

Intelligent Systems: Reasoning and Recognition

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Intelligence, Knowledge and Reasoning.

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Class notes on the web :

<http://www-prima.inrialpes.fr/Prima/Homepages/jlc/Courses/2009/ENSI2.SIRR/ENSI2.SIRR.html>

Intelligence, Knowledge and Reasoning

What do we mean by Intelligence?

INTELLIGENCE :

(Petit Robert) "La faculté de connaître et comprendre,
incluant la perception, l'apprentissage, l'intuition, le jugement et la conception."

(Dictionnaire American Heritage) "The ability to know and to reason"

(Newell and Simon) :

"Application of Knowledge to Problem Solving"

What is Knowledge?

What is knowledge? - Competence

Whatever enables the solution of problems.

Knowledge is defined by function and not by representation.

What is Reasoning?

Generation of new knowledge by inference.

Examples of types of inference:

Deduction : $(p \wedge (p \rightarrow q)) \Rightarrow (q)$

Abduction : $(q \wedge (p \rightarrow q)) \Rightarrow \text{Maybe}(p)$

Induction: $p(A) \rightarrow q, p(B) \rightarrow q, \dots \Rightarrow \forall x (p(x) \rightarrow q)$

For expert systems technology, reasoning is accomplished by manipulation symbols.

What is a symbol?

A symbol is a 3rd order relation between

- A sign
- A thing
- An interpreter

Dominant Paradigm in AI : The Physical Symbol System hypothesis (Newell 1980).

Note that symbols permit abstraction.

What does it mean to Understand?

Understanding can be described as the ability to predict and explain. Understanding typically relies on some form of model that can be used to predict the outcome of a process or phenomena. Decomposing the model into components and interactions between components provides a means to explain a process or phenomena.

Kinds of Knowledge

Cognitive Psychologists identify different categories of knowledge:

Declarative: A symbolic expression of competence.

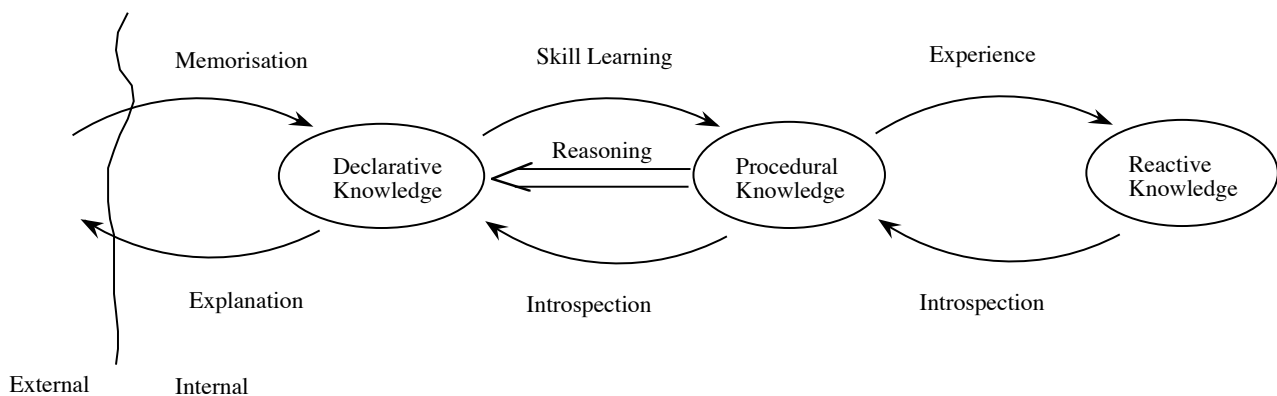
Declarative knowledge is abstract

Declarative knowledge is used to communicate and to reason.

Procedural: A series of steps to solve a problem.

A compiled expression of knowledge

Reactive: stimulus - response.



Newell proposes the distinction between "superficial" knowledge and "deep" knowledge.

- **Superficial knowledge** provides reasoning without understanding. A common example of **superficial** reasoning is reasoning by symbol manipulation, without regard to the meaning of the symbols.

- **Deep knowledge** requires the ability to predict and explain, and requires some form of model.

The technologies for "Expert Systems" are based on symbol manipulation, without regard for the meaning of the symbols. Thus Expert Systems are based on superficial knowledge.

The term "Artificial Intelligence" emerged from a pioneering workshop at Dartmouth University in 1956. Pioneers attending this workshop included Alan Newell, Herb Simon, John McCarthy, Marvin Minsky, Nils Nilsson, and Ed Feigenbaum.

Throughout the 1960s and 1970's the domain was not reputable, and research was limited to four or five universities:

MIT : Approach was to invent a powerful universal reasoning machine

Stanford: Approach was Lots of symbolic knowledge and a little bit of reasoning

CMU: Build a computing science based on cognitive models of biological systems.

Edinburgh and Grenoble: Logic Programming as a universal reasoning mechanism.

Results

MIT => Behavioral robotics, Frames, Schema systems.

CMU => Rule based production systems and Cognitive Models and

Edinburgh and Grenoble => Logic Programming (Prolog)

Stanford => Expert System technologies.