Artificial Intelligence is part of cognitive sciences:

Philosophy: logic, knowledge

Psychology: perception, reasoning, learning

Linguistics: semantics (best example of AI)

Neuroscience: neural networks

* Objectives:

Developing artifacts able to perceive, reason and learn.

Modelling cognition, so we can understand how we perceive, how we reason and how we learn.

**Thinking machines**

Thinking: ¿Does the computer perform data processing or also symbol manipulation?

**¿When do we use AI?**

When there is no algorithm that provides the solution of a problem DIRECTLY. We need an intelligent program that SEARCHES for a solution.

When we want our program to perform the appropriate action in a given situation.

When we want our program to recognize a pattern.

When we want our program to discover patterns.

When we want our program to improve its performance (learn).

The imitation game: A woman, a man and an interrogator play the game. The interrogator ask questions to them and tries to determine which of one of the two players is the woman.

The Turing test by Turign, based on the imitation game. Turing proposes a computer instead of the man. The interrogator ask questions to them and tries to determine which one of the two players is the person. If the interrogator fails, then we can say the computer is intelligent. HERE INTELLIGENCE is to say the correct thing in a given moment / to perform the appropriate action in a given situation.

First paper on Machine Intelligence: Computer machinery and intelligence (Alan Turing, 1950 )

The Chinese Room by John Searle: Suppose the computer passes the Turing test and the written messages are written in Chinese characters. Does the computer UNDERSTAND Chinese or APPEAR TO HAVE THE ABILITY TO UNDERSTAND Chinese?

With the Chinese room, we try to figure out if it is just appearance. Using AI techniques we develop artifacts that are intelligent (real)/ appear to be intelligent (simulated).

**Strong AI**

A computer well programmed and with the appropriate input data, would have a MIND IN THE SAME SENSE AS THE HUMAN MIND.

But with the CHINESE ROOM there is only syntax processing **no semantics !**

**The meeting at Dartmouth College (1956): McCarthy, Newell, Minsky, Simon**

Summer research project on AI.

Ai is the ability to SOLVE PROBLEMS, but PROBLEM SOLVING is SEARCHING for a solution. It implies:

1. A search space
2. A search algorithm
3. Heuristics to guide the search (not to be a blind search)

Games as a microworld to test problem solving.

1. Chess programs. HUGE search space. Search must be SELECTIVE, not blind. A HEURISTIC SEARCH IS INTELLIGENT
2. The 15 puzzle. HUHE SEARCH SPACE (we need TERABYTES and many years)

The general problem solver (GPS, Newell and Simon,1959):

It could play chess and solve mathematical theorems. It was a Logic Machine and used a knowledge base as a SET OF RULES, independent of the problem solver engine.

It uses the means-ends-analysis as searching strategy: initial state, final state (the goal), current state, set of possible actions to be applied to the states.

* Process

An action that can be applied to the current state is selected, in order to go from the current state to a new state. The criteria is to reduce the distance between the current and the final state.

Preform the action and reach a new current state.

If the current state is not the final state, then go back to step 1. Else stop.

Knowledge representation (became an area of AI)

Problem solving (SEARCHING) requires KNOWLEDGE (is what to do in a given situation).

The basic architecture of an AI system: SEARCHING ENGINE + KNOWLEDGE BASE

The design and development of Knowledge Based Systems (KBS):

1. Analysis of real knowledge.
2. Knowledge acquisition.
3. Computational modeling of knowledge (knowledge representation).
4. Knowledge manipulation by an interface engine for problem solving or educational porpuses.
5. Knowledge management.

Semantic networks: Semantic relations guide the searching process.

Declarative knowledge: Knowledge about something. Is applied in a situation when the system needs to provide information. (Paris is the capital of France, If .. then)

Procedural knowledge: knowledge about what or how to do something. Is applied in a situation when the system needs to perform an action or sequence of actions. (In order to cook:, calculate, cut, bring paper).

**Logic Predicates**

PROLOG (PROgrammin in LOGic, 1972). Knowledge represented with logic predicates.

Facts and rules. A program in PROLOG is a deductive base. Data = code.

There is an inference engine that manipulates the facts and rules. Responds also if a predicate is TRUE or not, and under which value is true.

**The Fifth Generation Computer**

Japanese National Project (1982-1992)

In a knowledge society, computers should be knowledge manipulation machines.

Processor: Inference engine

Database = Deductive database

Machine Language = PROLOG

It was ahead of its time, poor support from software and hardware companies. Huge expectations and poor results.

**Expert systems**

AI applications, based on mens-ends-analysis basic architecture.

Rule based on knowledge bases and an inference engine.

Popular tools for knowledge engineering.

Usually diagnosis and classification applications.

Expert systems development environment = rule editor + inference engine

**Connectionism (1990´s)**

“Elephants don´t play chess”

Parallel distributed processing (Rumelhart and McClelland)

* AI systems must be able to interact

with the real world.

* Pattern recognition.

“The map is not the territory”. Situated cognition vs knowledge representation. (William Clancey)

**Intelligence without representation** (Rodney A. Brooks)

**Soft Computing**

“…inexact solutions to computationally hard tasks… tolerant of imprecision, uncertainty, partial truth, and approximation.

In effect, the role model for soft computing is the human mind. “

* **Neural Networks** (John Hopfield)
* **Fuzzy Systems** (Lofti Zadeh)
* **Genetic Algorithms** (David Goldberg)

**Distributed AI**

*Internet appears…*

*and AI moved towards collaboration and cooperation.*

**Multiagent systems**: **Intelligence emerges from the collaboration of non intelligent agents.**

(cannibals and missionaries example)

**Intelligent Agents**: **Agents that *deliberate***

Agent Oriented Programming (AOP) (Yoav Shoham)