

Computer Science and Artificial Intelligence



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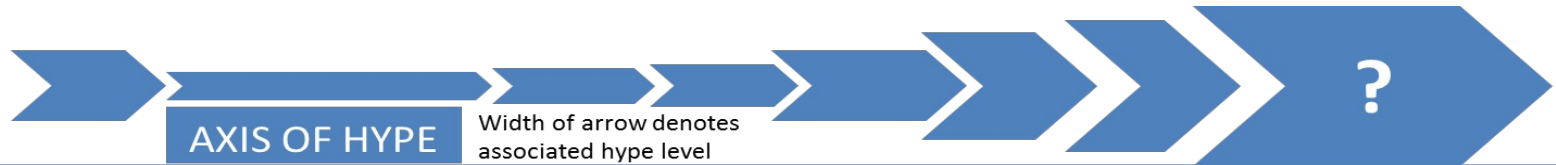
Content

- ☐ **Intelligence and Machines**
- ☐ Perception
- ☐ Reasoning
- ☐ Additional Areas of Research
- ☐ Artificial Neural Networks
- ☐ Robotics
- ☐ Considering the Consequences
- ☐ About Computer Science Department

What is AI?

- **Artificial intelligence** is the field of computer science that seeks to **build autonomous machines**
 - machines that can carry out complex tasks **without human intervention**.
 - machines be able to **perceive** and **reason**.
- The field of artificial intelligence is **quite large** and **merges with other subjects** such as psychology, neurology, mathematics, linguistics, and electrical and mechanical engineering.

What is AI?



ARTIFICIAL DOES NOT EXIST, AND MAY NEVER EXIST INTELLIGENCE

Early artificial intelligence stirs excitement.



MACHINE IS A LOGICAL CONTRADICTION AND LOGICALLY IMPOSSIBLE, THUS NONSENSE LEARNING

Machine learning begins to flourish.



DEEP IS ALSO NOT LEARNING LEARNING

Deep learning breakthroughs drive AI boom.

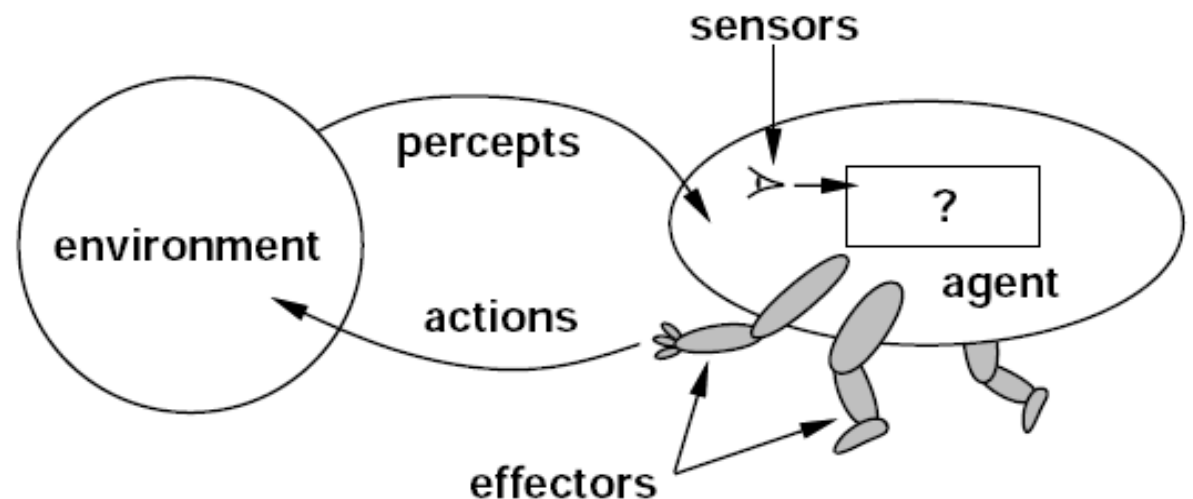


1950's 1960's 1970's 1980's 1990's 2000's 2010's

Since AI has continued to not exist since it was first posited as possible, hype has become the only means of maintaining interest and funding in AI. By creating smaller subsets of something that has continuously failed to materialize we confuse the public and maintain our positions of influence in academia and technology. Who knows what made up term we will think of next. My money is on systems of intelligence although data science has gotten off to a really strong start.

Intelligent Agents

- **Agent:** A “device” that responds to stimuli from its environment
 - **Sensors** (microphones, cameras, range sensors, and air or soil sampling devices, ...)
 - **Actuators** (wheels, legs, wings, grippers, and speech synthesizers,...)
- Much of the research in artificial intelligence can be viewed in the context of **building agents that behave intelligently**



Intelligent Agents

- An agent as an individual machine such as a **robot**.
- However, an agent may take **other forms** such as an autonomous airplane, a character in an interactive video game, or a process communicating with other processes over the Internet (perhaps as a client, a server, or a peer).



Unmanned aerial vehicle

Levels of Intelligent Behavior

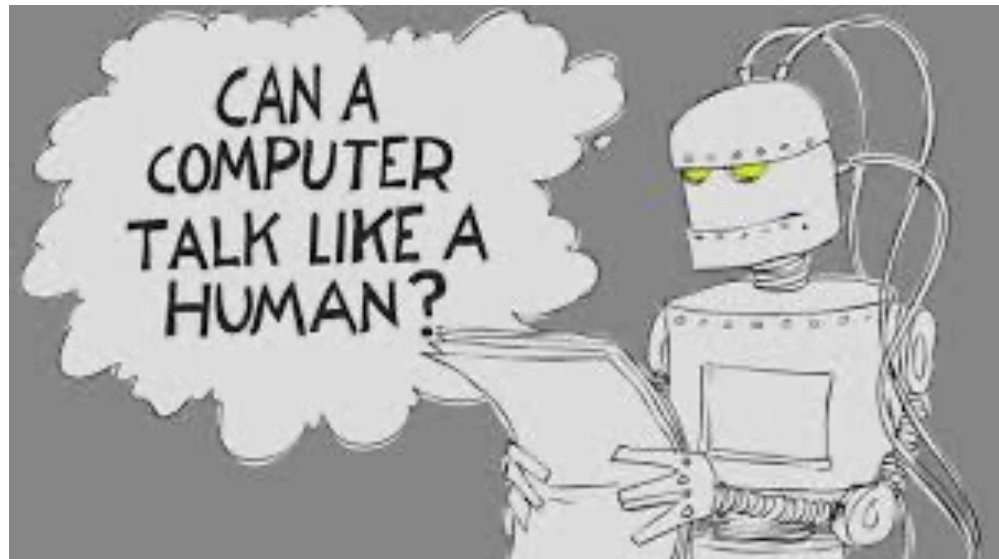
- **Reflex**: actions are **predetermined responses** to the input data
- **More intelligent** behavior requires knowledge of the environment and involves such activities as:
 - Goal seeking (such as winning a game of chess or maneuvering through a crowded passageway)
 - Learning (an agent's responses improve over time)

Approaches to Research in Artificial Intelligence

- **Engineering track:** develop systems that exhibit intelligent behavior.
 - Performance oriented (produce a product that meets certain performance goals)
- **Theoretical track:** develop a computational understanding of animal—especially human—intelligence.
 - Simulation oriented (expand our understanding of intelligence)

Turing Test

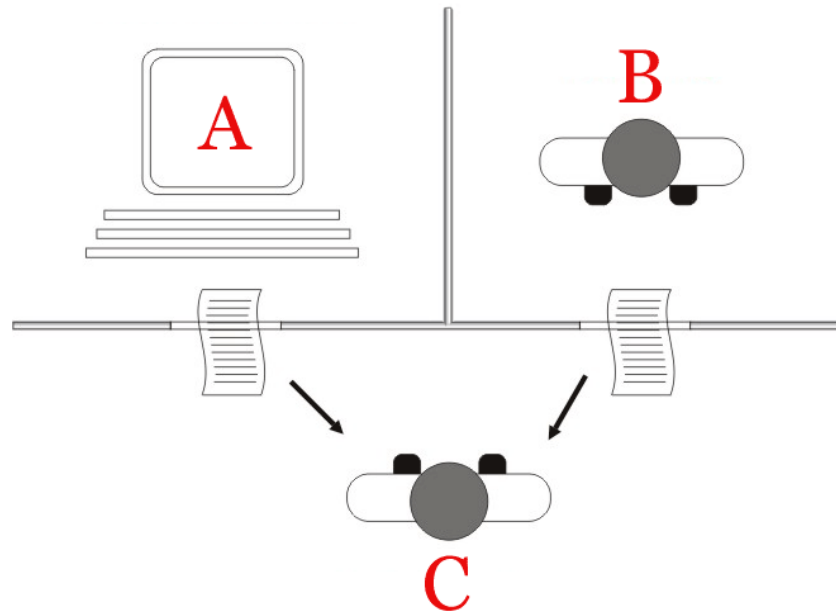
- **Turing test** (proposed by Alan Turing in 1950) has served as a benchmark in measuring progress in the field of artificial intelligence.



<https://www.youtube.com/watch?v=3wLqsRLvV-c>

Turing Test

- Test setup: Human interrogator communicates with test subject by typewriter.
- Test: Can the human interrogator distinguish whether the test subject is human or machine?

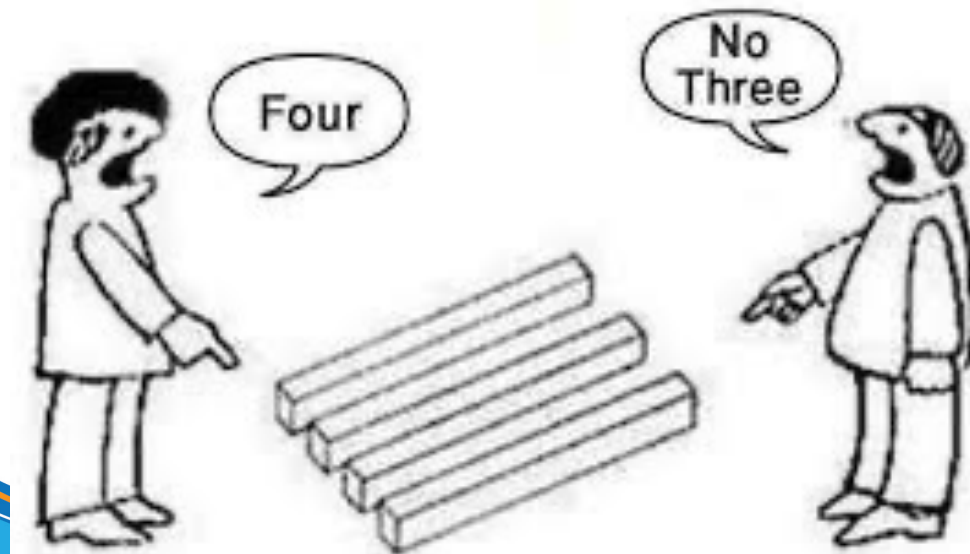


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Perception

- To respond intelligently to the input from its sensors, an **agent must be able to understand that input** (perceive).
- Two areas of research in perception that have proven to be especially challenging:
 - ▣ understanding images and language.



Example



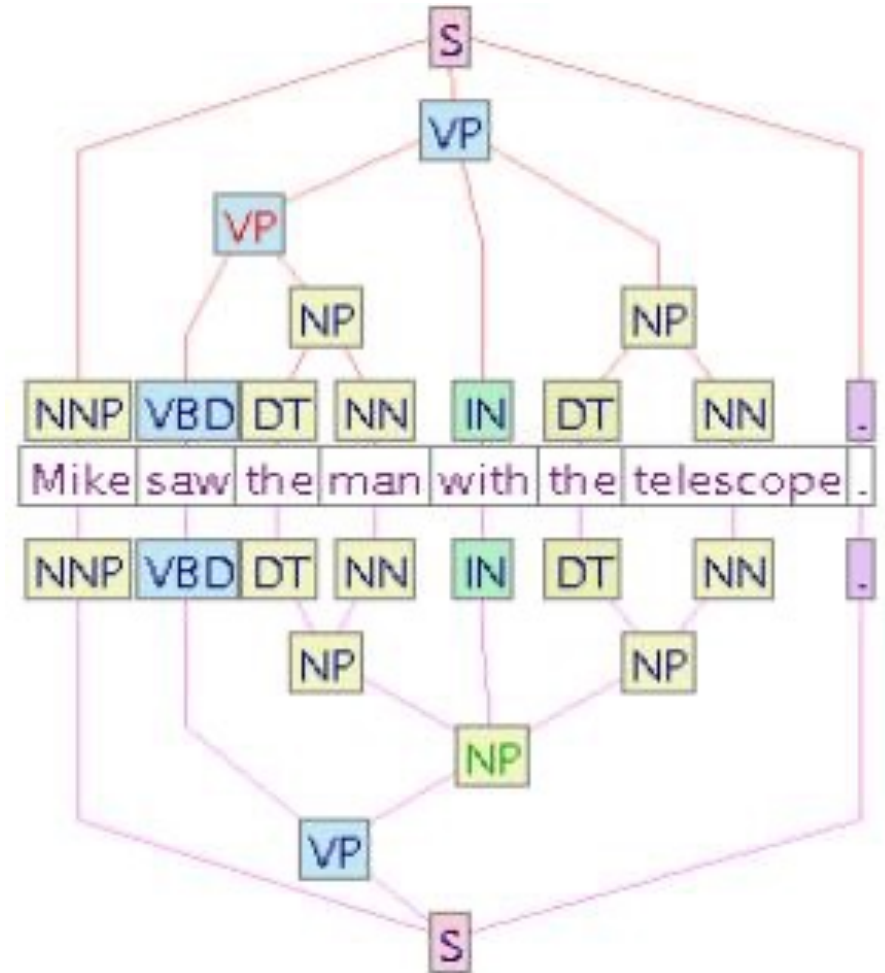
Techniques for Understanding Images

- ☐ Template matching
- ☐ **Image processing** (identifying characteristics of the image)
 - ☐ edge enhancement
 - ☐ region finding
 - ☐ smoothing
- ☐ **Image analysis** (the process of understanding what these characteristics mean)



Language Processing

- ☐ Syntactic Analysis
- ☐ Semantic Analysis
- ☐ Contextual Analysis



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Reasoning

- Reasoning is the act of deriving a conclusion from certain premises using a given methodology.
- Reasoning is a process of thinking.
- Reasoning is logically arguing.
- Reasoning is drawing inference.
- It must figure out what it needs to know from what it already knows

Reasoning Example

If we know :

Robins are birds, and

All birds have wings

Then if we ask:

Do robins have wings?

To **answer** this question - some **reasoning** must go.

Heuristic Strategies

- **Heuristic:** A “rule of thumb” for making decisions
- Requirements for good heuristics
 - Must be easier to compute than a complete solution
 - Must provide a reasonable estimate of proximity to a goal

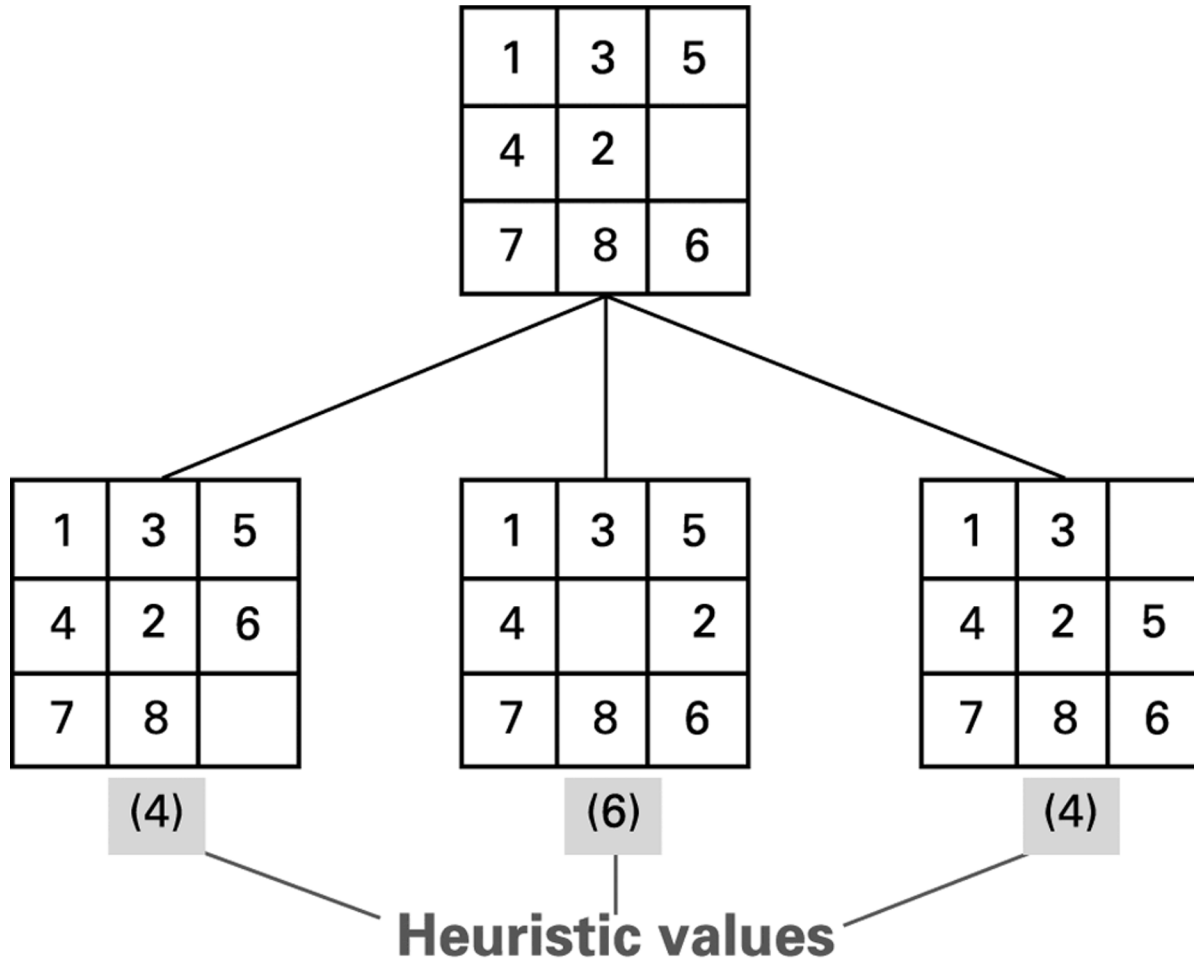
An unsolved eight-puzzle

1	5	2
4	8	
7	6	3

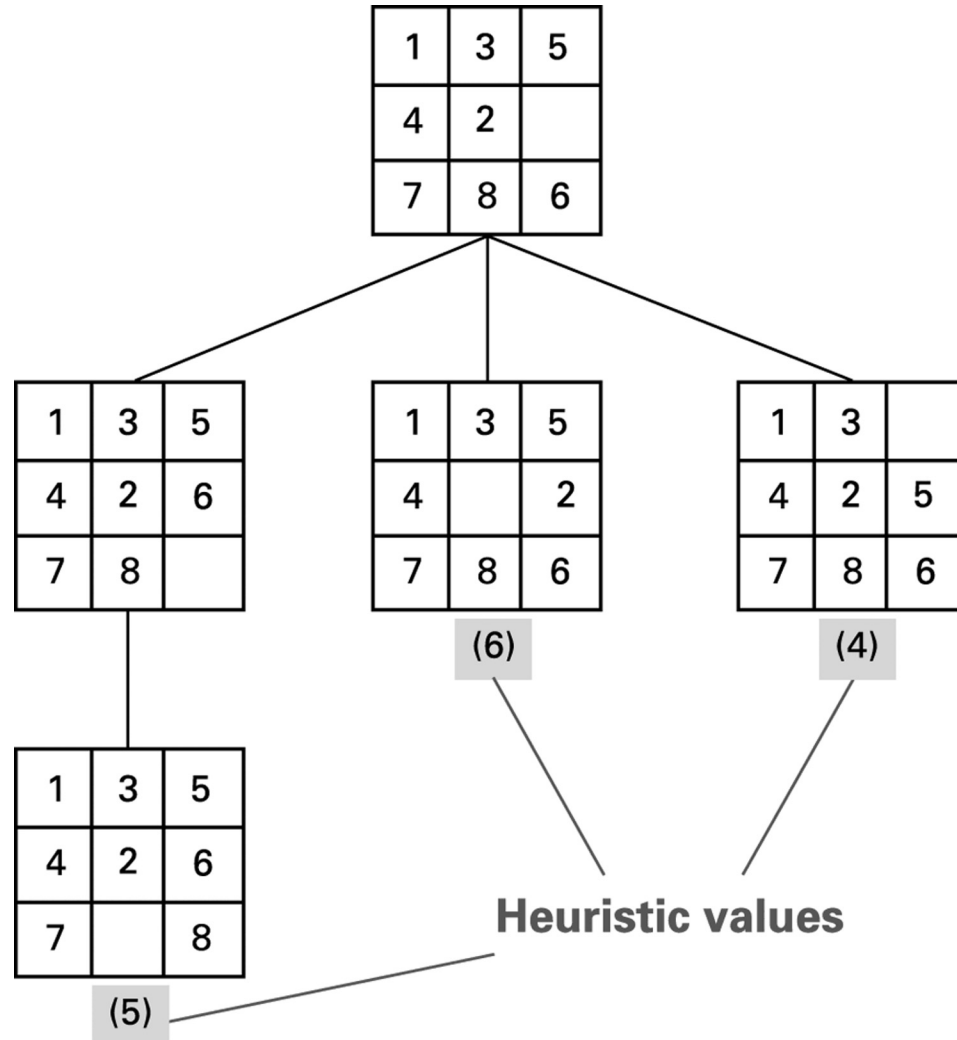
These tiles are at least one move from their original positions.

These tiles are at least two moves from their original positions.

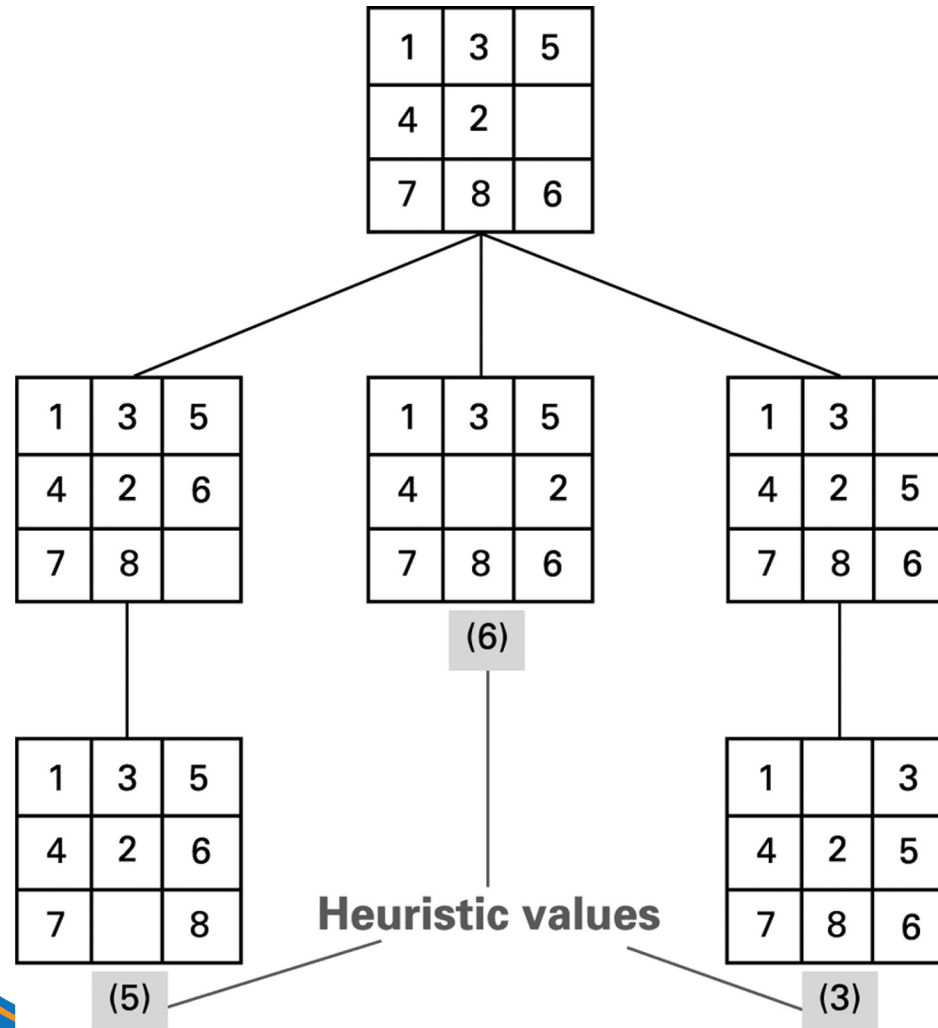
The beginnings of heuristic search



The search tree after two passes



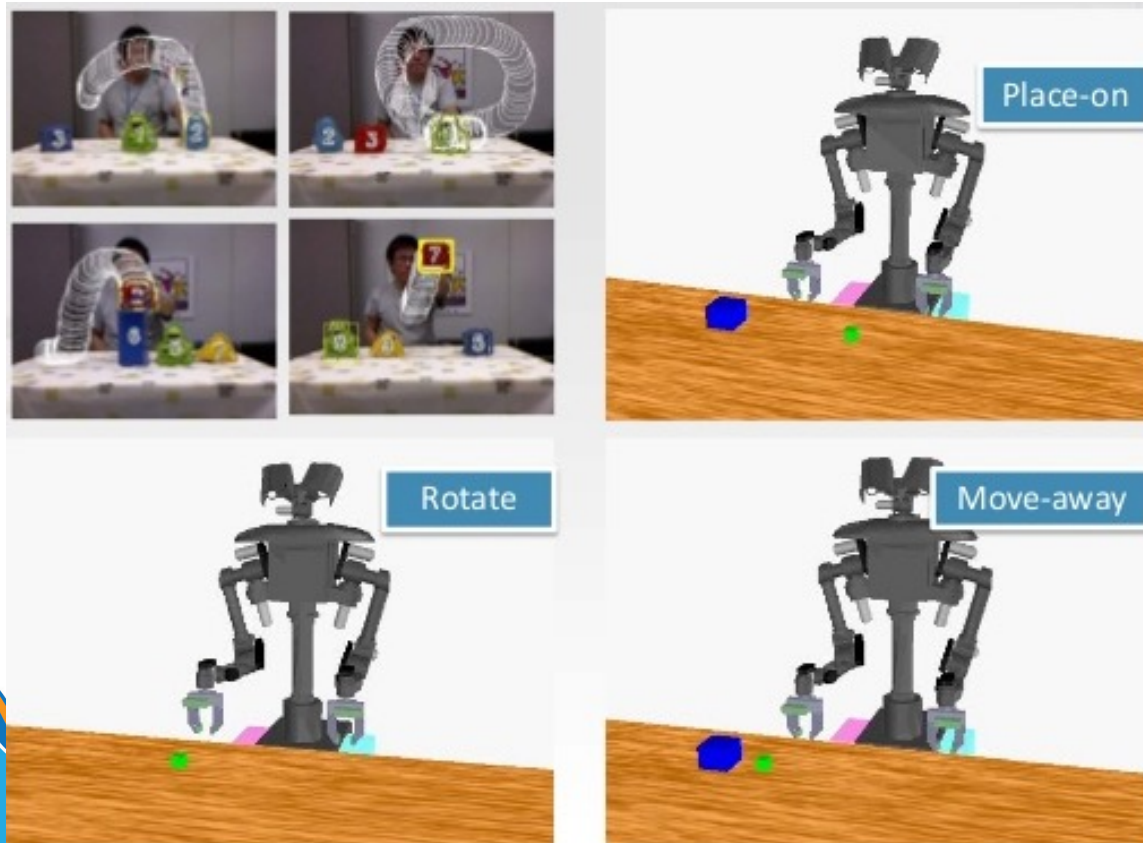
The search tree after three passes



Learning

□ Imitation

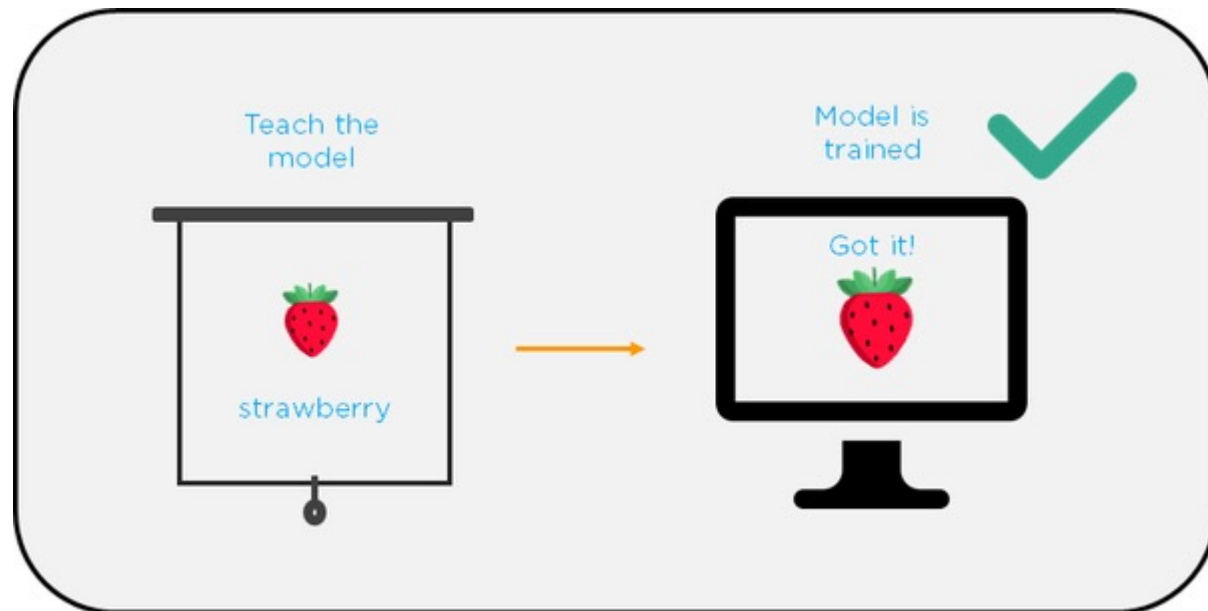
- directly demonstrates the steps in a task and the computer simply records the steps.



Learning

□ Supervised learning

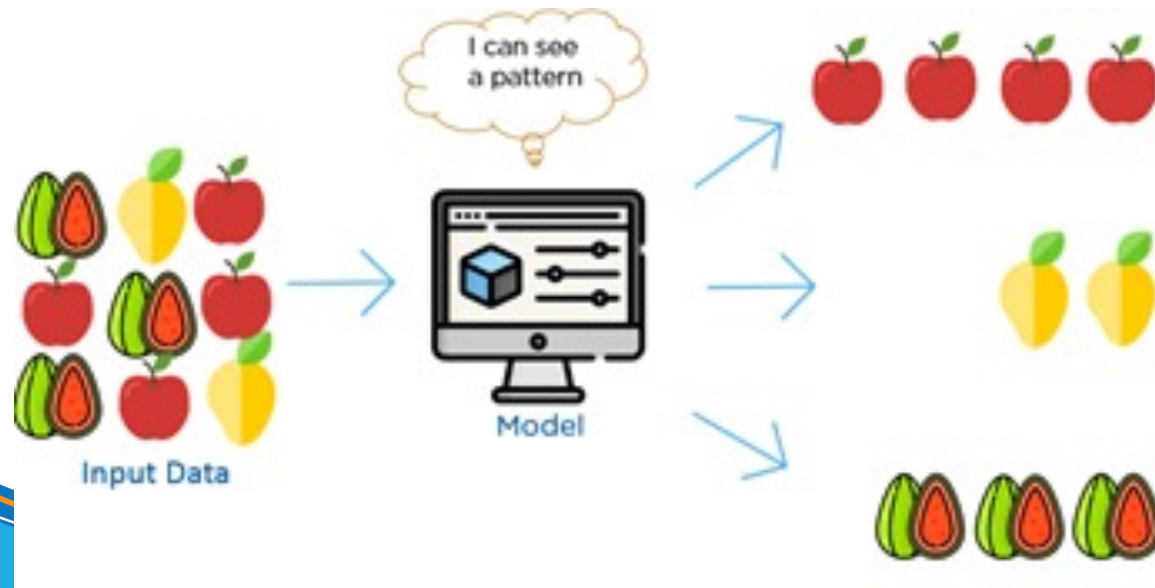
- Task of learning a function that maps an input to an output based on example input-output pairs.



Learning

□ Unsupervised Learning

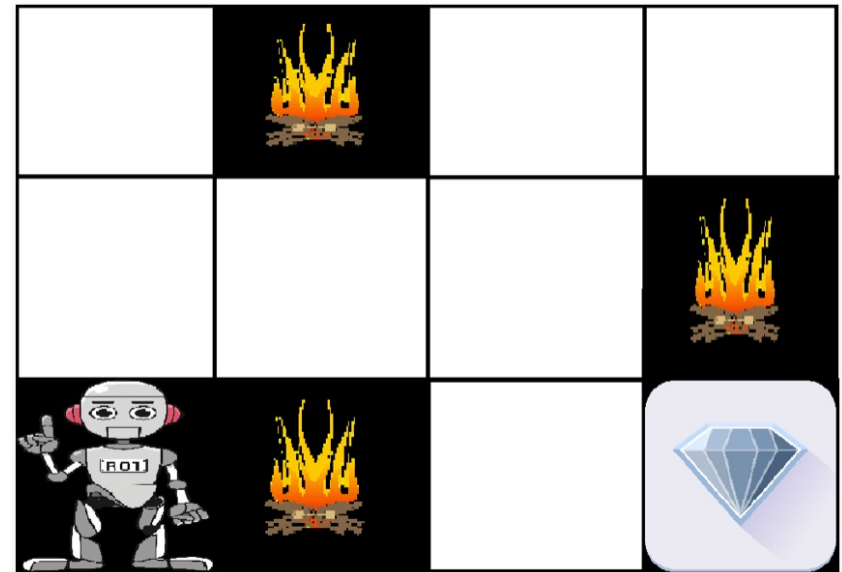
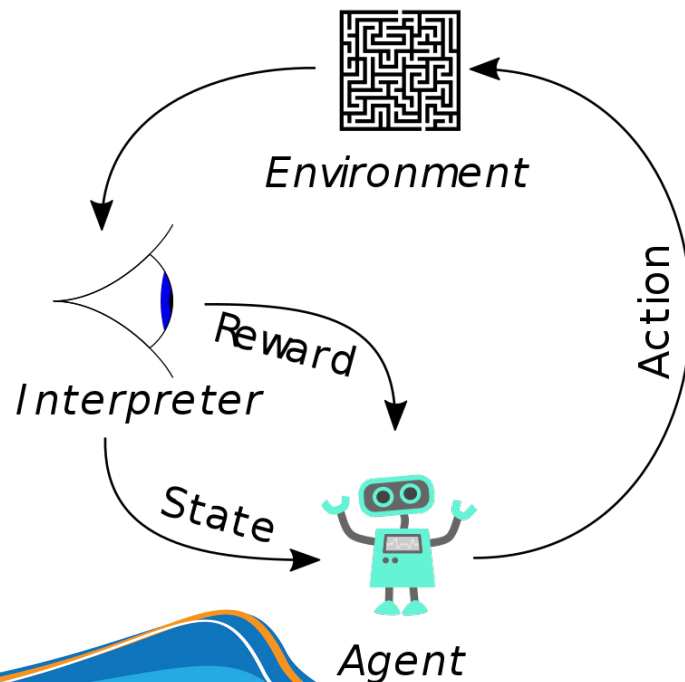
- learns from test data that has not been labeled, classified or categorized
- Instead of responding to feedback, unsupervised learning identifies commonalities in the data and reacts based on the presence or absence of such commonalities in each new piece of data.



Learning

□ Reinforcement learning

- refers to goal-oriented algorithms, which learn how to take actions in an environment so as to maximize some notion of cumulative reward.



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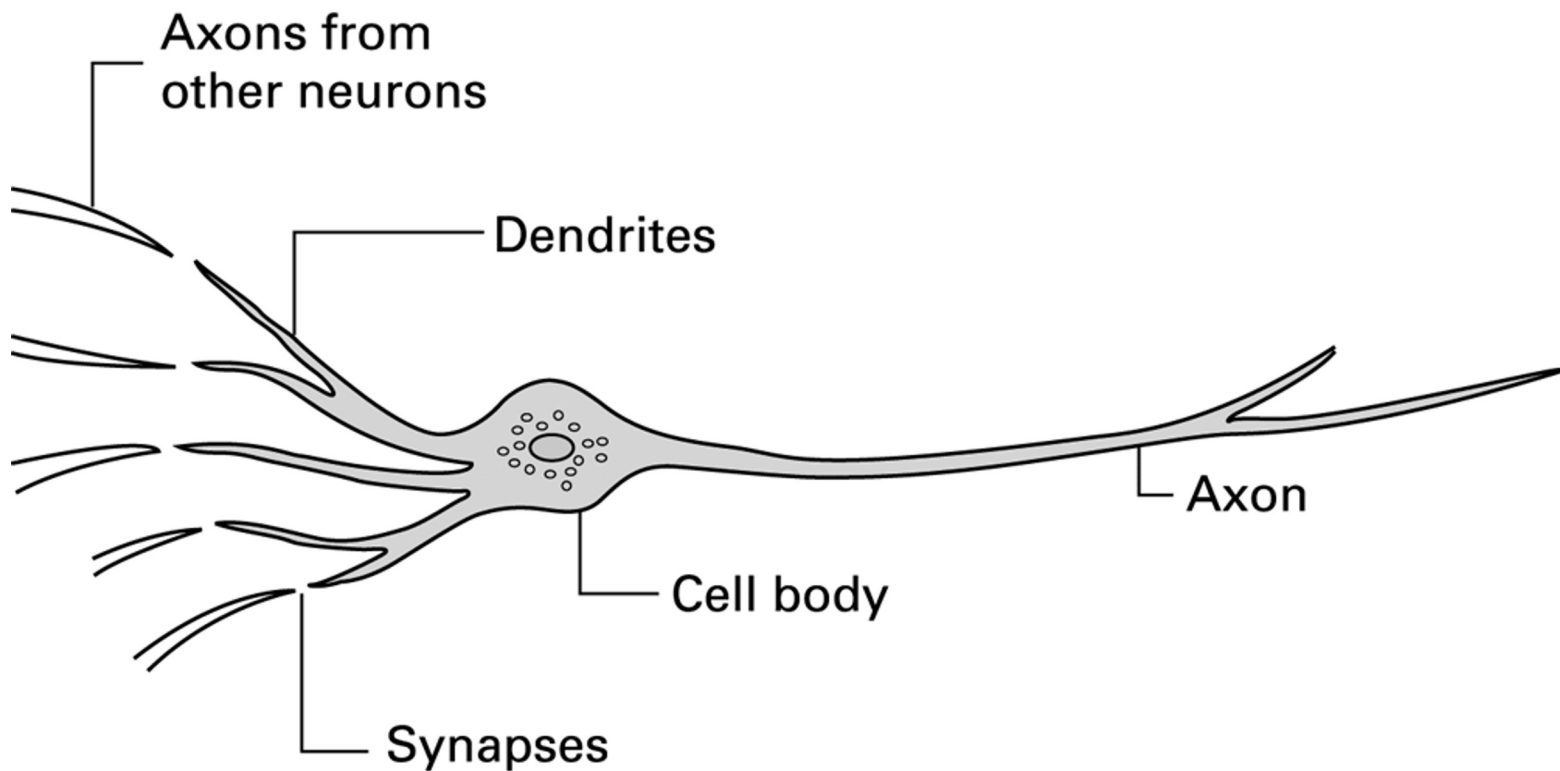
Artificial Neural Networks

- Many researchers are turning to approaches that leverage phenomena observed in nature.
- One such approach is genetic algorithms.
- Another approach is the **artificial neural network** (human mind)

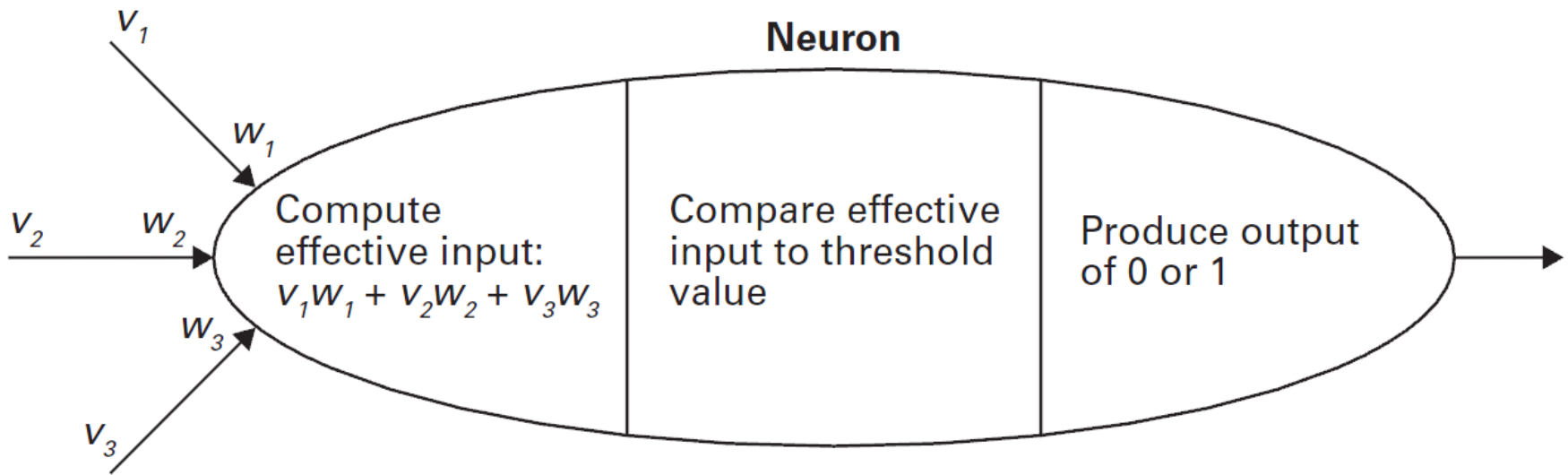
Artificial Neural Networks

- Artificial Neuron
 - Each input is multiplied by a weighting factor.
 - Output is 1 if sum of weighted inputs exceeds the threshold value; 0 otherwise.
- Network is programmed by adjusting weights using feedback from examples.

A neuron in a living biological system

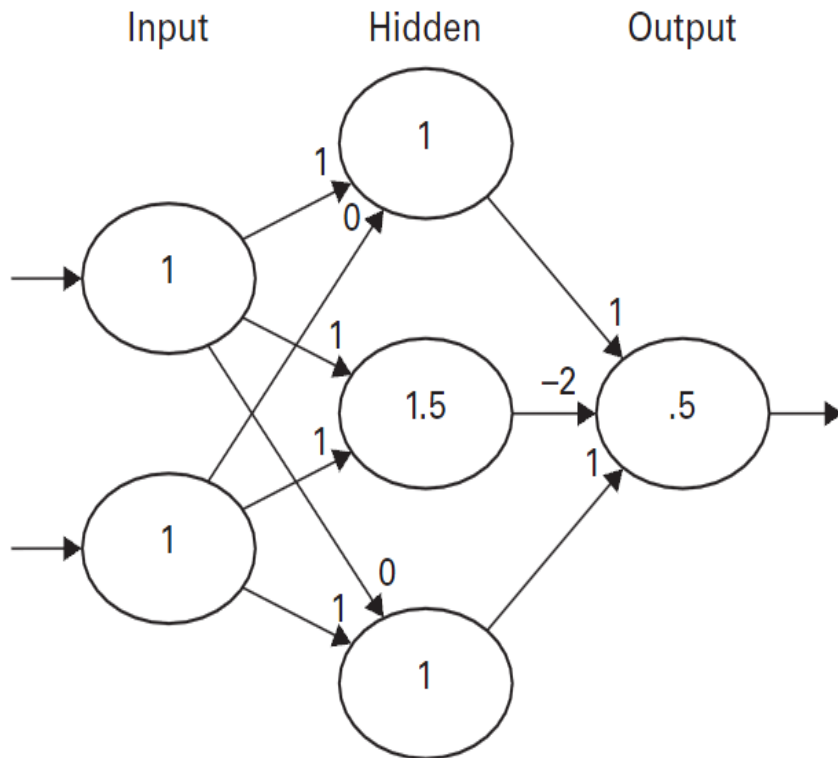


The activities within a processing unit

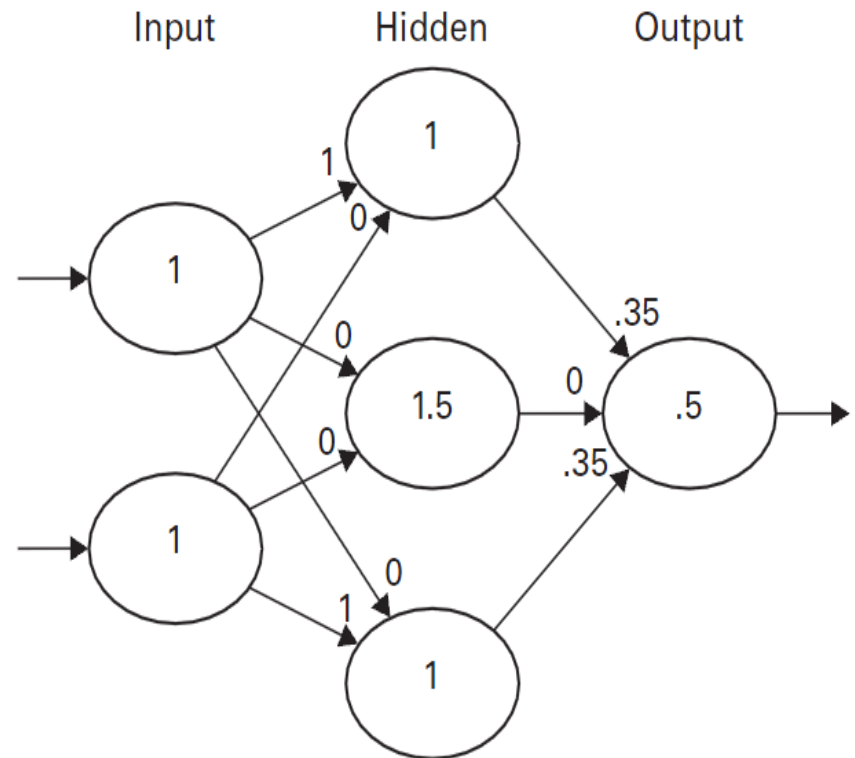


A neural network with two different programs

a.



b.



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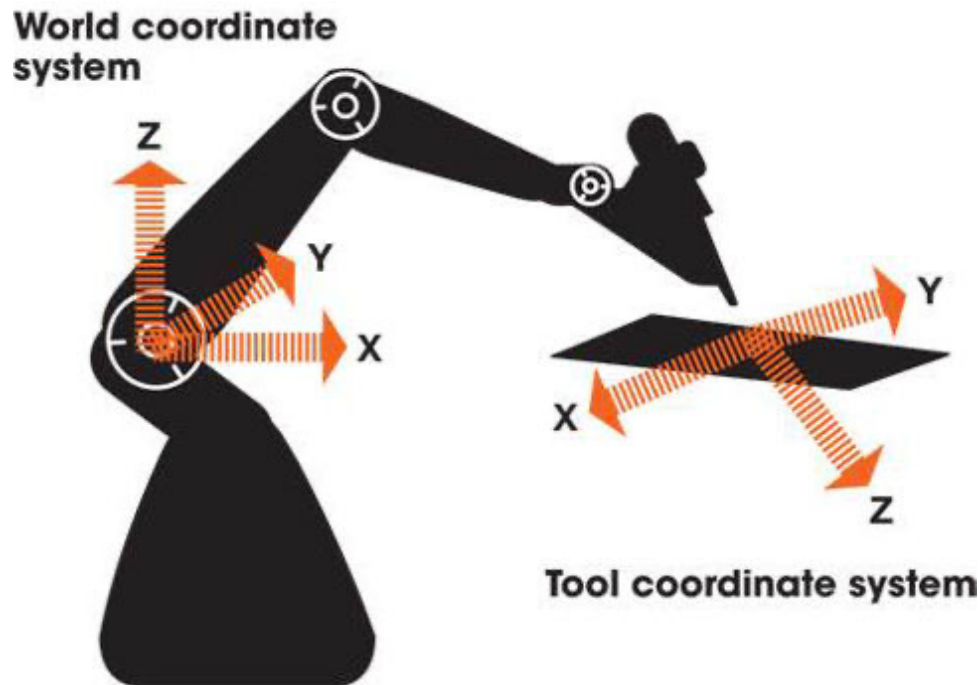
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Robotics

- ☐ Truly autonomous robots require progress in perception and reasoning.
- ☐ To interact with the world, robots need mechanisms to manipulate objects and to move about.
- ☐ In the early days of robotics, the field was closely allied with the development of **manipulators**, most often **mechanical arms** with elbows, wrists, and hands or tools.

Robotics

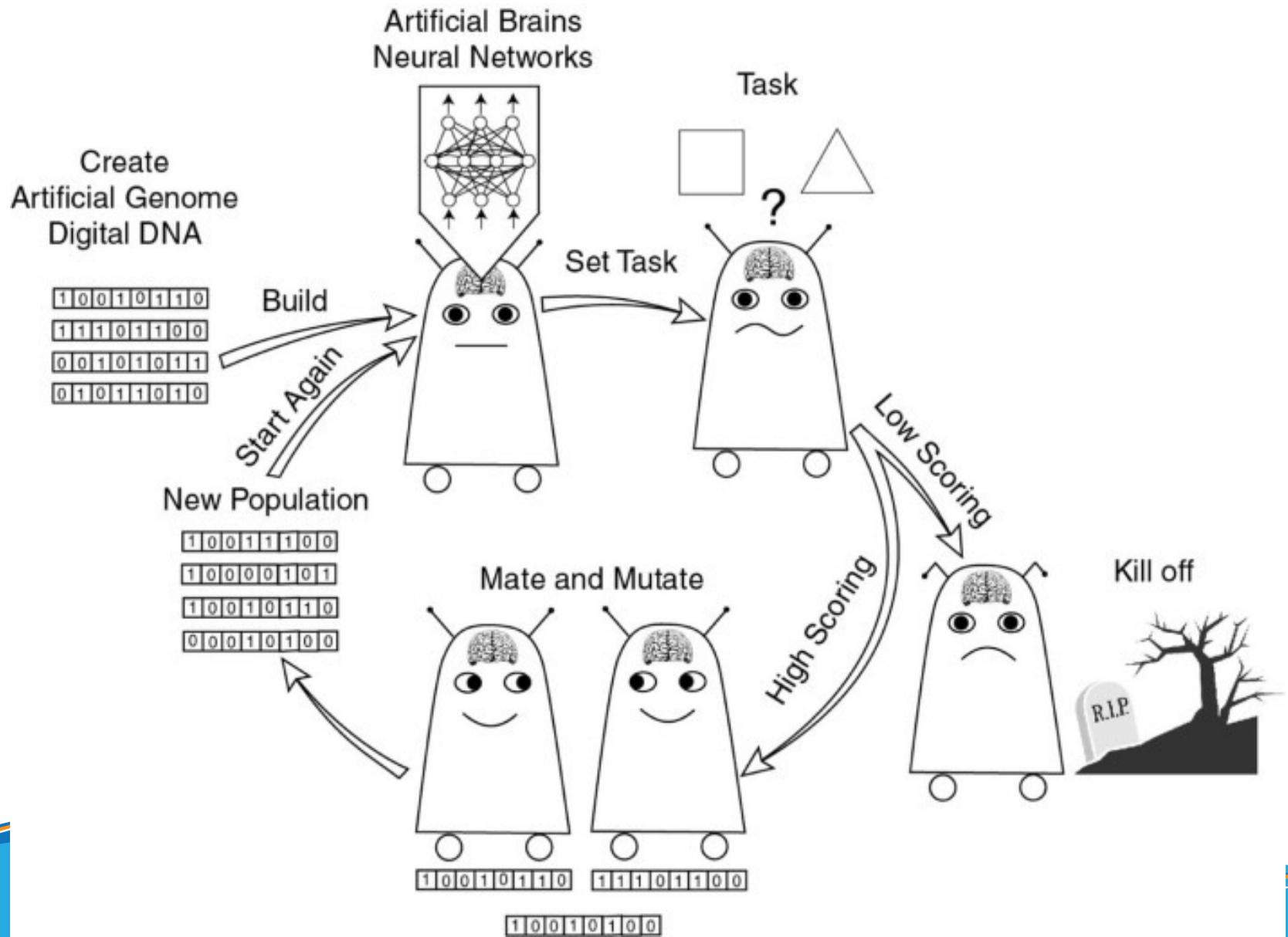
- Research dealt not only with how such devices could be maneuvered but also with how **knowledge of their location** and **orientation** could be maintained and applied.



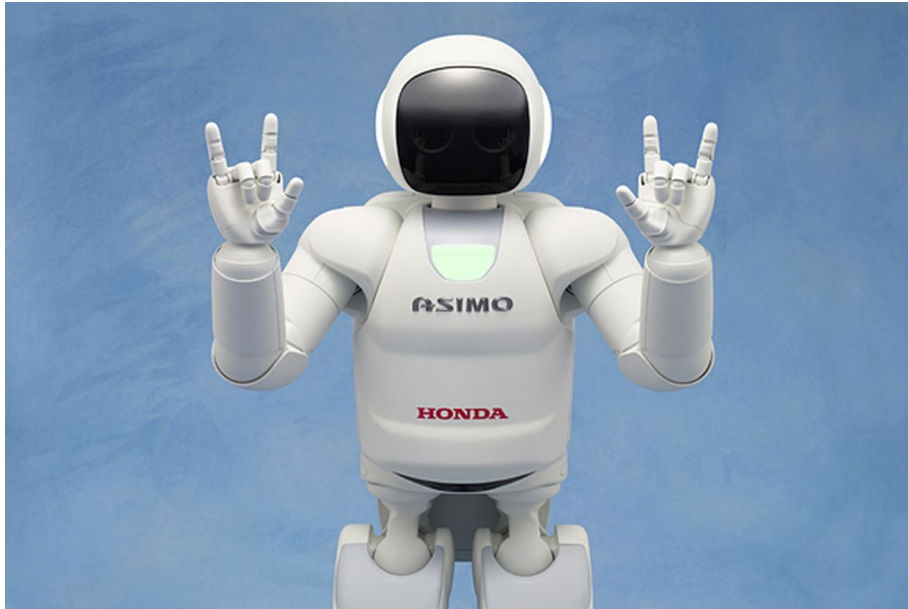
Evolutionary robotics

- **Evolutionary robotics** (ER) is a methodology that uses evolutionary computation to develop controllers and/or hardware for autonomous robots.
- Algorithms in ER frequently operate on populations of candidate controllers, initially selected from some distribution.
- This population is then repeatedly modified according to a fitness function.

Evolutionary robotics



Evolutionary robotics



asimo



Tartan Racing

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Issues Raised by Artificial Intelligence

Discuss about:

- ☐ When should a computer's decision be trusted over a human's?
- ☐ If a computer can do a job better than a human, when should a human do the job anyway?
- ☐ What would be the social impact if computer "intelligence" surpasses that of many humans?

