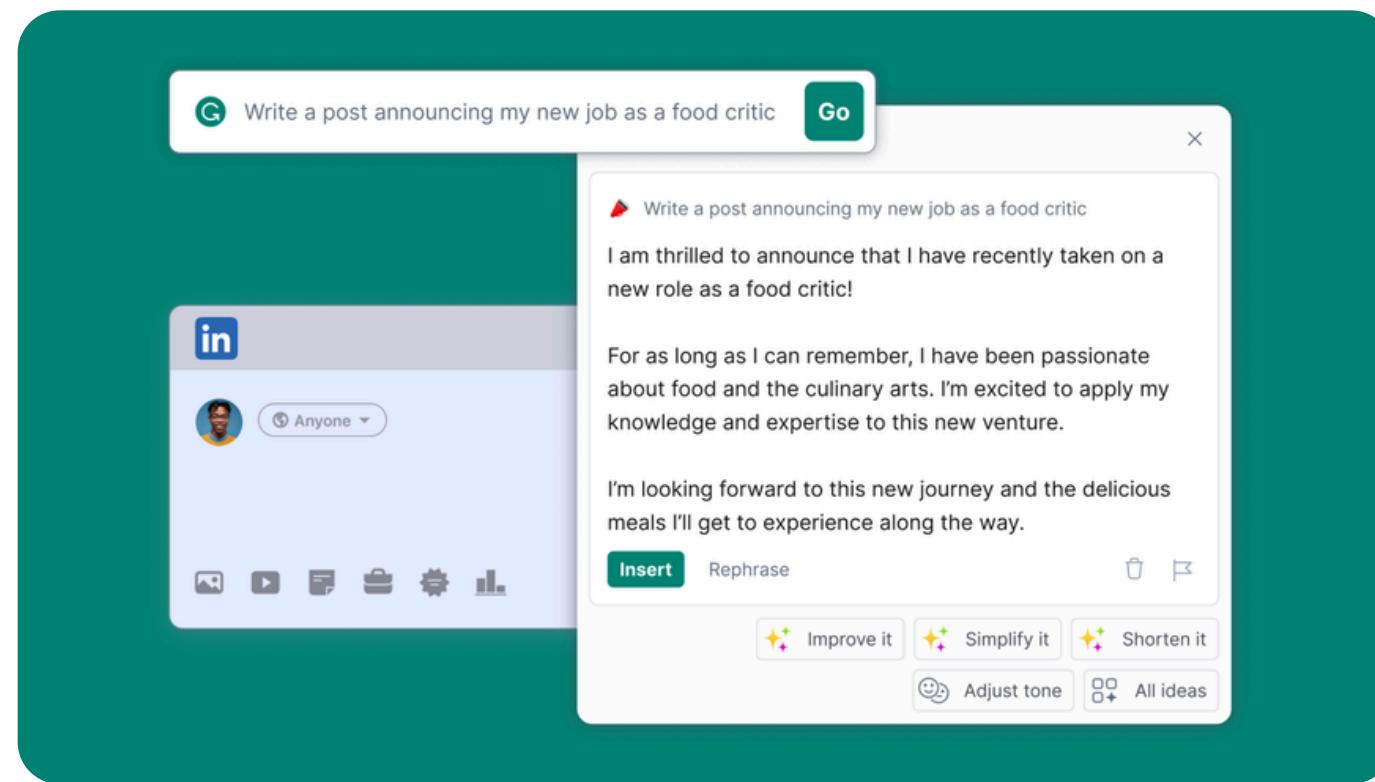
Artificial Intelligence in Movies

In movies, robots are able to talk, think, have emotions, and make decisions just like humans.



WHAT DO YOU THINK

Artificial Intelligence is?



WHAT DO YOU THINK

Artificial Intelligence is?

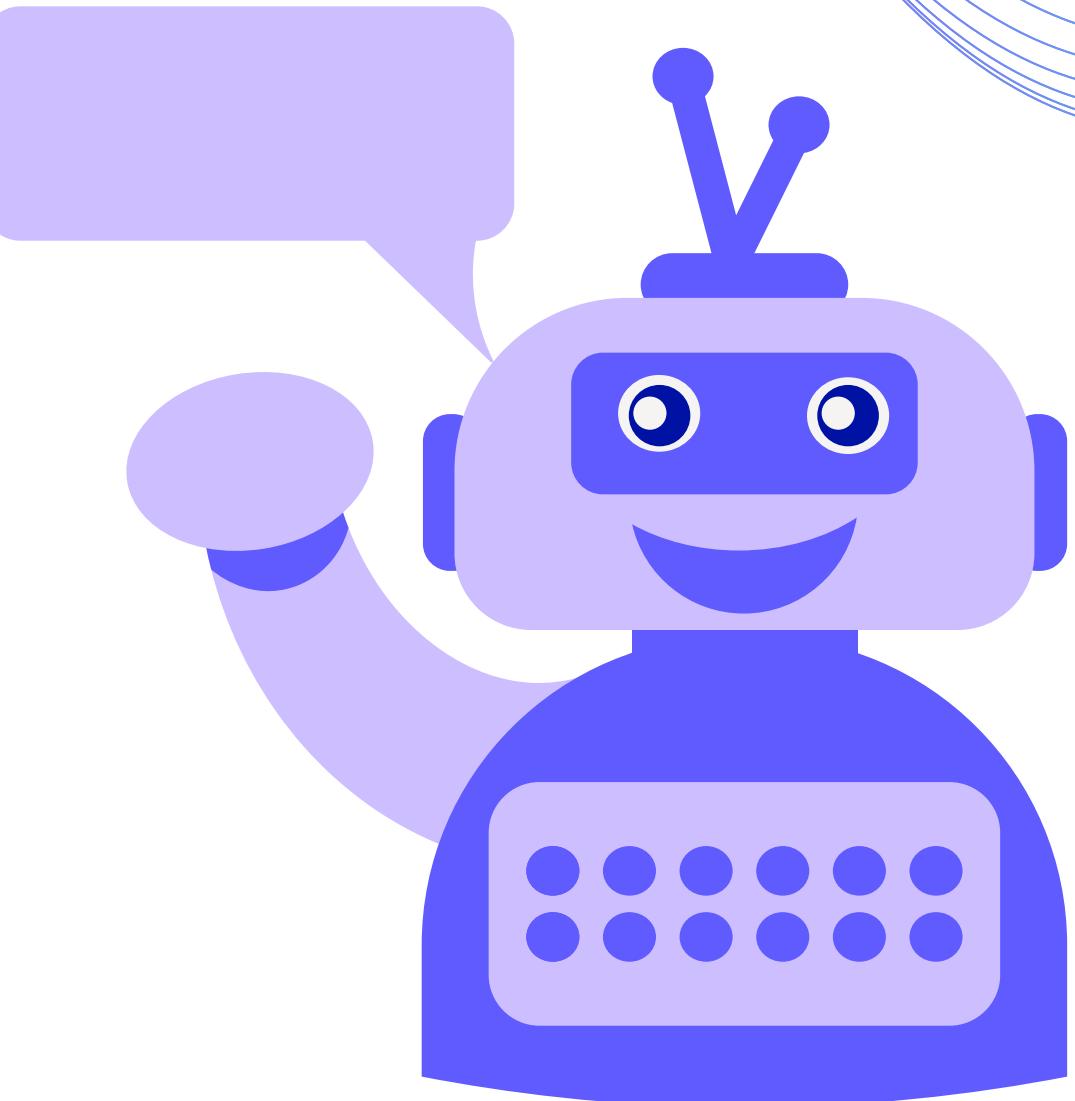


NETFLIX

TikTok

WHAT IS AI

A.I is the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making and translation between languages....
(Oxford dictionary)



WHAT IS AI

The power of a machine to copy and learn from intelligent human behavior.

BIG DATA

Capable of processing massive amounts of **structured and unstructured data** which can change constantly

REASONING

Ability to reason (deductive or inductive) and to draw inferences based on situation. **Context driven awareness** of system.



Ability to **learn** based on historical patterns, expert input and feed-back loop

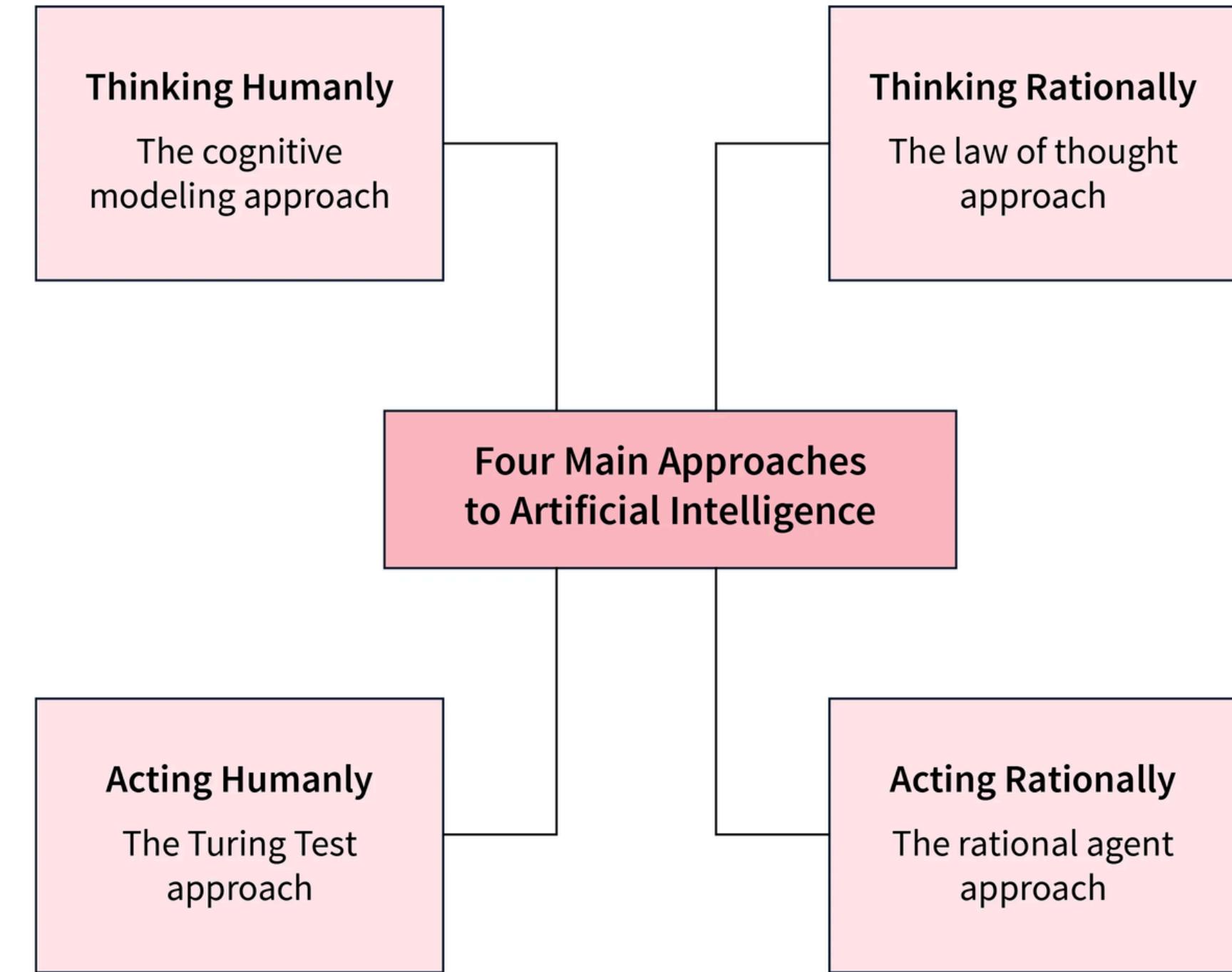
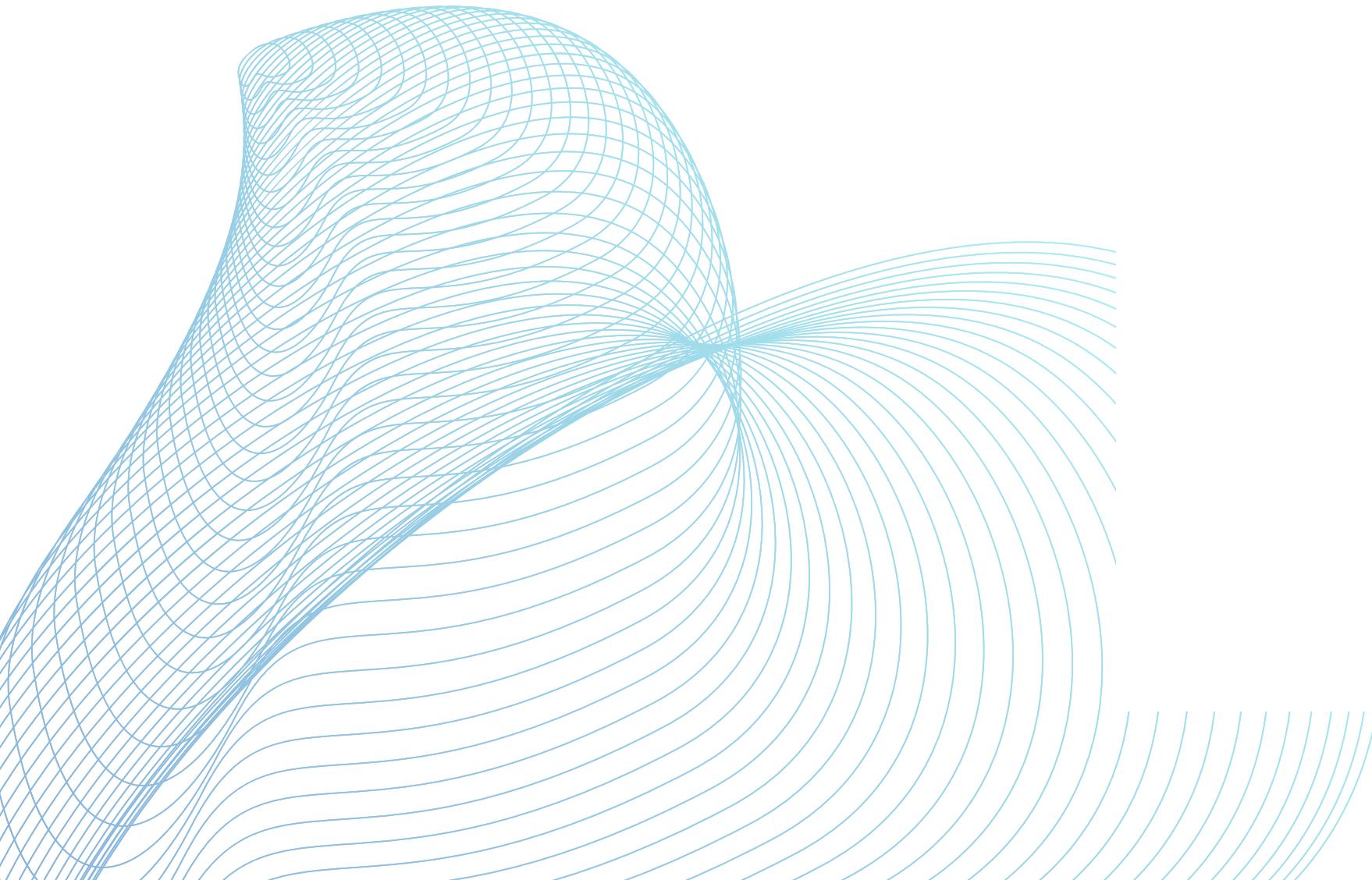
LEARNING

Capable of analyzing and **solving complex problems** in special-purpose and general-purpose domain

PROBLEM SOLVING

WHAT IS AI

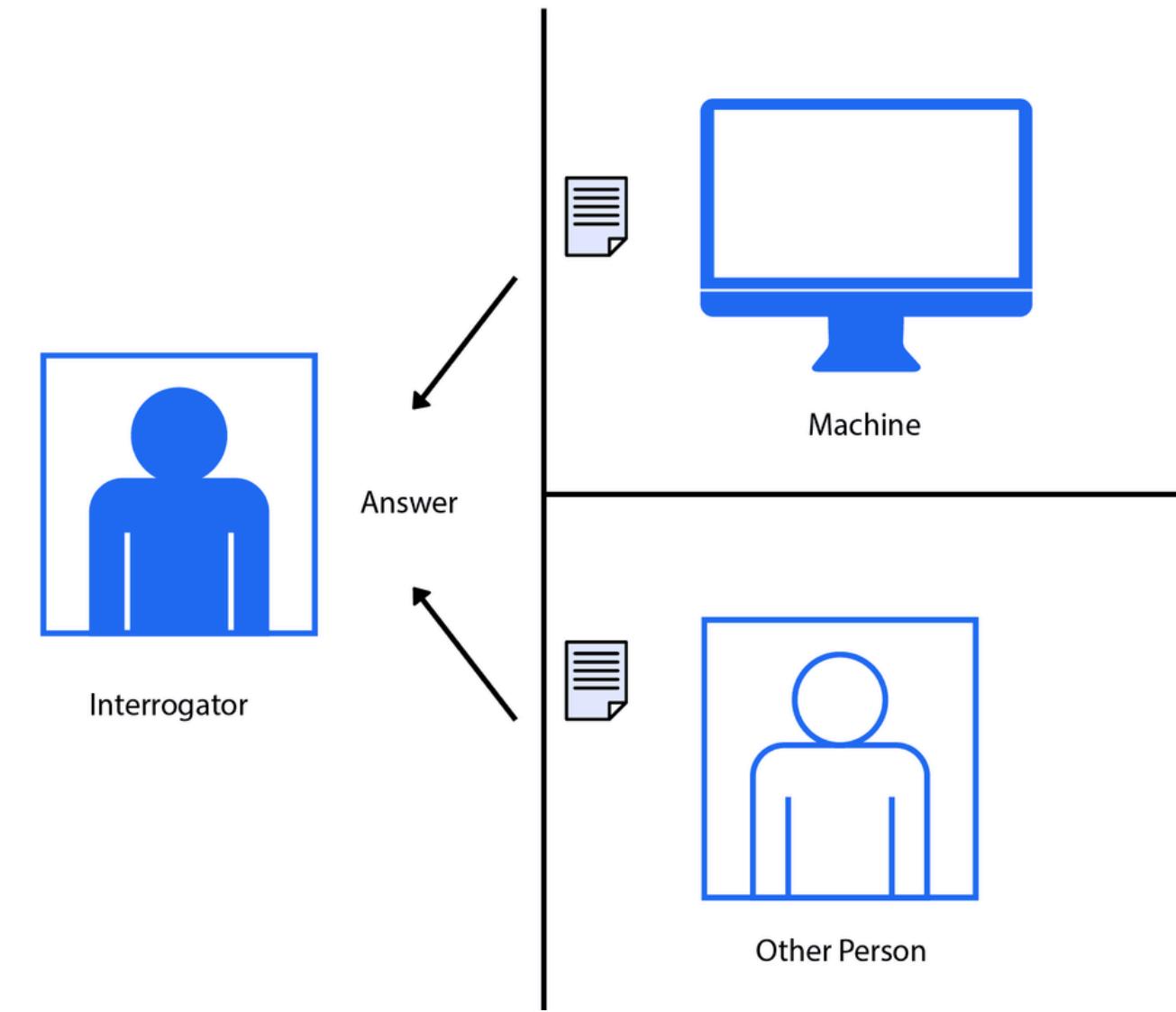
AI can be separated into four categories as following:



ACTING HUMANLY: TURING TEST

Was proposed by A. Turing in 1950.

Turing Test



ACTING HUMANLY: TURING TEST

The computer would need to possess the following capabilities:

- natural language processing: to communicate successfully in English
- knowledge representation: to store what it knows or hears
- automated reasoning: to use the stored information to answer questions and to draw new conclusions
- machine learning: to adapt to new circumstances and to detect and extrapolate patterns.

ACTING HUMANLY: TURING TEST

To pass the total Turing test, the computer will need:

- computer vision: to perceive objects.
- robotics: manipulate objects and move about.

Prepared for all major components of AT in following 60 years.

THINKING HUMANLY: COGNITIVE MODELING

Requires scientific theories of internal activities of the brain:

- Predict and test behavior of human subjects (**Cognitive Science**)
- Direct identification from neurological data (**Cognitive NeuroScience**)

THINKING RATIONALLY: “LAW OF THOUGHT”

- Aristotle attempted to codify “right thinking:
 - Use “laws of thought” to yield correct conclusions by logic.
 - For example: “Socrates is a man; all men are mortal; therefore, Socrates is mortal”.
- Direct line through mathematics and philosophy to AI.
- Obstacles:
 - Not all intelligent behavior can be described by logical notations.
 - A big difference between being able to solve a problem “in principle” and doing so in practice.

ACTING RATIONALLY: RATIONAL AGENT

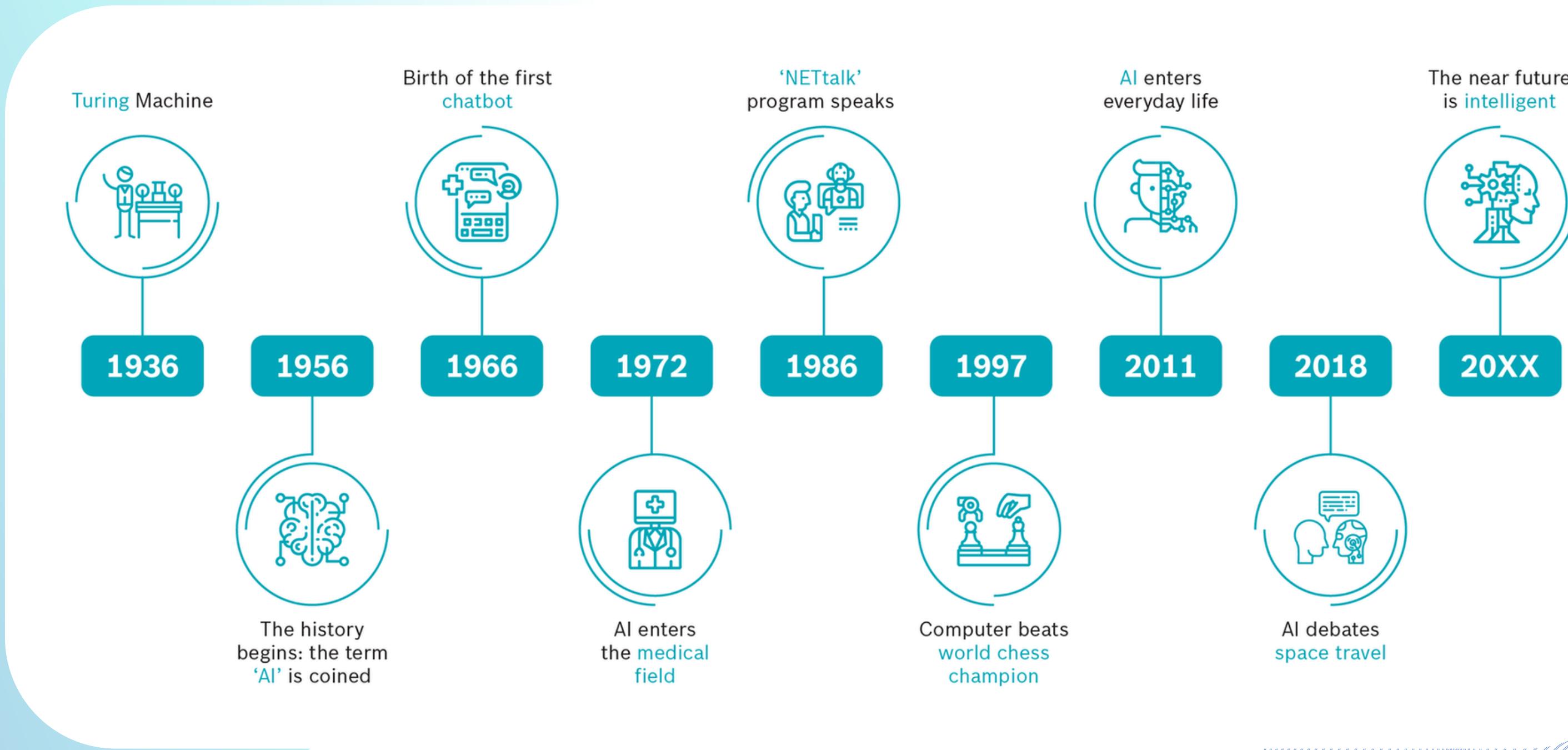
- A rational agent is one that can act so as to achieve the best results even when there is uncertainty.
- Rational behavior: doing the right thing.
- Doesn't necessarily involve thinking but thinking should be in the service of rational action.

RATIONAL AGENTS

- An agent is something that can perceive and act.
- For a given class of environments and tasks, we look for the agent (or class of agents) which obtains the best performance.
- Computational limitations make perfect rationality unachievable. Therefore, one needs to design best program for given machine resources.



HISTORY OF ARTIFICIAL INTELLIGENCE





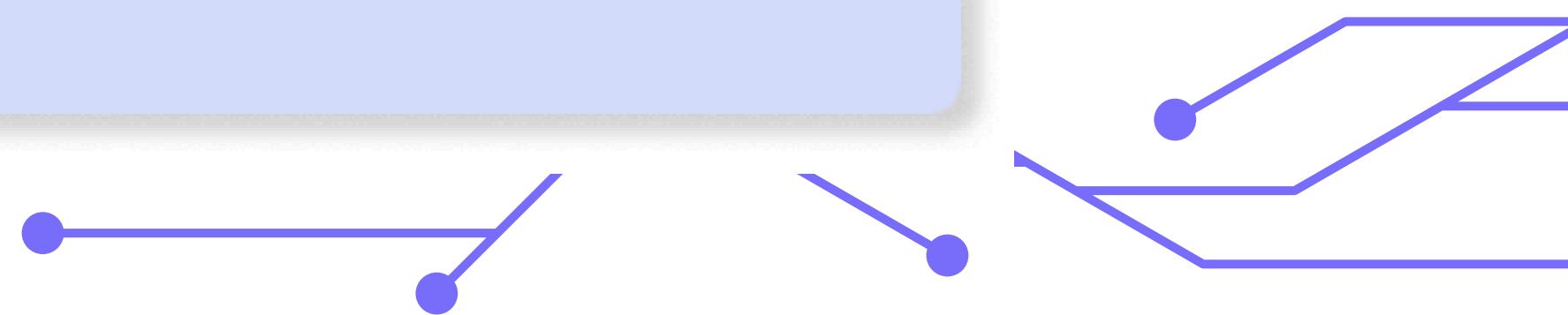
WHAT AI CAN AND CANNOT DO

What AI Can Do

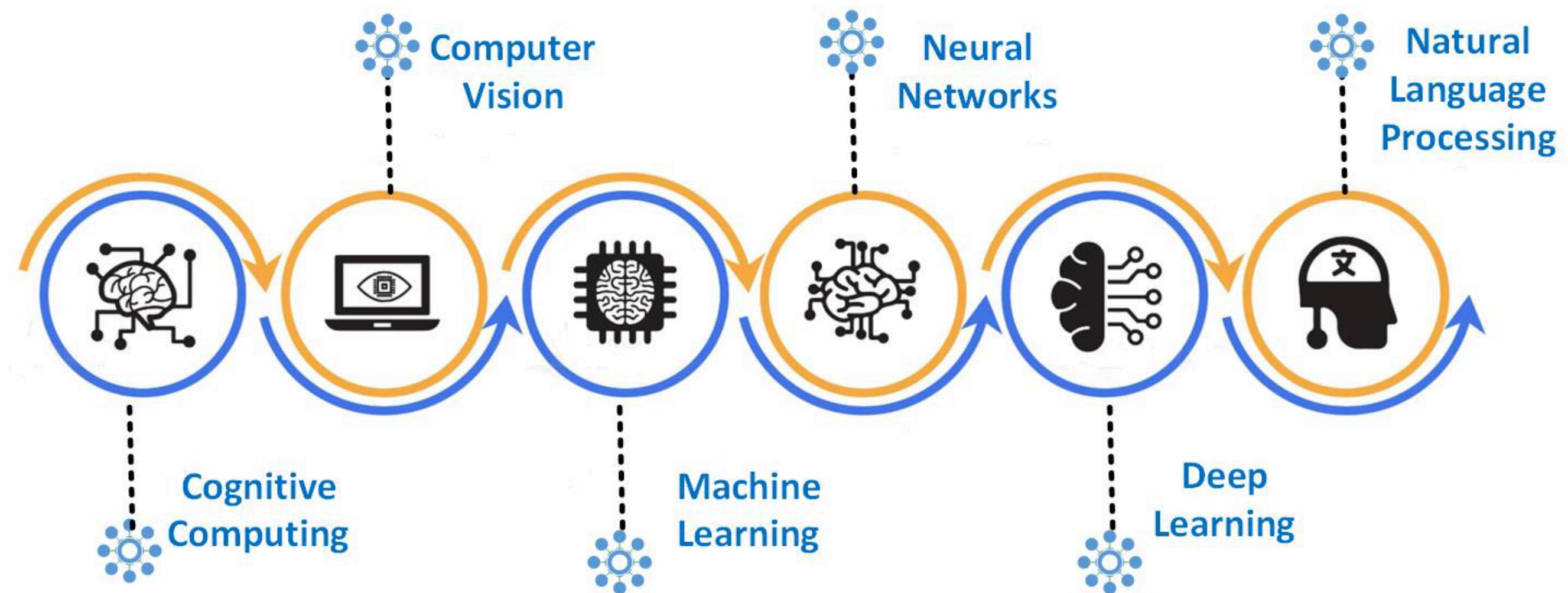
- Generate Quick Results
- Scan Large Databases and Search Facts in Few Seconds
- Find Mathematical and Logical Solutions with Fewer Errors
- Make Decisions based on Solely Objective Criteria

What AI Cannot Do

- Generate Results in Novel Situations
- Develop Own Unique Insights
- Think Intuitively and Abstractly
- Engage in Social Interactions and Communication
- Have Emotional Intelligence



MAJOR SUBFIELDS OF ARTIFICIAL INTELLIGENCE



TYPES OF AI

Narrow AI (Weak AI): Thực hiện một số công việc nhất định, không có khả năng bắt chước, tái tạo trí thông minh con người,

VD: Trợ lý ảo, Chatbot, Xe tự lái, robots lau nhà

General AI (Strong AI): Có trí thông minh chung bắt chước trí thông minh, hành vi của con người, có khả năng học hỏi và áp dụng trí thông minh để giải quyết các vấn đề.

Super AI: Giả định không chỉ bắt chước, hiểu được trí thông minh và hành vi của con người; tự nhận thức, vượt qua khả năng trí tuệ - khả năng của con người.

TYPES OF AI

Predicted AI: Đưa ra dự đoán, nhằm tự động hóa chính xác các hoạt động, giảm sự can thiệp của con người.

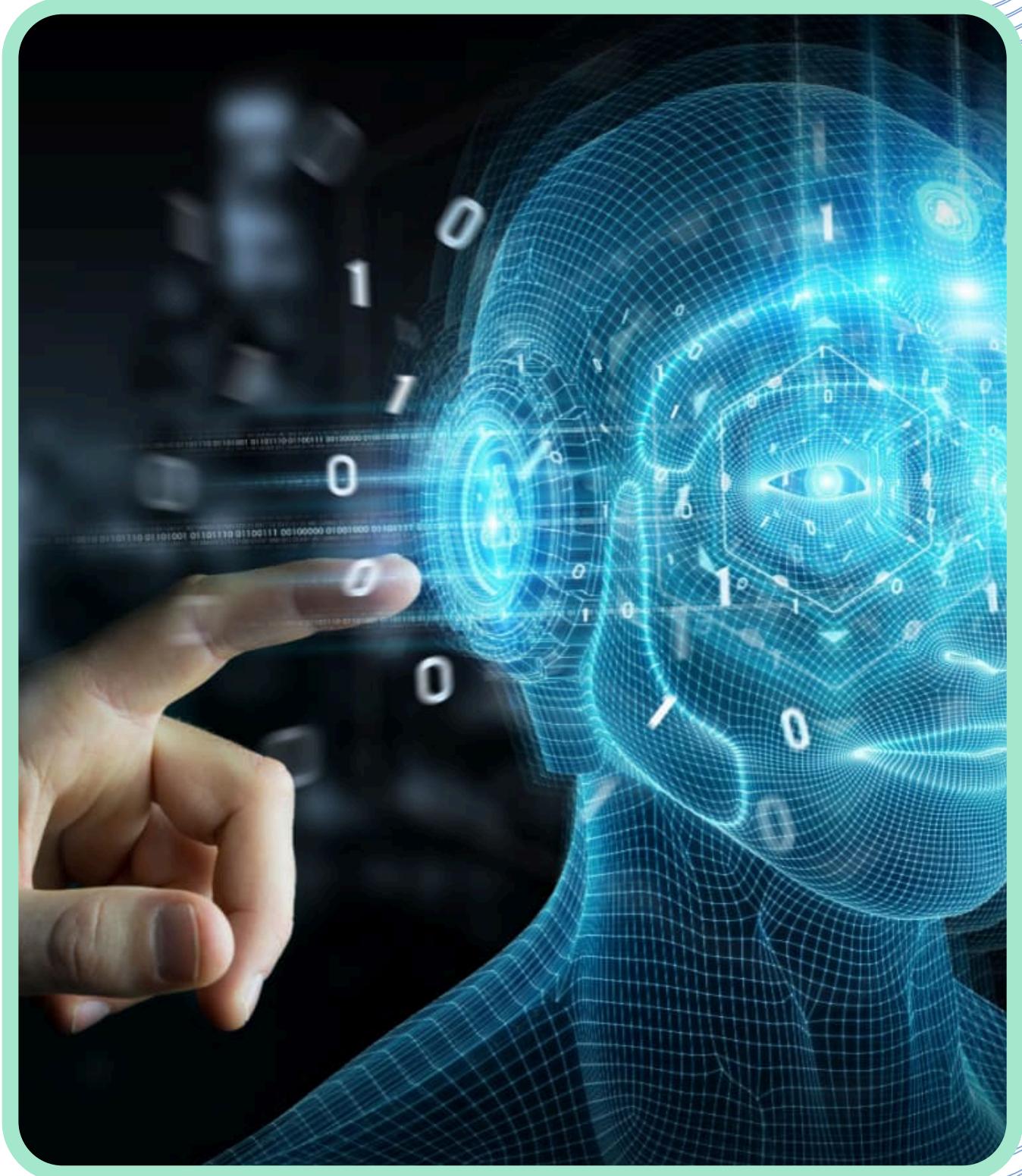
VD: lọc thư rác, chatbot, dự đoán hành vi của khách hàng...

Generative AI: Tạo ra nội dung mới: tạo ra hình ảnh, văn bản, âm thanh mới có hình thức tương đương với những gì con người có thể viết hoặc tạo.

Explainable AI (XAI): Cho phép con người hiểu, tin tưởng vào kết quả do thuật toán AI tạo ra; giúp mô tả tính chính xác, công bằng, minh bạch và kết quả của mô hình trong quá trình ra quyết định do AI cung cấp.

INTELLIGENT AGENTS

- Agents and environments
- Rationality
- PEAS model
- Environment types
- Agent types

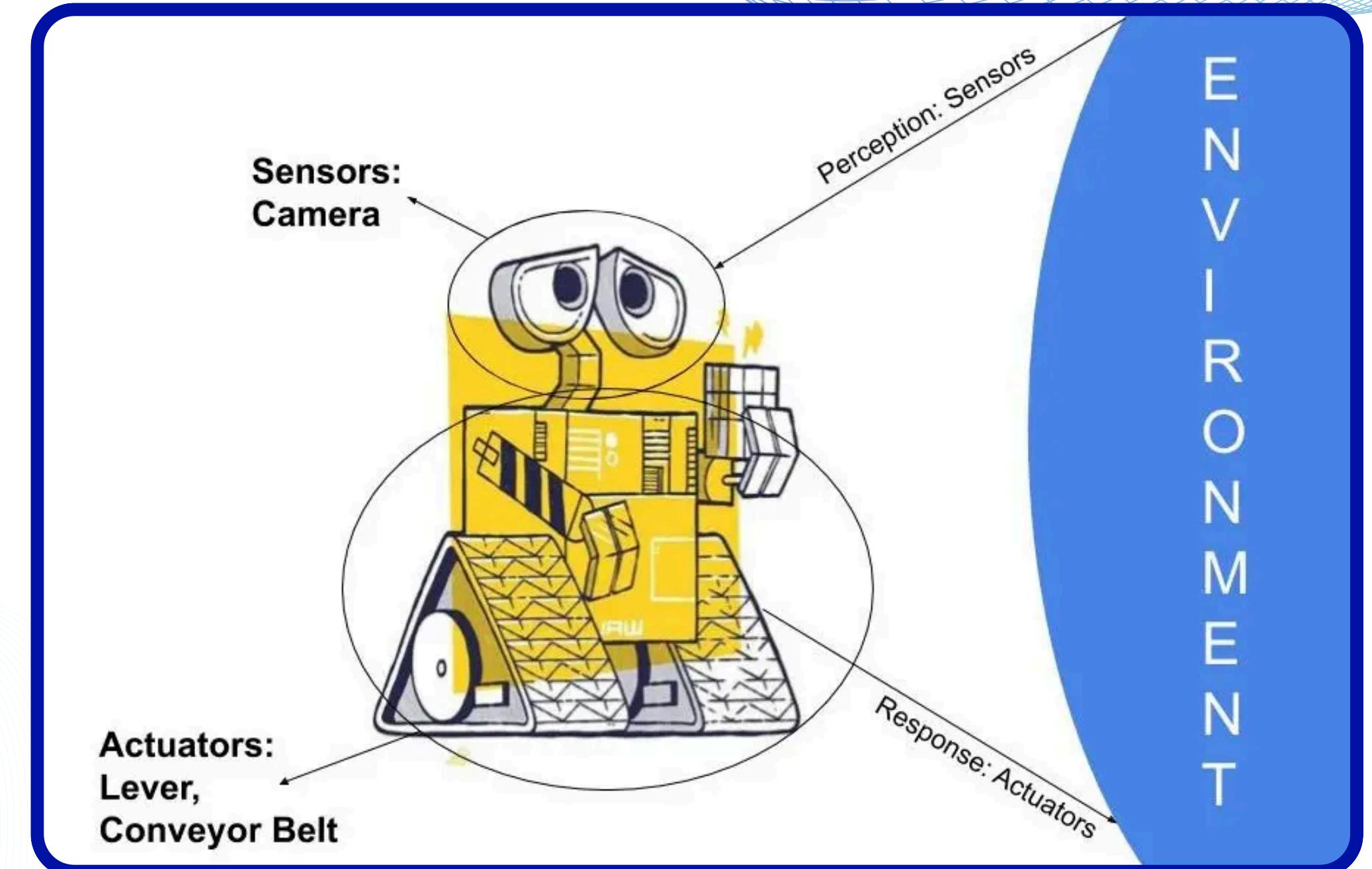


AGENTS

- An agent is anything that can be viewed as perceiving its environment through sensors and acts upon that environment through actuators.
- Human agent: eyes, ears, skin and other organs for sensors; hands, legs, mouth and other body parts for actuators.

AGENTS

- Robot agents: cameras and infrared range finders for sensors; different motors for actuators.



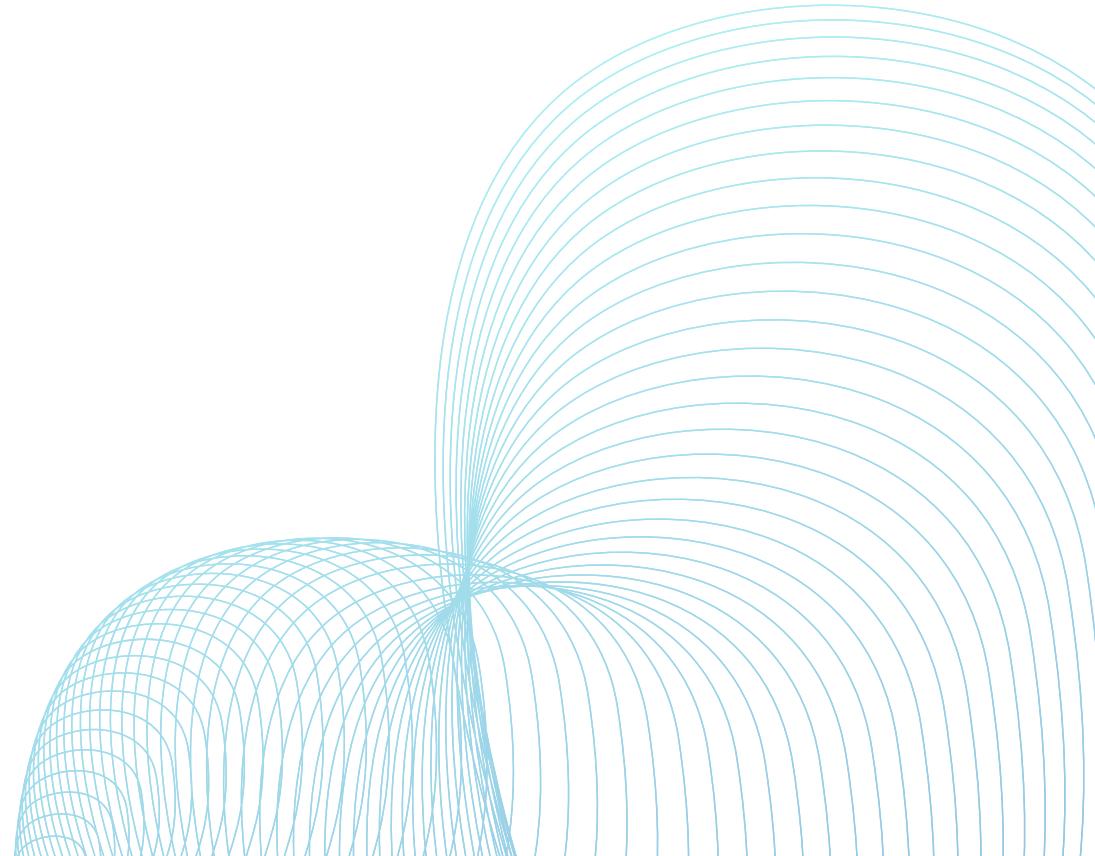
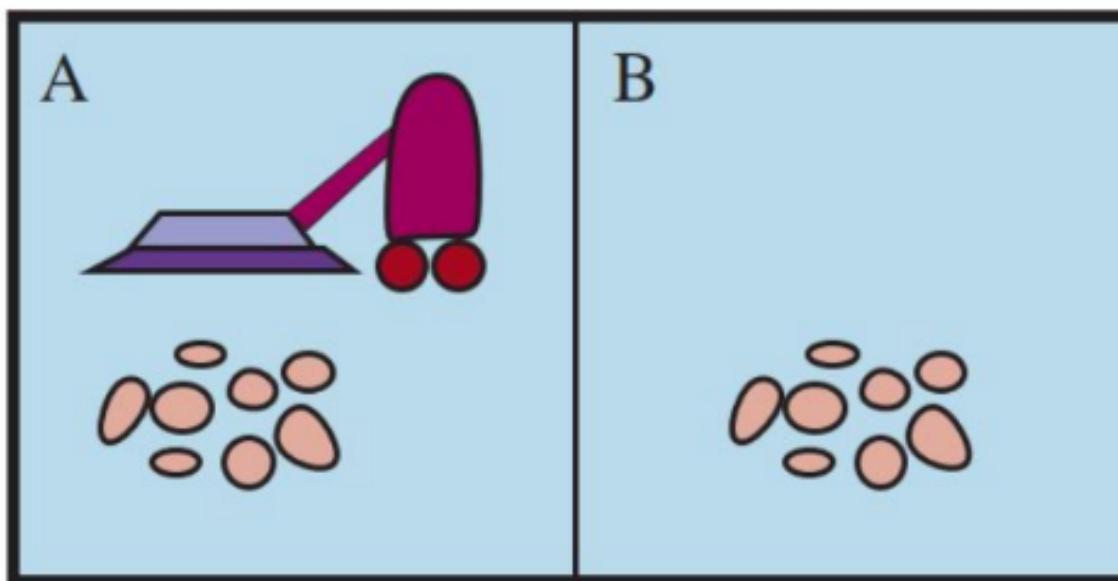
AGENTS

- One can consider the agent function maps from its percept history to actions.
- The agent program runs on the physical architecture to produce f.

AGENT = ARCHITECTURE + PROGRAM

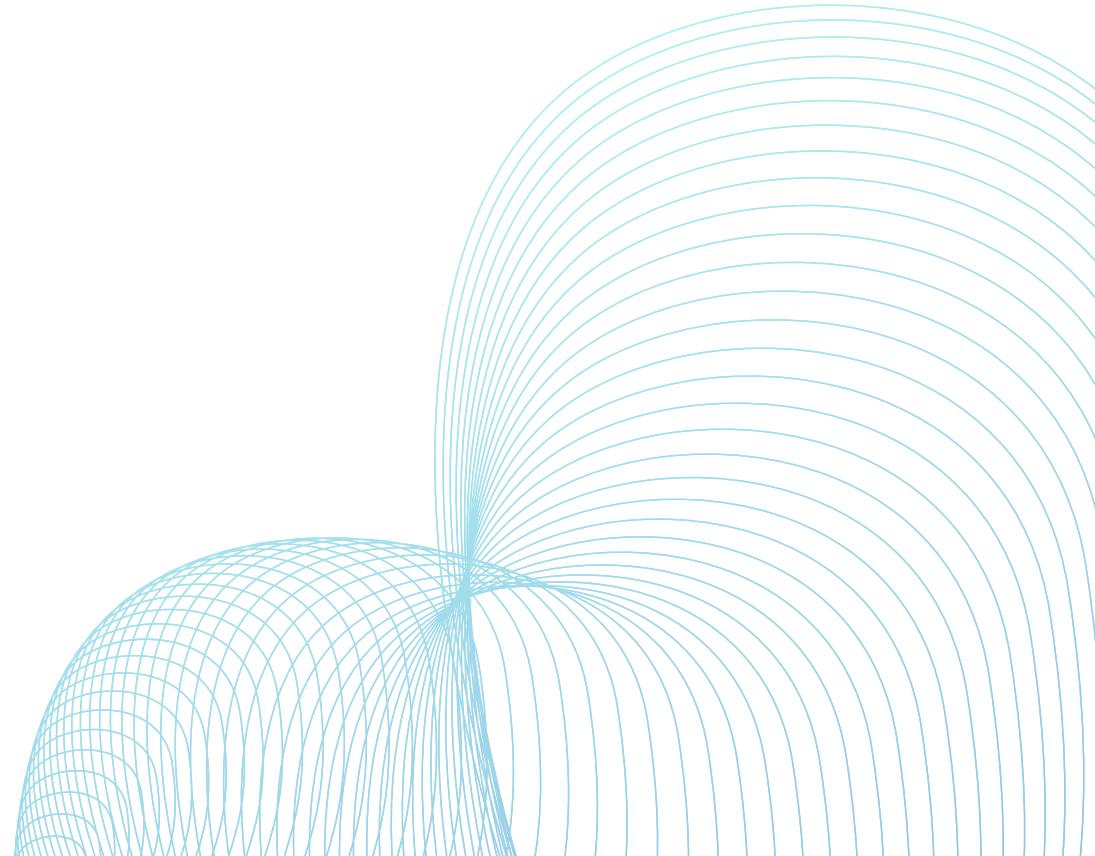
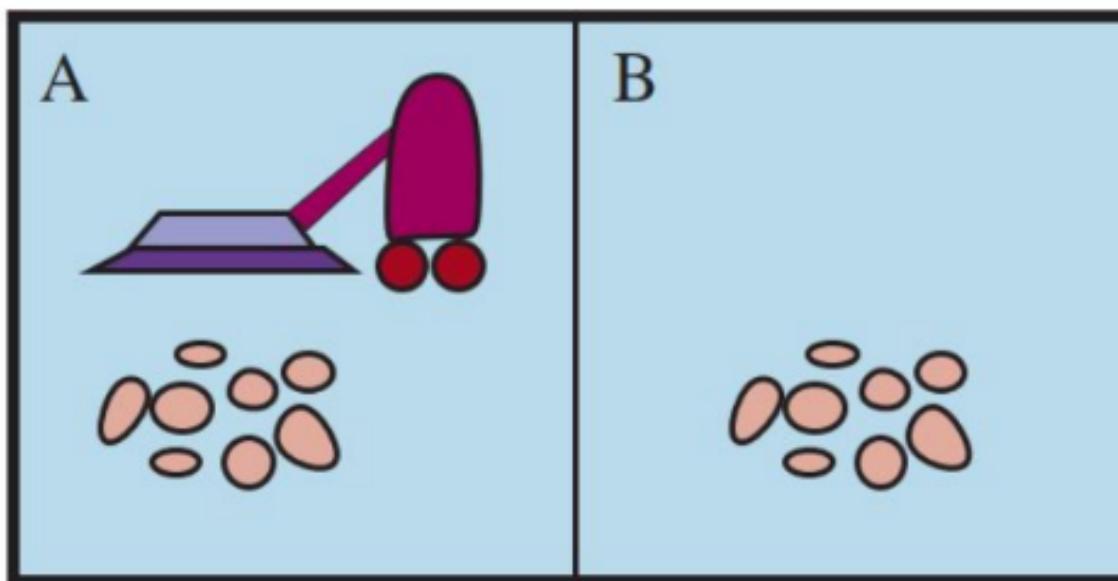
VACUUM-CLEANER WORLD

- The particular world has two locations: square A and B.
- The vacuum agent: perceive which square it is in and whether there is dirt in the square.



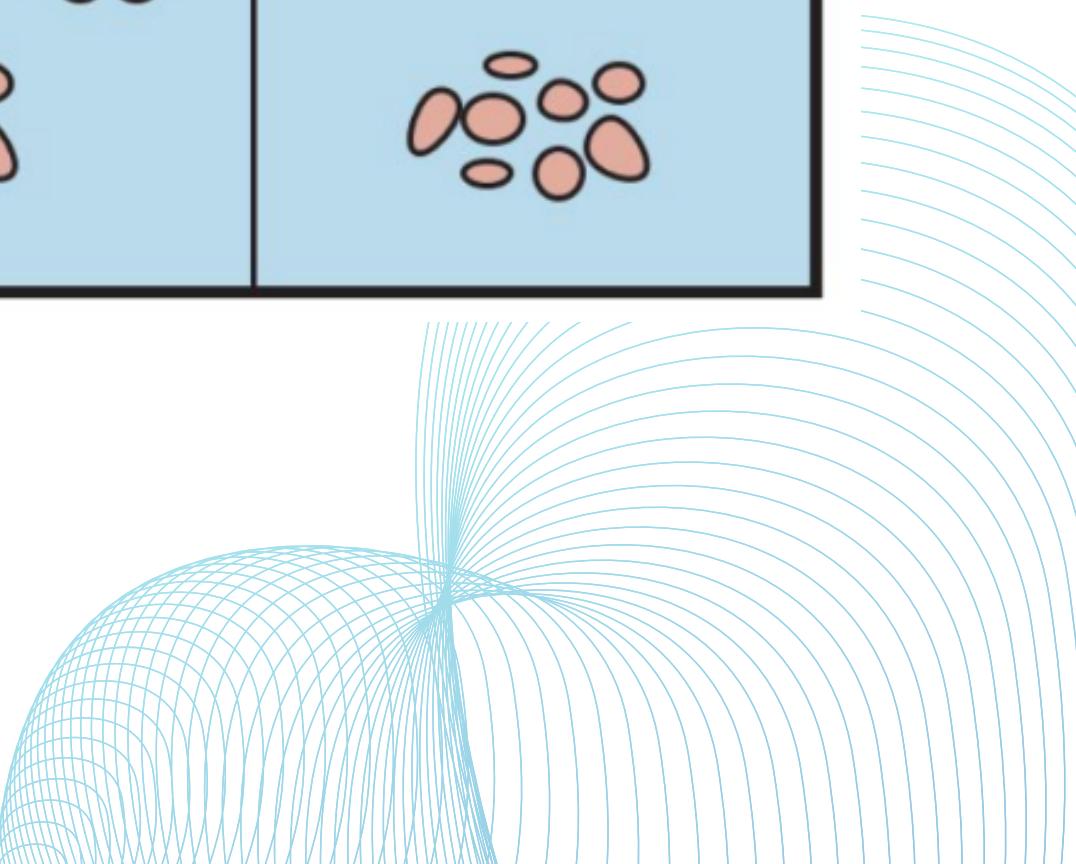
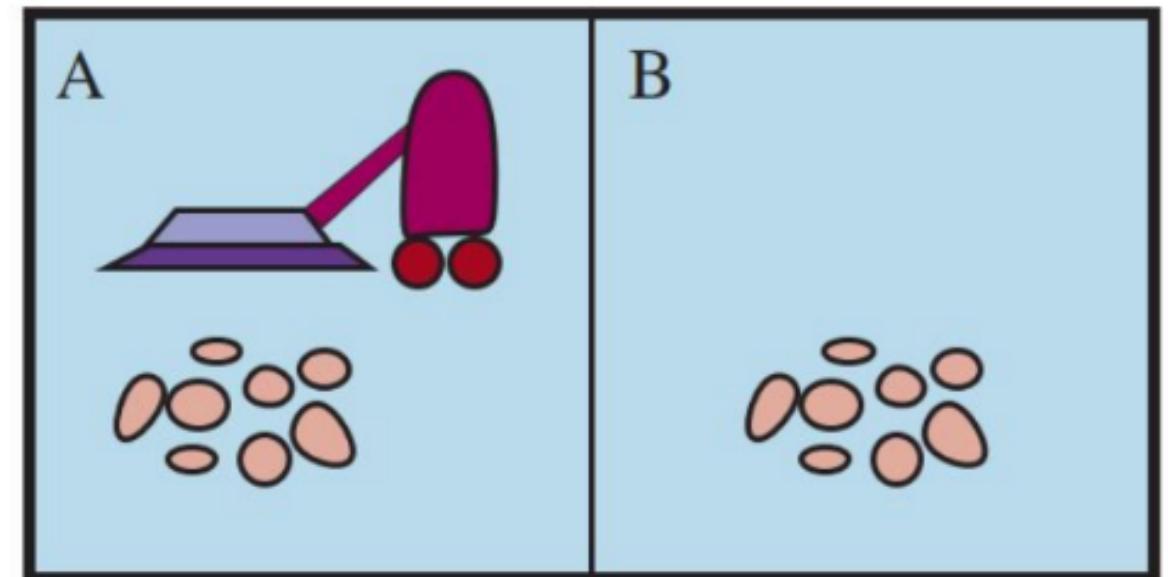
VACUUM-CLEANER WORLD

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VACUUM-CLEANER WORLD

- The agent function: if the current square is dirty, move right and suck up the dirt, otherwise move to another square.
- Percepts: locations and contents, e.g [A,Dirty].
- Action: left, right, suck, and NoOp.





VACUUM-CLEANER WORLD

Percept sequence	Action
$[A, Clean]$	<i>Right</i>
$[A, Dirty]$	<i>Suck</i>
$[B, Clean]$	<i>Left</i>
$[B, Dirty]$	<i>Suck</i>
$[A, Clean], [A, Clean]$	<i>Right</i>
$[A, Clean], [A, Dirty]$	<i>Suck</i>
:	:
$[A, Clean], [A, Clean], [A, Clean]$	<i>Right</i>
$[A, Clean], [A, Clean], [A, Dirty]$	<i>Suck</i>
:	:

Figure 2.3 Partial tabulation of a simple agent function for the vacuum-cleaner world shown in Figure 2.2.

RATIONAL AGENTS

- A rational agent should make the great efforts to “*do the right thing*”, based on what it can perceive and the actions it can perform.
- The right action is the one that will cause the agent to be the most successful.
- Performance measure: An objective criterion for success of an agent’s behaviors.

RATIONAL AGENTS

- For example: performance measure of a vacuum-cleaner can be proposed by the amount of dirt cleaned up, the amount of time taken, the amount of electricity consumed,...
- One should design performance measure according to what one actually wants in the environment, rather than according to how one thinks the agent should behave.

RATIONAL AGENTS

- For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.

RATIONAL AGENTS

- Rationality is different from omniscience (all knowing with infinite knowledge).
- Agents can perform actions in order to modify future percepts so as to obtain useful information (information gathering, exploration).
- An agent is autonomous if its behavior is determined by its own experience (with ability to learn and adapt).

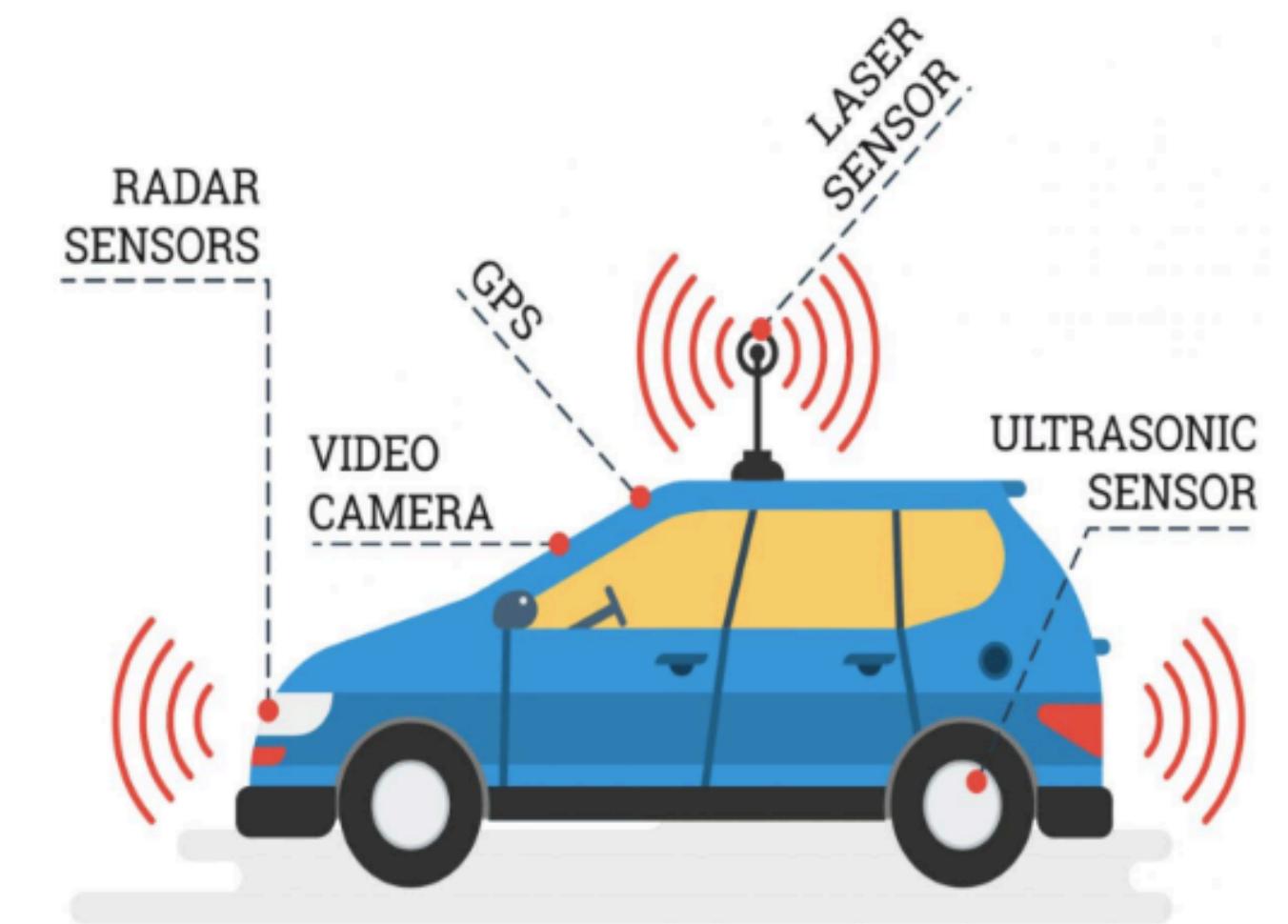
PEAS

- **PEAS: Performance Measure, Environment, Actuators, Sensors**
- Must first specify the setting for intelligent agent design.
- Example: design an automated taxi-driver:
 - Performance measure
 - Environment
 - Actuators
 - Sensors

PEAS

Design an automated taxi driver:

- Performance measure: Safe, fast, legal, comfortable trip, maximize profits.
- Environment: roads, other traffic, pedestrians, customers, police.
- Actuators: steering wheel, accelerator, brake, signal, horn.
- Sensors: cameras, sonar, speedometer, GPS, engine sensors, keyboards.



PEAS

Agent: Medical Diagnosis System:

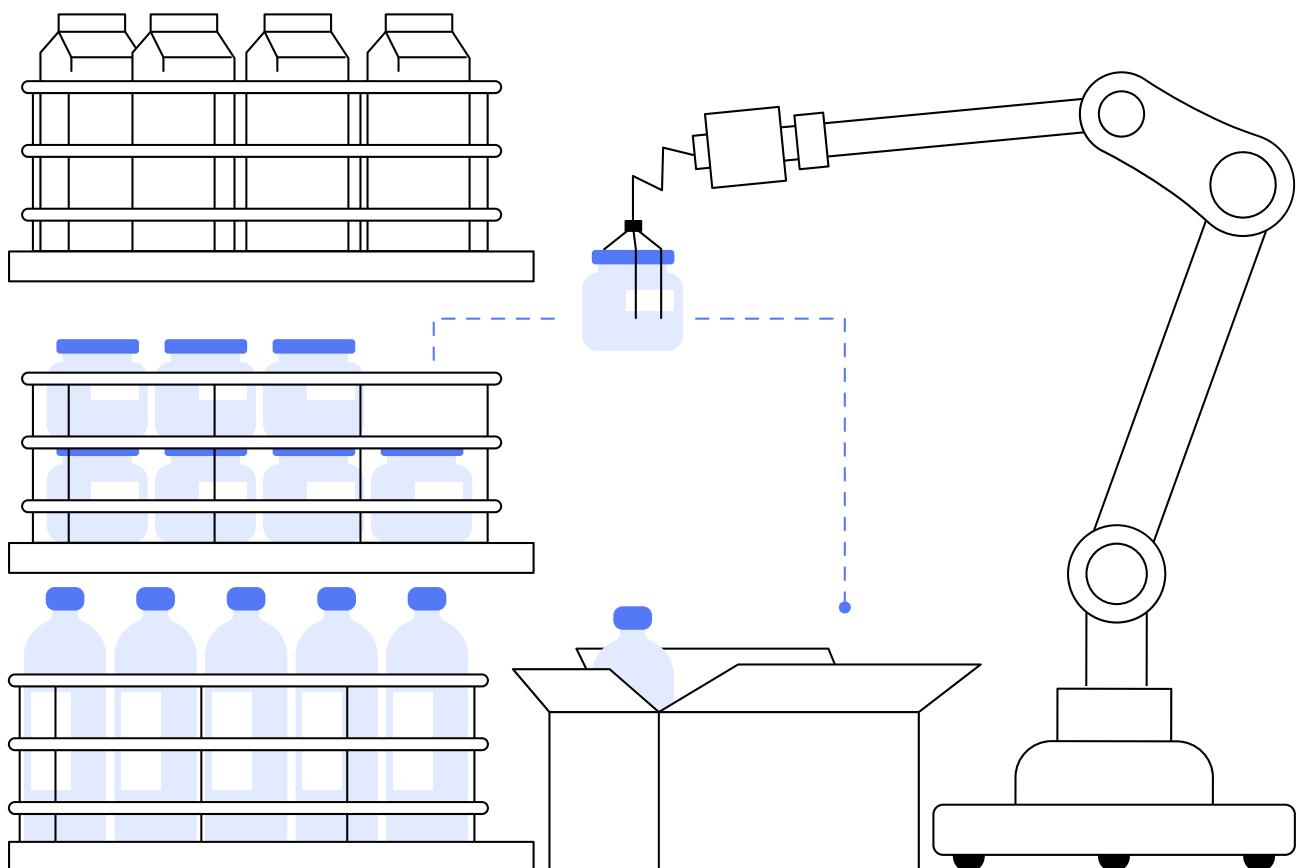
- Performance measure: healthy patients, minimize costs, lawsuits.
- Environment: patients, hospitals and staffs.
- Actuators: Screen display (questions, tests, diagnoses, treatments, referrals).
- Sensors: keyboard (entry of symptoms, findings, patient's answers)



PEAS

Agent: Part-picking robots.

- Performance measure: percentage of parts in correct bins.
- Environments: conveyor belt with parts and bins.
- Actuators: jointed arms and hands.
- Sensors: Camera, joint angle sensors.



PEAS

Agent: Interactive English tutor:

- Performance: measure: maximized student's score on test.
- Environment: the set of students.
- Actuators: Screen display (exercises, suggestions, corrections).
- Sensors: keyboard



PEAS

Agent: Satellite image analysis system:

- Performance measure: correct image categorization.
- Environment: downlink from orbiting satellite.
- Actuators: display categorization of scene.
- Sensors: color pixel arrays

