

Intelligent Systems (CSE-304-F)

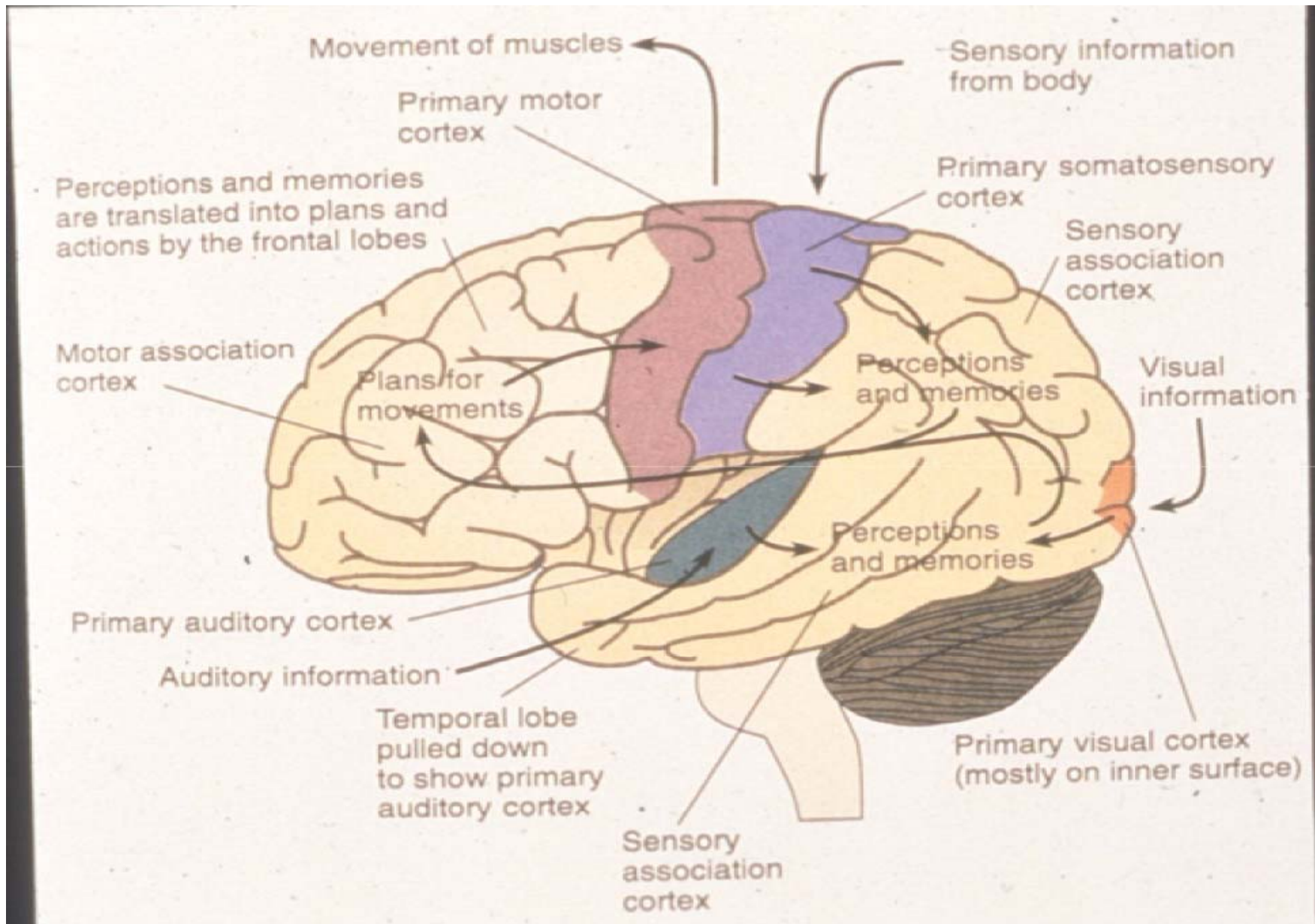
Section A

- 1. Introduction**
- 2. Foundation of AI?**
- 3. History of AI?**
- 4. What is AI?**
- 5. What are AI problems?**
- 6. What are AI techniques?**
- 7. AI Programming languages?**
- 8. Introduction to LISP and PROLOG**
- 9. Problem spaces and searches**
- 10. Blind search strategies**
- 11. Breadth first – Depth first – Heuristic search techniques, Hill Climbing**
- 12. Best first – A* algorithm – game tree**
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- 15. Alpha beta pruning**

Introduction

MIND, BODY and SOUL

The Brain



Computer metaphor of the human mind

Hardware - the brain

Infrastructure - brain components: cortex, thalamus, cerebellum, basal ganglia, etc.

ROM - inborn knowledge (e.g. acrophobia)

Software - knowledge

Declarative knowledge - textbooks knowledge

Facts - e.g. *Mary is a pilot*

Rules - e.g. *All snakes are reptiles*, formula for solving quadratic equations, etc.

Procedural knowledge - skills (e.g. playing piano, touch typing, swimming, etc.)

Interference - emotions, instincts, reflexes (e.g. hunger, thirst, orgasm, etc.)

positive emotions (e.g. passion, laugh, elation, zeal, energy, etc.)

negative emotions, instincts, reflexes (e.g. anger, envy, hate, malice, etc.)

In the above light, we can simplify genius to the following:

Genius is based on good hardware, excellent knowledge, strong motivation, and minimum negative interference.

In other words:

1. it is helpful to be blessed with a healthy brain (**hardware**)
2. this brain must be subject to a lifelong training in acquiring useful knowledge (**software**); esp. problem solving knowledge
3. knowledgeable brain must be driven by strong motivational factors (**drive**), including positive emotions (passion, enthusiasm, love, etc.)
4. well-driven knowledgeable brain must avoid negative **interference** from inborn weaknesses and destructive emotions (e.g. few things cloud judgment as badly as anger, and few things are as distracting as love)

WHAT IS INTELLIGENCE?

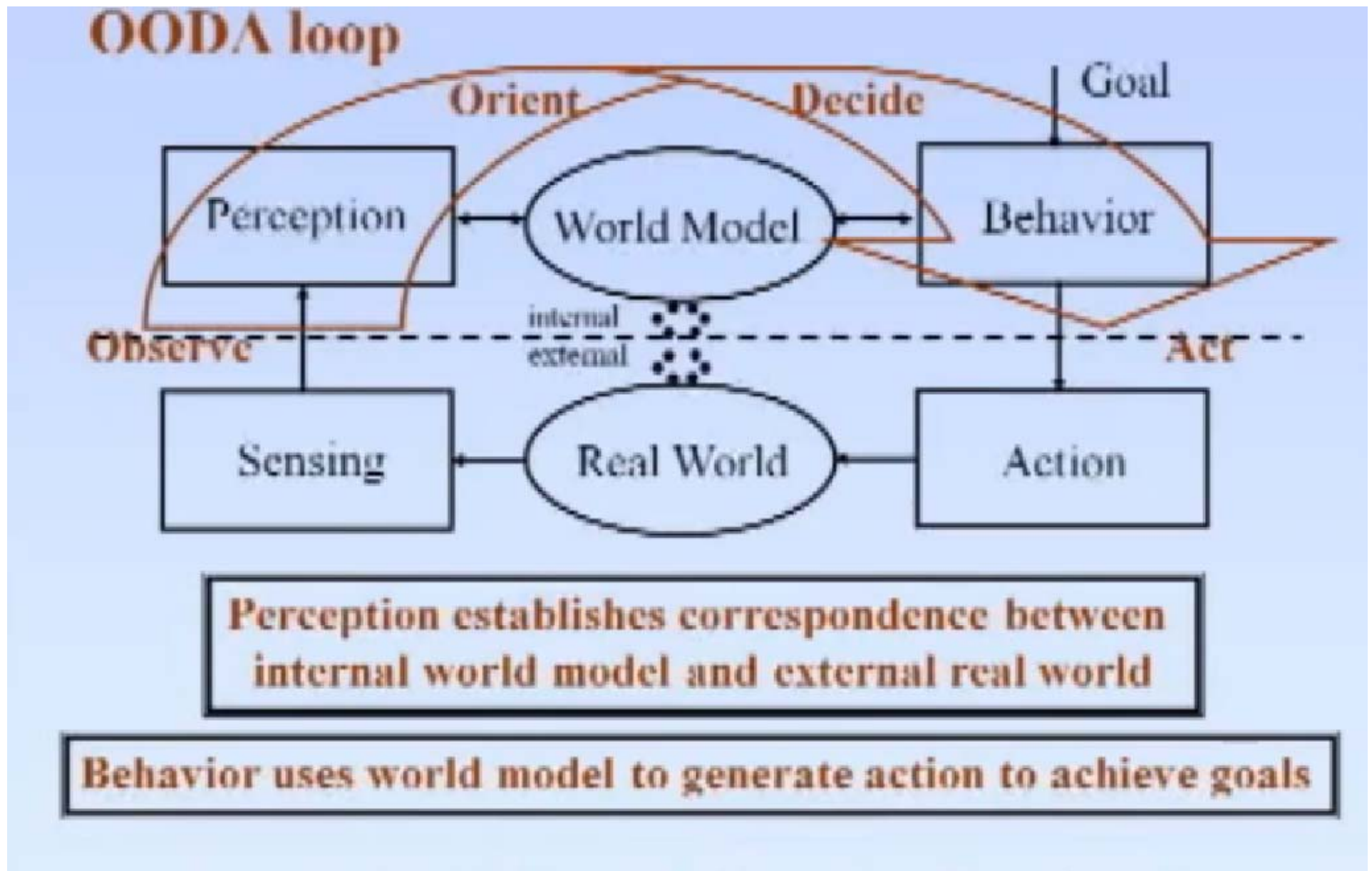
You will find many definitions of human intelligence of which three make the most of the daily use of the word:

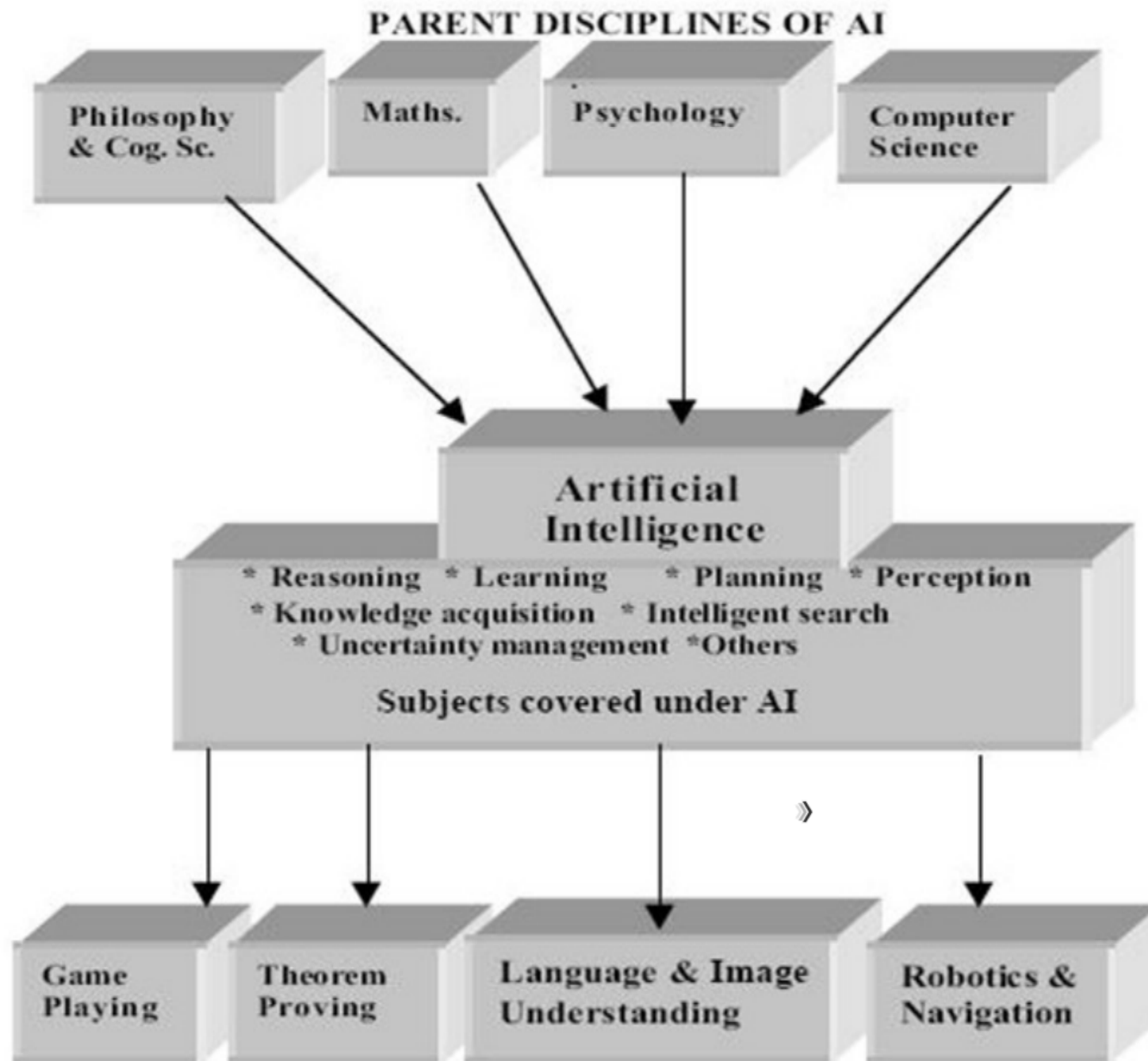
1.problem solving ability - the power of the human mind to process information and solve problems. When you see a bright scientist with wide knowledge and numerous discoveries to his credit, you may say: *This person is really intelligent! Look at his record!* To use a computer metaphor, the scientist is endowed with the best hardware and software money can buy. He or she is optimally equipped for problem solving

2.processing power - the raw nimbleness and agility of the human mind. When you see a smart student quickly learn new things, think logically, solve puzzles and show uncanny wit, you may say: *This guy is really intelligent! See how fast his brain reacts!* The student has a fast processor installed and his RAM has a lightning access time. He may though still need a couple of years to "build" good software through years of study. IQ tests attempt to measure this sort of intelligence in abstraction of knowledge. The difficulty of improving processing power by training comes for similar reasons as the fact that programming cannot speed up the processor

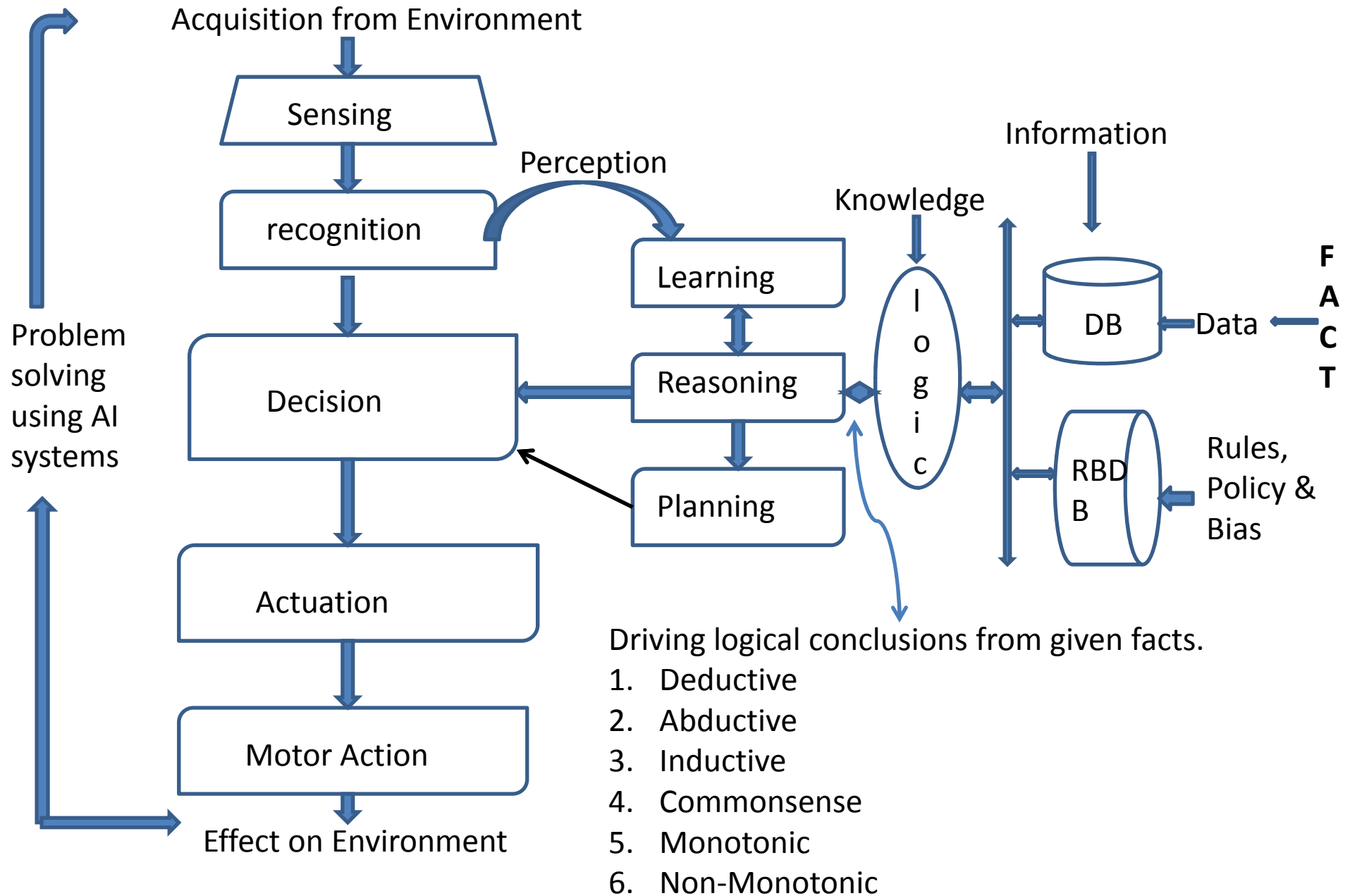
intelligence potential - the potential to develop intelligence in senses listed above. When you see a young child that shows a number of talents and seems to be on a straight path to become a nimble student or a prolific scientist, you may say: *This kid is really intelligent! The sky is the limit for him.* The kid is equipped with high quality extensible hardware infrastructure. He is on the best path to reach highest intelligence both in terms of processing power and problem solving ability

Intelligent System?





AI - Cycle

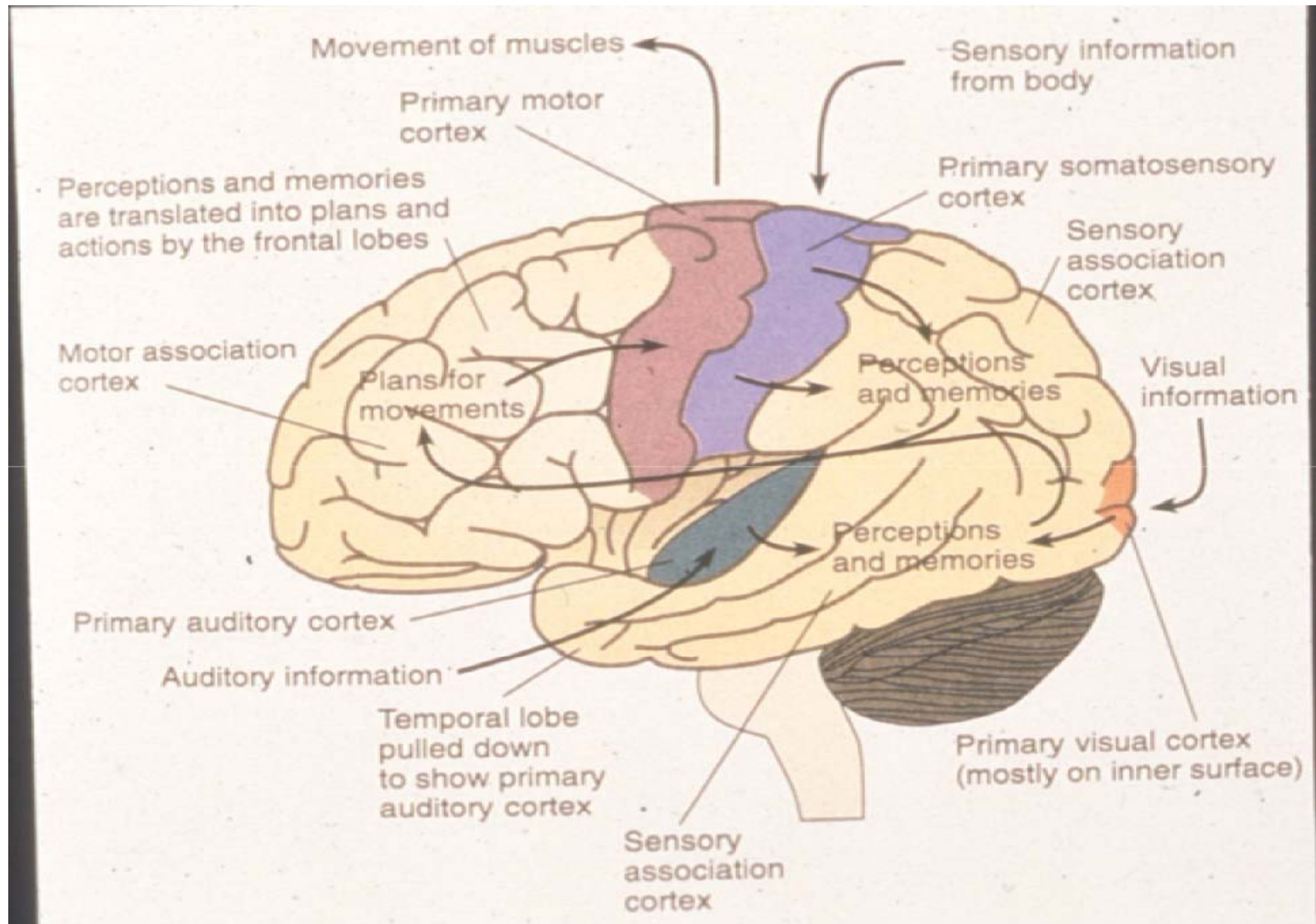


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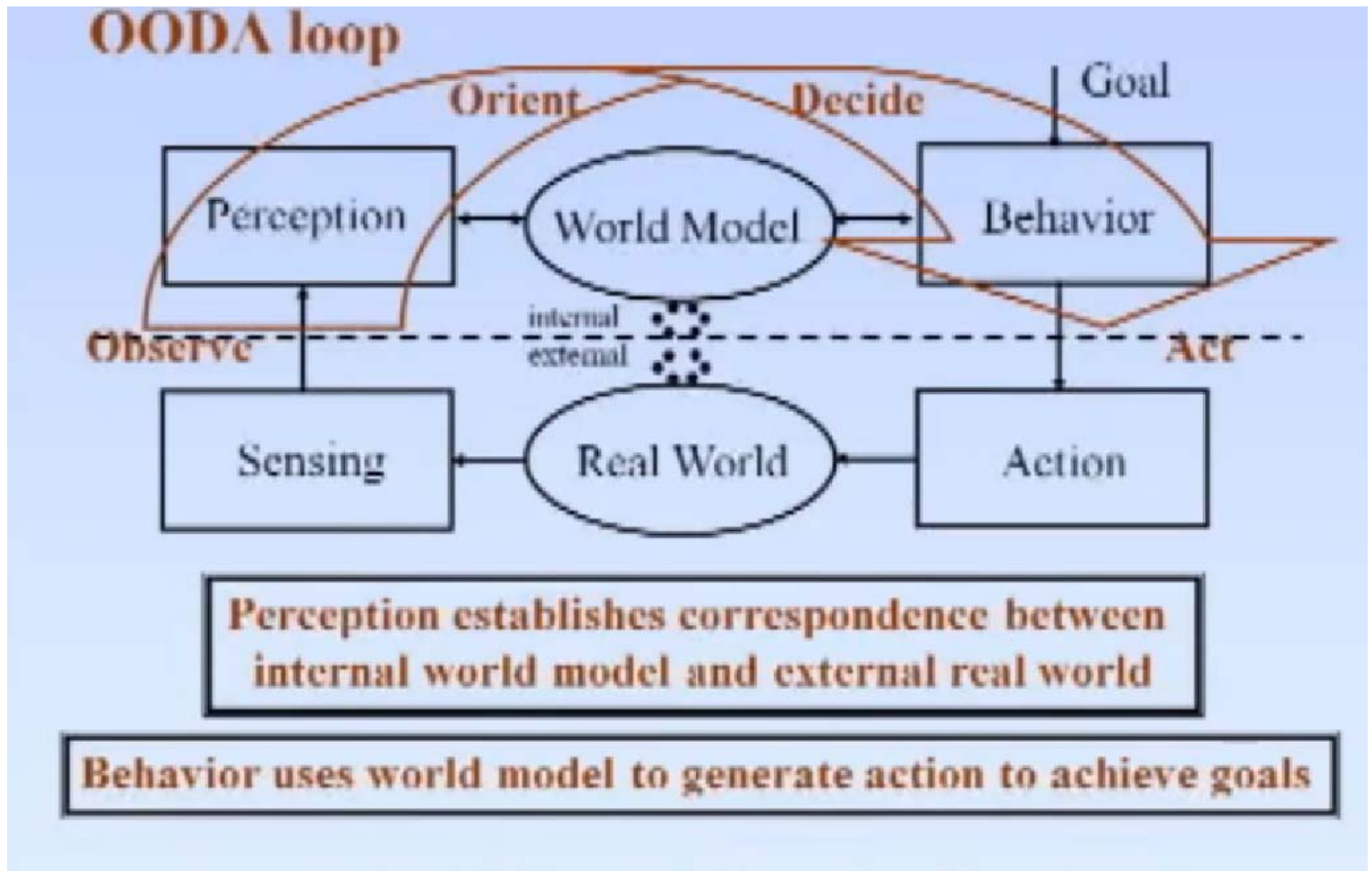
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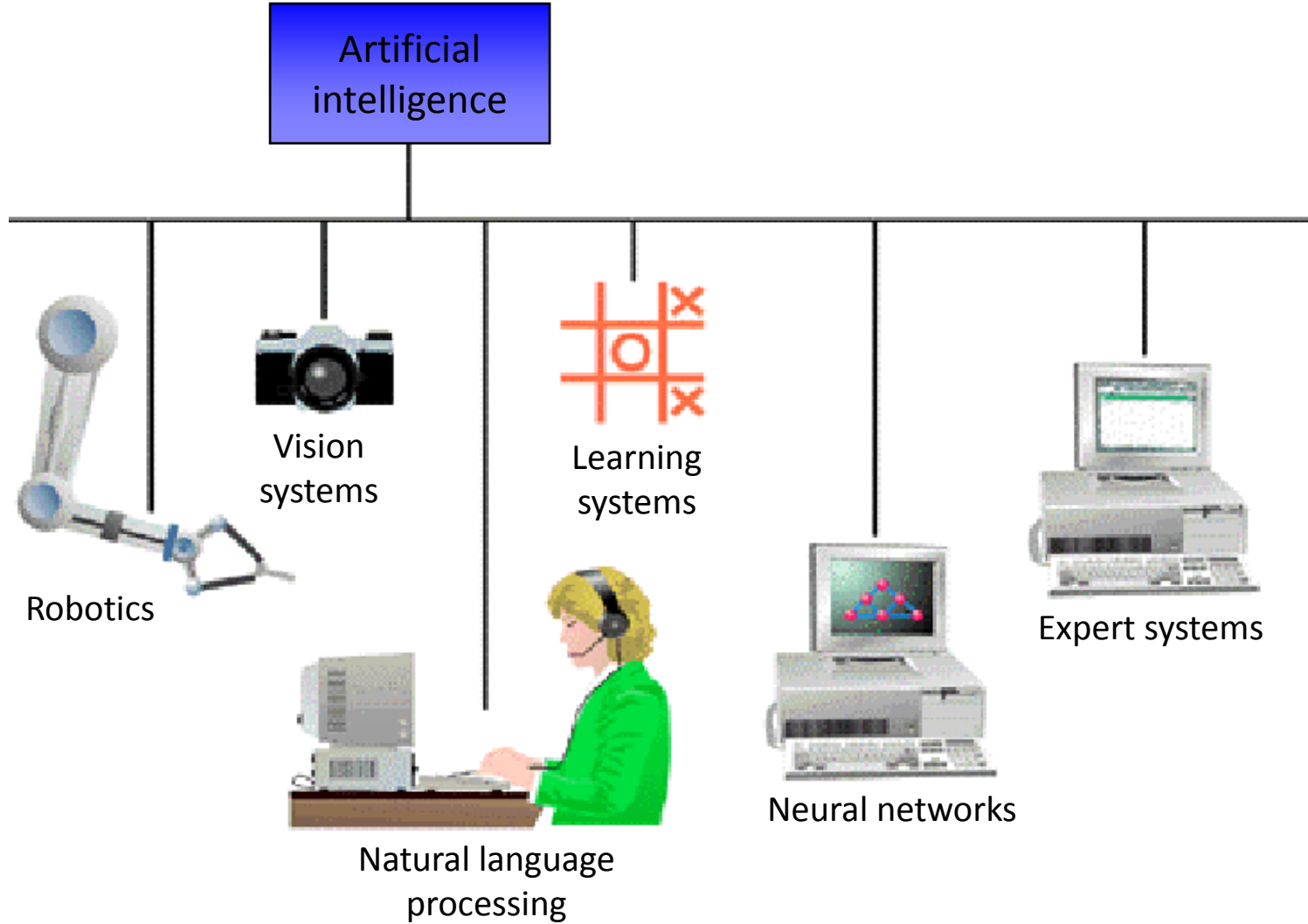
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Overview of Artificial Intelligence

- Intelligent behaviour
 - Learn from experience
 - Apply knowledge acquired from experience
 - Handle complex situations
 - Solve problems when important information is missing
 - Determine what is important
 - React quickly and correctly to a new situation
 - Understand visual images
 - Process and manipulate symbols
 - Be creative and imaginative
 - Use heuristics

Intelligent System?

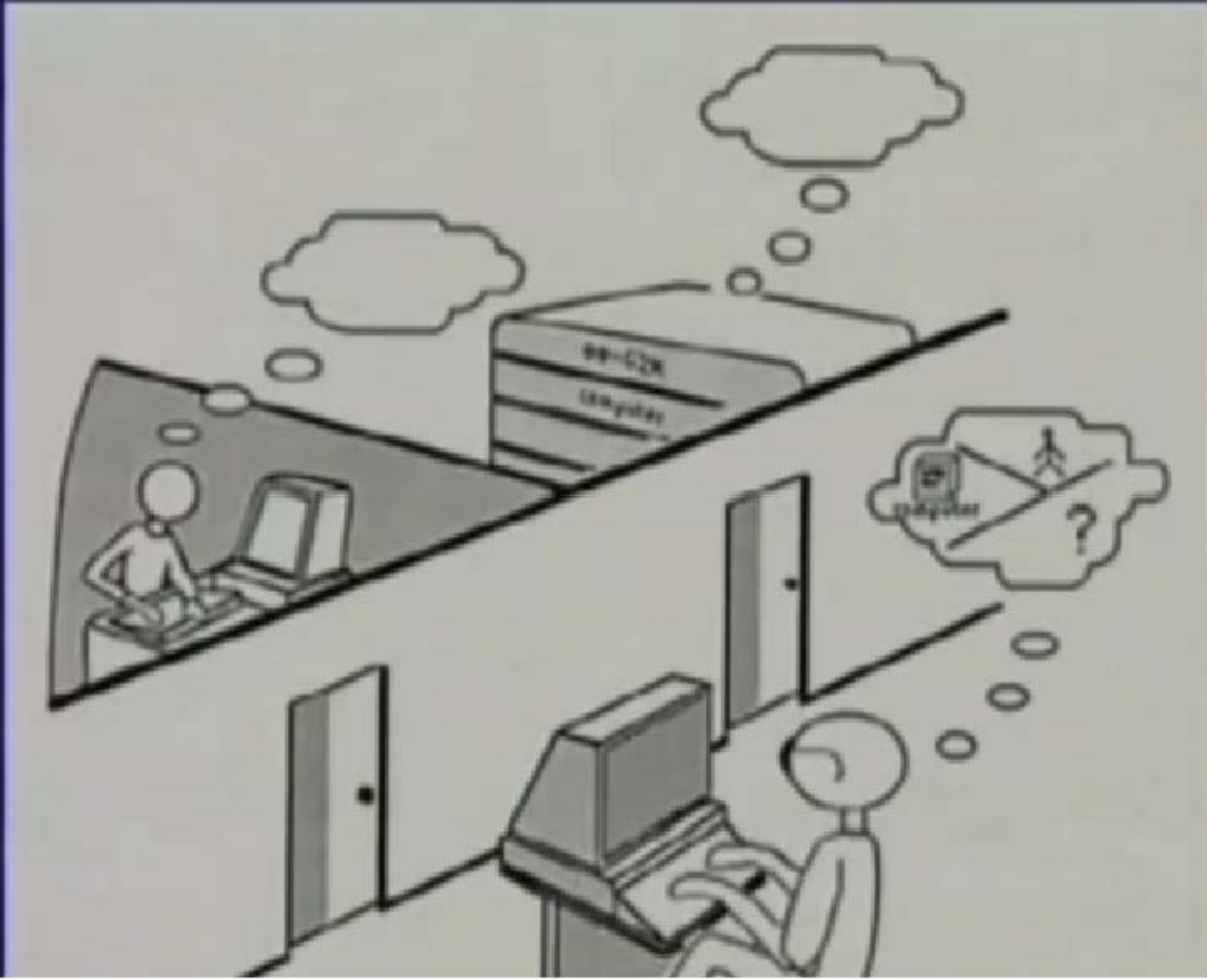




Approaches to AI



Turing Test



Foundation of AI

History of mankind – Master and Slave theory

1. Wanted to have total control over slave
2. Wanted to exercise control over slave by means of giving orders (communication)

Industrial Age

1. Use of tools and technologies to fulfill the basic needs of the humanity
2. Birth of “Cybernetics” dealing with the control and communication between man and machine.
3. Advent of computers in all facets of life.

Philosophy (428 B.C. – present)

1. Can formal rules be used to draw valid conclusions?
2. How does the mental mind arise from a physical brain?
3. Where does knowledge come from?
4. How does knowledge lead to action?

Mathematics (c. 800 – present)

1. What are the formal rules to draw valid conclusions?
2. What can be computed?
3. How to convert the uncertain information into mathematical models?

Neuroscience (1861 – present)

1. How do brain process information?

Psychology (1879 – present)

1. How do humans and animals think and act?

Computer engineering (1940 – present)

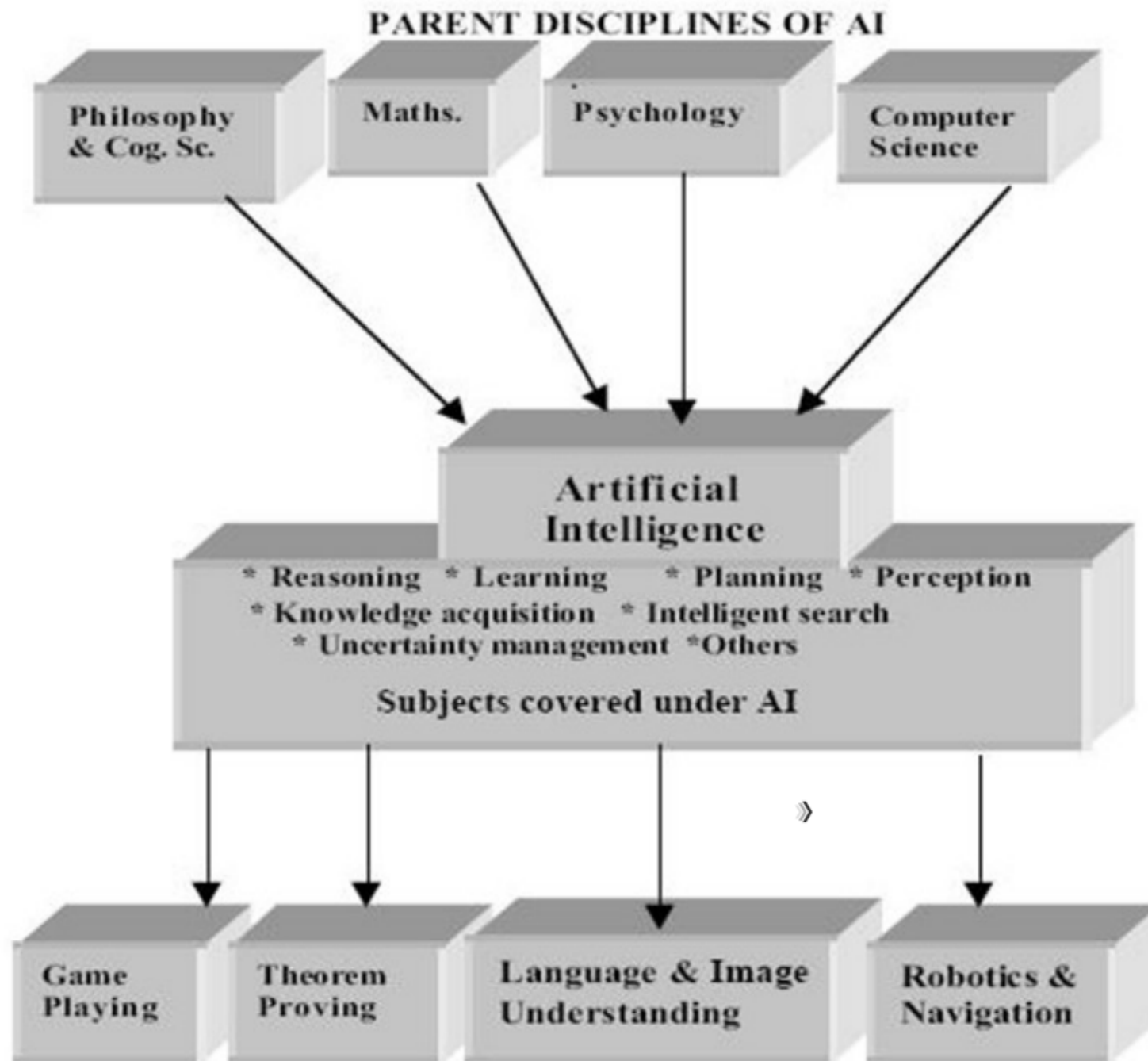
1. How can we build an efficient computer?

Control theory and Cybernetics (1948 – present)

1. How can artifacts operate under their own control?

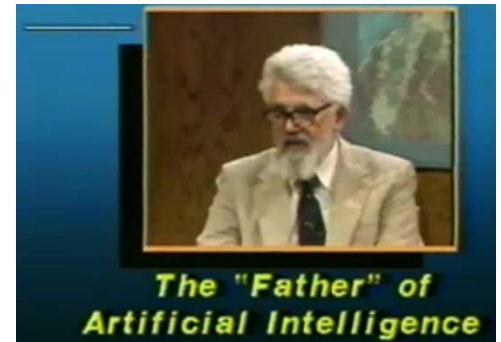
Linguistics (1957 – present)

1. How does language relate to thought?



APPLICATION AREAS OF AI

History Of AI

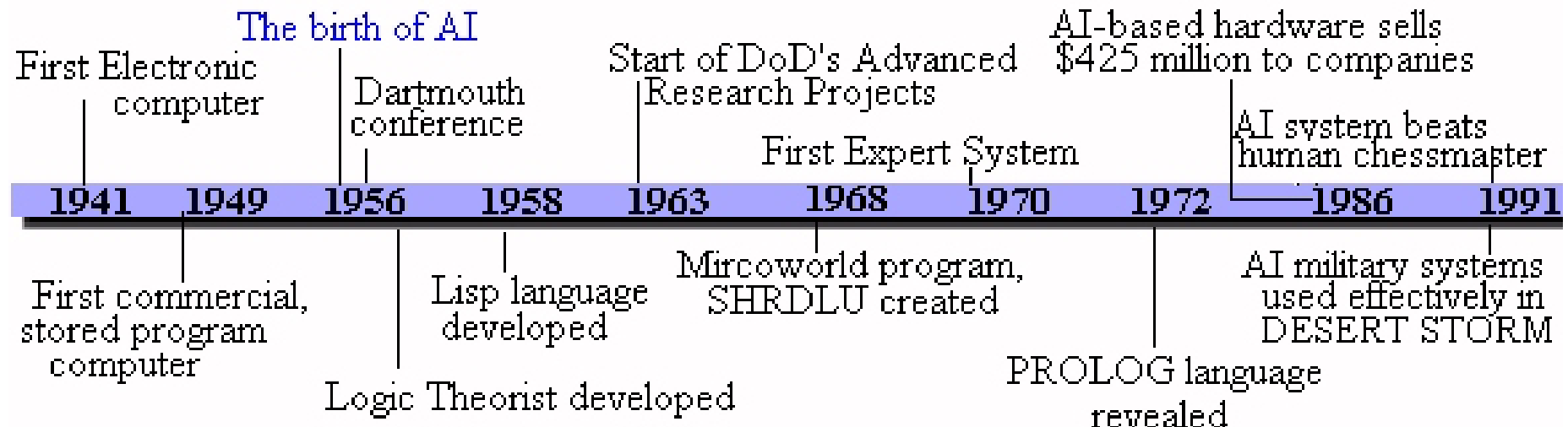


The gestation of artificial intelligence (1943-1955)

1. Warren McCulloch and Walter Pitts and Allan Turing (1943)
 - a. Knowledge of the basic physiology and function of neurons in the brain.
 - b. A formal analysis of propositional logic
 - c. Turing's "theory of computation"

The birth of artificial intelligence (1956)

1. John McCarthy – Known as father of AI.





Norbert Wiener

History Of AI

The Beginnings of AI:

Although the computer provided the technology necessary for AI, it was not until the early 1950's that the link between human intelligence and machines was really observed. [Norbert Wiener](#) was one of the first Americans to make observations on the principle of feedback theory. The most familiar example of feedback theory is the thermostat: It controls the temperature of an environment by gathering the actual temperature of the house, comparing it to the desired temperature, and responding by turning the heat up or down. What was so important about his research into feedback loops was that Wiener theorized that all intelligent behavior was the result of feedback mechanisms. Mechanisms that could possibly be simulated by machines. This discovery influenced much of early development of AI.

Knowledge Expansion

In the seven years after the conference, AI began to pick up momentum. Although the field was still undefined, ideas formed at the conference were re-examined, and built upon. Centers for AI research began forming at Carnegie Mellon and MIT, and a new challenges were faced: further research was placed upon creating systems that could efficiently solve problems, by limiting the search, such as the Logic Theorist. And second, making systems that could learn by themselves. In 1957, the first version of a new program The *General Problem Solver*(GPS) was tested.

The program developed by the same pair which developed the Logic Theorist. The GPS was an extension of Wiener's feedback principle, and was capable of solving a greater extent of common sense problems. A couple of years after the GPS, IBM contracted a team to research artificial intelligence. Herbert Gelerneter spent 3 years working on a program for solving geometry theorems. While more programs were being produced, McCarthy was busy developing a major breakthrough in AI history. In 1958 McCarthy announced his new development; the LISP language, which is still used today. LISP stands for LISt Processing, and was soon adopted as the language of choice among most AI developers.

What is AI?

The branch of [computer science](#) concerned with making [computers](#) behave like humans. The term was coined in 1956 by John McCarthy at the Massachusetts Institute of Technology. Artificial intelligence includes

- games playing: [programming](#) computers to play games such as chess and checkers
- [expert systems](#) : programming computers to make decisions in real-life situations (for example, some expert systems help doctors diagnose diseases based on symptoms)
- [natural language](#) : programming computers to understand natural human [languages](#)
- [neural networks](#) : [Systems](#) that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains
- [robotics](#) : programming computers to *see* and *hear* and react to other sensory stimuli

Currently, no computers exhibit full artificial intelligence (that is, are able to simulate human behavior). The greatest advances have occurred in the field of games playing. The best computer chess programs are now capable of beating humans. In May, 1997, an IBM super-computer called *Deep Blue* defeated world chess champion Gary Kasparov in a chess match.

In the area of robotics, computers are now widely used in assembly plants, but they are capable only of very limited tasks. Robots have great difficulty identifying objects based on appearance or feel, and they still move and handle objects clumsily.

Natural-language processing offers the greatest potential rewards because it would allow people to interact with computers without needing any specialized knowledge. You could simply walk up to a computer and talk to it. Unfortunately, programming computers to understand natural languages has proved to be more difficult than originally thought. Some rudimentary translation systems that translate from one human language to another are in existence, but they are not nearly as good as human translators. There are also [voice recognition](#) systems that can convert spoken sounds into written words, but they do not *understand* what they are writing; they simply take dictation. Even these systems are quite limited -- you must speak slowly and distinctly.

In the early 1980s, expert systems were believed to represent the future of artificial intelligence and of computers in general. To date, however, they have not lived up to expectations. Many expert systems help human experts in such fields as medicine and engineering, but they are very expensive to produce and are helpful only in special situations.

Today, the hottest area of artificial intelligence is neural networks, which are proving successful in a number of disciplines such as voice recognition and natural-language processing.

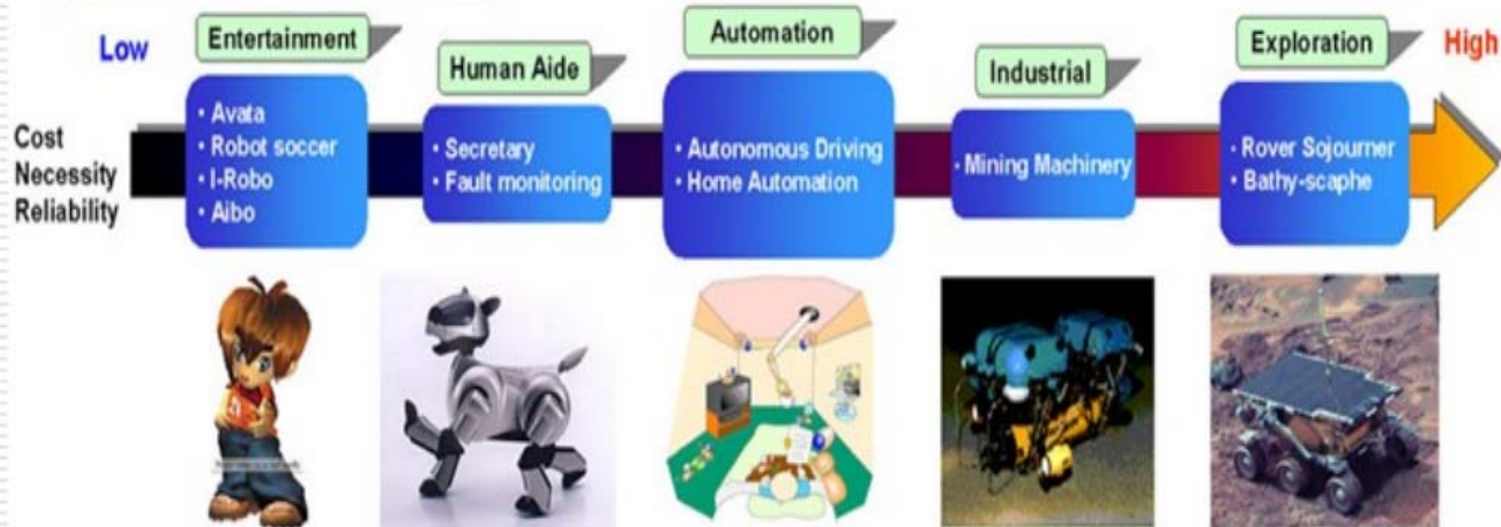
There are several [programming languages](#) that are known as [AI](#) languages because they are used almost exclusively for AI [applications](#). The two most common are [LISP](#) and [Prolog](#).

AI Problems?

1. Perception of the world around us is crucial to our survival. Animals with much less intelligence than people are capable of more sophisticated visual perceptions than are current machines. Perceptual tasks are difficult because they involve analog (rather than digital) signals; the signals are typically very noisy and usually a large number of things (some of which may be partially obscuring others) must be perceived at once.
2. The ability to use language to communicate a wide variety of ideas is perhaps the most important things that separates human from other animals. The problem of understanding spoken language is a perception problem and is hard to solve for the reasons just discussed. But suppose we simplify the problem by restricting it to written language. This problem, usually referred to as “natural language understanding”, is still extremely difficult. In order to understand sentences about a topic, it is necessary to know not only a lot about the language itself (its vocabulary and grammar) but also a good deal about the topic so that unstated assumptions can be recognized.
3. Storing exact knowledge is difficult in computers.

AI techniques?

Realization



Implementation

- Autonomous Mobile Agent (Robot Car Race)
 - Intelligence in Competing Environment with Real time
 - Multiple Agent with Changing Environment



System Architecture

