A Comparative Study of Procedural and Declarative Knowledge Representation and Reasoning

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***Abstract*--- Knowledge representation and reasoning is most desirable factor to make the system intelligent. A System can be said to be intelligent if its intelligence is equal to the intelligence of animal (human) being in a particular area. Because of incomplete, ambiguous and unclear information the job of making intelligent system is quite difficult. The objective of this work is to present the rule and application technique for making the system effective and optimistic. The condition for optimistic and effective is because the system must be intelligent to reply the response (answer) with a sureness of some factor. The researchers present the comparison between various knowledge representative and reasoning techniques.**

Keywords: **artificial intelligence, knowledge, reasoning.**

I. INTRODUCTION

Artificial Intelligence (AI) is a rapidly advancing technology, made possible by numerous researches that may have significant impacts on our everyday lives in the field of computer science and computer engineering. AI traditionally refers to an artificial creation of human-like intelligence that can learn, reason, plan, perceive, or process natural language (Russell and Norvig, 2009). One remarkable aspect of intelligent behaviour is that it is clearly conditioned by the ability to learn and perform a very wide range of activities. We make decisions about what to do based on what we know (or believe) about the world, effortlessly and unconsciously. (Jahanzaib, and Tarique, 2015) noted that "the term intelligence refers to the ability to acquire and apply different skills and knowledge to solve a given problem. In addition, intelligence is also concerned with the use of general mental capability to solve, reason, and learning various situations". Intelligence consists of both human intelligence and artificial intelligence.

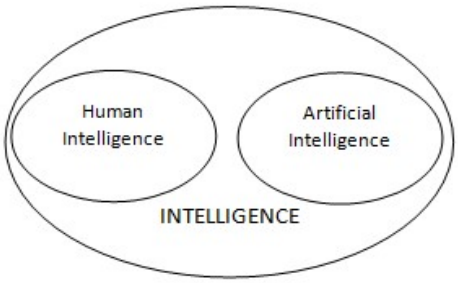

Fig. 1.Categories of Intelligence

Human intelligence concerns itself with problem solving, learning and reasoning while artificial intelligence is all about replicating the human intelligence to solve problems, logic, thinking and reasoning.

It's so normal to use what we learn in this way that we only pay attention to it when it's not there.If we say someone has behaved, like when someone uses a lit match to see if there is any fuel in the gas tank of a vehicle, what we usually mean is not that there is something the person has not understood, but that the person has not been able to use what they have known. We might say: "You weren't thinking!" Indeed, it is that is supposed to bring what is relevant in what we know to bear on what we are trying to do.

One definition of Artificial Intelligence (AI) is that it is the study of intelligent behaviour achieved through computational means (…). But how machines do all these things comes under knowledge representation and reasoning. Hence we can describe Knowledge representation as following:

- Representation of information and reasoning (KR, KRR) is the aspect of Artificial Intelligence that involves AI agents learning and how thought leads to agents ' intelligent behaviour.
- It is responsible for representing real-world data so that a computer can understand and use this knowledge to solve complex real-world problems such as medical diagnosis or natural language interaction with people.
- It's also a way to describe how artificial intelligence information can be portrayed. Knowledge storage not only stores information in some database, but it also helps a smart machine to benefit from that knowledge and experiences so that it can act smartly as a human being.

A Knowledge

Knowledge is the information about a domain that can be used to solve problems in that domain. To solve many problems requires much knowledge, and this knowledge must be represented in the computer. As part of designing a program to solve problems, we must define how the knowledge will be represented. In artificial intelligence, knowledge representation is the study of how the beliefs, intentions, and value judgments of an intelligent agent can be expressed in a

transparent, symbolic notation suitable for automated reasoning (Davis, 2001). It is the understanding or knowledge with reality, information and circumstances experiences. Following are the types of knowledge in artificial intelligence:

Knowledge representation and reasoning (KR², KR&R) Is an artificial intelligence (AI) discipline dedicated to portraying world information in a way that a computer system can use to solve complex tasks such as diagnosing a medical condition or holding a natural language conversation. Information representation integrates empirical research on how people solve problems and interpret knowledge in order to design formalisms that promote the design and construction of complex systems. Representation of knowledge and reasoning also combines logic results to simplify different types of reasoning, such as the application of rules or sets and subsets relations.

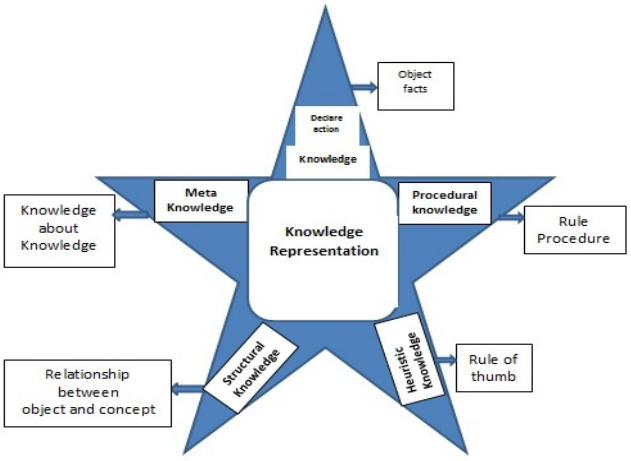

Fig. 2. Types of Knowledge Representation and Reasoning

Robotic technology is now on the rise as it is applicable to many areas such as automobile, medicine, industries, schools, hospitals etc. (Turan et al 2017) observed that "AI is an efficient means to make artificial thinking machines and machine control with expert systems which greatly explain users ' intelligent behaviour, training, and successful advice.In general, AI is basically known as the ability or potential of robotics to decide, solve problems and reason".

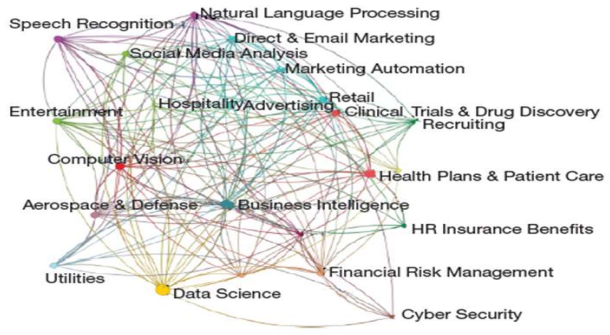

Fig. 2.Application Area of Artificial Intelligence (Joost, et al 2019)

B. Reasoning

Reasoning is the mental process of deriving logical conclusion from available knowledge, evidence, and beliefs and making predictions. Or we can conclude, "Reasoning is a means of infering information from existing data." It is called reasoning to manipulate symbols to generate results. One way that AI representations differ in traditional languages from computer programs is that an AI representation typically specifies what needs to be calculated, not how to calculate it. We may specify that the agent should find a patient's most likely disease, or specify that a robot should get coffee, but not give detailed instructions on how to do this (Poole, 2017). Much of AI reasoning involves searching the space of possibilities to determine how a task is to be completed. The reasoning is important in artificial intelligence so that the robot can still think rationally like a human brain and behave like a human being.

C. Turing Test

To check for artificial intelligence in a system, Alan Turing developed and proposed a game called Turing Test.

Joost, et al 2019 further clarified that "it's played with three men, a man (A), a woman (B), and a questioner (C) who can be of either gender. The interrogator, apart from the other two, remains in a house. The object of the interrogator's game is to decide which of the other two is the man and the female. He identifies them by X and Y tags and says either "X is A and Y is B" or "X is B and Y is A" at the end of the game.

We are now asking the question: "What will happen if a robot in this game takes part of A?"If the game is played like this, the interrogator will wrongly decide as often as he does when the game is played between a man and a woman? Such questions replace the "Do machines think?" original question."

II. COMPARE OF PROCEDURAL AND DECLARATIVEKNOWLEDGE REPRESENTATION AND REASONING

A. Procedural Knowledge

Procedural Knowledge also known as interpretive knowledge is the type of knowledge in which it clarifies how a particular thing can be accomplished. It is not so popular because it is generally not used. It emphasizes how to do something to solve a given problem. Procedural awareness in artificial intelligence is one form of information that an intelligent agent may possess. Such knowledge is often portrayed as a partial or complete machine or computer program in the finite state. A well-known example is the procedural reasoning method, which could include procedures such as "navigate to a space" or "plan a course" in the case of a mobile robot navigating in a house.

Procedural knowledge is what in the form of discrete rules can be expressed. Usually, procedural knowledge is derived either from an instruction manual for a particular system or

through interviewing an expert on how to accomplish the task. The rules can be highly complex and context-dependent, and it is often difficult to get all the dependencies and constraints from the expert, but they can be expressed as a sequence of declarative statements when they are obtained.

Procedural knowledge is a type of knowledge where in the knowledge itself the essential control information required to use the information is integrated. It also used the knowledge that follows the instructions given in the knowledge with an interpreter.

Example
Program to calculate average of TWO numbers.
Solution:

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CLS
LET A = 2
LET B = 4
LET SUM = A+B
LET AVERAGE = SUM/2
PRINT AVERAGE
END
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So, this is how the average of two number is calculated by following a lengthy process instead of just collecting facts.

B. Declarative knowledge Representation and Reasoning

Declarative information is characterized as the data stored in memory and considered to be static in nature. Other names are also given, such as descriptive knowledge, proposalal knowledge, etc. It's the information part that explains how things are. Things / events / processes, their attributes, and the relationships between these things / events / processes and their attributes characterize the declarative information domain. Declarative representations are useful for knowledge (meta-knowledge) communication and reasoning. Declarative Knowledge Representations for symbolic representation of declarative knowledge have been explored as a general representation (Veera, 2018).

A Declarative Knowledge is where only knowledge is defined, but it does not include the use to which information is used. To use this declarative knowledge, we need to combine it with software that explains what to do with the knowledge and how to do it (Smart, 2019).

Example

Let's explain this by the example of an employee whose ID, name, address, salary has to be stored in a database where it's fact-based information doesn't require a lot of effort to get it.

III. DIFFERENCE BETWEEN PROCEDURAL AND DECLARATIVE KNOWLEDGE REPRESENTATION

Procedural knowledge Representation and Reasoning	Declarative knowledge Representation and Reasoning
➢ High efficiency ➢ Low modifiability ➢ Low cognitive adequacy (better for knowledge engineers ➢ Procedural Knowledge i.e means to incorporate on AI systems through procedures like LISP and PROLOG languages ➢ Object facts	➢ Higher level of abstraction ➢ Suitable for indipendent facts ➢ Good cognitive matching (better for domain experts and end-users) ➢ Declarative Knowledge means to incorporate on AI systems through Declarative mechanisms like Semantic Nets, CD Diagrams, Frames and Scripts. ➢ Rule Procedure

Table 1: showing the difference between procedural and declarative knowledge representation. Adapted from ()

A. Key Differences between Procedural and Declarative Knowledge Representation and Reasoning

1. It is known as procedural awareness when conscious thinking and conscious preparation are involved in learning. On the contrary, he is not aware of declarative information.
2. Declarative knowledge is verbalized, shared, copied, processed and easily stored while it is difficult to express procedural knowledge.
3. Declarative knowledge is more commonly used among procedural and declarative knowledge.
4. Procedural knowledge is acquired through experience, action and subjective insight. Declarative knowledge, on the other hand, is derived from objects, systems, processes and principles.
5. Procedural knowledge is in essence process-oriented, whereas data-oriented declarative knowledge.

The first difference between them is that only the knowledge is specified by the declarative representation, but not the mechanism to implement the knowledge. On the contrary, together with the experience, the procedural representation provides the control information. The concept of "relationship" is a fundamental concept for organizing such structures (James, 2013).

IV. CONCLUSION

Knowledge representation and reasoning (KR, KRR) is Artificial Intelligence's aspect of learning about AI agents and how thinking leads to agents ' intelligent behaviour. The key difference between the representation and reasoning of Declarative and Procedural Knowledge is: Procedural Knowledge is derived from experience, action and subjective insight. Declarative knowledge, on the other hand, is obtained from artifacts, processes, processes and concepts. Procedural knowledge is process-oriented, while declarative knowledge is data-oriented.

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