

A Critical Conceptual Analysis of Definitions of Artificial Intelligence as Applicable to Computer Engineering

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Abstract: The purpose of artificial intelligence is to acquire knowledge of required subject. Knowledge acquisition involves knowledge of dark energy (74% of universe), knowledge of dark matter (22%) and knowledge of visible matter (4%). This knowledge can be gathered through biological sensors (5 senses) and non-biological sensors like, robot, TV, mobile, camera, microscopes, radar, computer etc. The present definitions of artificial intelligence cover only the computer portion of the visible world i.e., an iota of 4% hence are not complete. A complete definition is required to cover the entire universe and all the means of acquisition of intelligence through artificial means. This paper analyses all the existing definitions of artificial intelligence and recommends that "Artificial Intelligence is the mechanical simulation system of collecting knowledge and information and processing intelligence of universe: (collating and interpreting) and disseminating it to the eligible in the form of actionable intelligence".

Key Words:

Artificial intelligence, Biological sensors, Acquisition, Interpretation

Academic Discipline and Sub-Disciplines

Computer Science & Engineering

SUBJECT CLASSIFICATION

Artificial Intelligence

TYPE (METHOD/APPROACH)

Historical Inquiry

I. Introduction

Artificial intelligence is a subject taught as a subject in computer science and engineering discipline. It primarily limits itself to the processing of data through computers. The definitions used to define artificial intelligence have also been modified time to time according to the need of either the faculty or the usage. These definitions have limited the scope of artificial intelligence to a very limited extent and the true spirit of intelligence is not taken into account. This paper aims to restore the scope of artificial intelligence by providing a definition matching its area of action and influence.

INTELLIGENCE

Intelligence can be defined as a **general mental ability** for reasoning, problem solving, and learning. Because of its general nature, intelligence integrates cognitive functions such as perception, attention, memory, language, or planning. Structural and functional neuro-imaging studies have generally supported a fronto-parietal network relevant for intelligence. This same network has also been found to underlie cognitive functions related to perception, short-term memory storage, and language. The distributed nature of this network and its involvement in a wide range of cognitive functions fits well with the integrative nature of intelligence (Colom et al, 2010).

Directories define intelligence as the ability to acquire, understand and apply knowledge or the ability to exercise thought and reason. According to Unified Theories of Cognition, intelligence may be Natural (biological) or Non Natural (Mechanical) (Allen Newell: Unified Theory of Cognition). Biological intelligence is primarily based on the five senses controlled by mind while the mechanical intelligence is based on artificial sensors controlled by a mechano-neural network (Patterson, 2004). Allen Newell defines intelligence as: 'the degree to which a system approximates a knowledge-level system' (Allen Newell: Unified Theory of Cognition). Natural Beings collect intelligence through their senses while mechanical or artificial intelligence is collected by machines by simulating nature. It involves collecting, collating, interpreting (processing) and dissemination of knowledge and information for action. Knowledge is the key element. Oxford English Dictionary defines knowledge as (i) expertise, and skills acquired by a person through experience or education; the theoretical or practical understanding of a subject, (ii) what is known in a particular field or in total; facts and information or (iii) awareness or familiarity gained by experience of a fact or situation. Knowledge representation and knowledge engineering (Russell & Norvig 2003), are central to Artificial Intelligence

research. The term *knowledge* is also used to mean the confident understanding of a subject with the ability to use it for a specific purpose if appropriate (Winston, 2001).

KNOWLEDGE ACQUISITION

Knowledge acquisition involves complex cognitive processes of perception, learning, communication, association and reasoning (Winston, 2001).

KNOWLEDGE ACQUISITION BOUNDARIES OF MECHANICAL METHODS

Knowledge acquisition involves

- Knowledge of dark energy (74% of universe)
- Knowledge of dark matter (22%)
- Knowledge of visible matter (4%)

(a) Knowledge through soul, intellect and biological sensors (5 senses)

(b) Knowledge through non-biological sensors

- (i) Robot
- (ii) TV
- (iii) Mobile
- (iv) Camera
- (v) Radar
- (vi) Computer

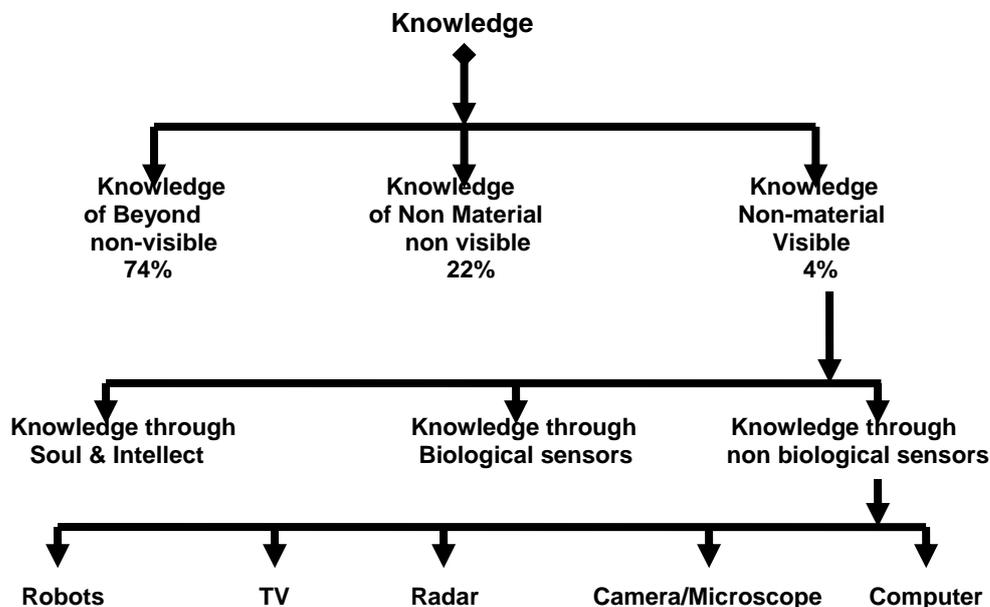


Fig 1 showing scope of knowledge and intelligence

ARTIFICIAL INTELLIGENCE

Artificial intelligence has been described differently over a period.

Mechanical replication:

The earlier definitions of Artificial Intelligence covered these boundaries of intelligence at the **mechanical level**. The first definition of Artificial Intelligence was given by John McCarthy: Computer Science Department of Stanford University, who coined the term in 1956 (Crevier 1993, p. 50), defines it as "the science and engineering of making intelligent machines."(McCarthy, 1955) The field was founded on the claim that a central property of human beings, intelligence can be so precisely described that it can be simulated by a machine (McCarthy et al, 1955).

Intelligence Agents:

Earlier AI textbooks define the field as "the study and design of intelligent agents,"(Poole et al1988) An intelligent agent is a system that perceives its environment and takes actions which maximize its chances of success (Russel & Novig, 2003). Artificial Intelligence is 'the capability of a device to perform functions that are normally associated with human intelligence, such as reasoning and optimization through experience (www.its.bldrdoc.gov).' Artificial intelligence (AI) is the intelligence of machines and the branch of computer

science which aims to create it (Wikipedia). The ability of a machine to learn from experience and perform tasks normally attributed to human intelligence, for example, problem solving, reasoning, and understanding natural language (www.idrc.ca).

Non-Naturally Occurring Systems:

The later definitions considered Artificial Intelligence as the Application of Non-Naturally Occurring Systems. E.g., Artificial Intelligence, 'is simply the application of artificial or non-naturally occurring systems that use the knowledge-level to achieve goals' (Wikipedia). A more practical definition that has been used for AI is 'attempting to build artificial systems that will perform better on tasks that humans currently do better' (Rich & Knight, 2004).

Ideas in Machines:

The trend of defining AI shifted gradually from mechanical devices to systems and then to ideas in machines. The later definition stated: 'Artificial intelligence is the study of ideas to bring into being machines that respond to stimulation consistent with traditional responses from humans, given the human capacity for contemplation, judgment and intention. Each such machine should engage in critical appraisal and selection of differing opinions within itself. Produced by human skill and labor, these machines should conduct themselves in agreement with life, spirit and sensitivity, though in reality, they are imitations' (Minsky, 1967). Or 'AI is the ability of Machine/Tools' : 'The ability of a machine to learn from experience and perform tasks normally attributed to human intelligence, for example, problem solving, reasoning, and understanding natural language (www.quantum3.co.za).' Or 'Tools that exhibit human intelligence and behaviour including self-learning robots, expert systems, voice recognition, natural and automated (www.unesco.org).'

Process of Simulation:

Next turn in defining AI was that of defining it as a process of Mimicking or Simulation e.g. AI was considered as the 'information processing by mimicking or simulation of the cerebral, nervous or cognitive processes (www.gbc.hu).'

Computers as AI instruments:

AI then was taken to be making computers work for humans e.g., 'Artificial Intelligence is the study of how to make computer do things which, at the moment people do better (Rich & Knight, 2004).' Soon the machine was replaced by making AI as the sole property of Computer e.g., 'AI Applies to a computer system that is able to operate in a manner similar to that of human intelligence; that is, it can understand natural language and is capable of solving problems, learning, adapting, recognizing, classifying, self-improvement, and reasoning' (www.quantum3.co.za).

AI as branch of Computer Science:

Machine to computer and then computer to branch of computer approximating human was adopted with the aim of making it a part of computers and excluding all other machines e.g., 'AI is the branch of computer science that attempts to approximate the results of human reasoning by organizing and manipulating factual and heuristic knowledge. Areas of AI activity include expert systems, natural language understanding, speech recognition, vision, and robotics (www.its.blrdoc.gov)' And 'The branch of Computing Science concerned with simulating aspects of human intelligence such as language comprehension and production, vision, planning (www.essex.ac.uk),' etc.

The scope was further narrowed down to a Branch of Computer Science meant for creating Computer System, e.g., 'Artificial intelligence (AI) is the intelligence of machines and the branch of computer science which aims to create it (Wikipedia).' And 'AI is a branch of Computer Science concerned with the study and creation of Computer systems that exhibit some form of intelligence, systems that learn new concepts and tastes, systems that can reason and draw useful conclusion about the world around us, systems that can understand a natural language or perceive and comprehend a visual scene and systems that perform other types of feats that require human types of Intelligence' (Patterson, 2004).

From intelligent machines to computers, computers to branch of computers, and the branch of computer dealing with creating computer system and then simulation was not the end but the beginning of the future course when it was directly connected with computer programs. 'The field of computer science dedicated to producing programs that attempt to mimic the processes of the human brain (www.optionetics.com).'

AI as programming and Computations with computers:

Ultimately machine elements was taken over by Program: 'The branch of computer science that deals with writing computer programs that can solve problems creatively (wordnet.princeton.edu).' Or 'the study of the

computations that make it possible to perceive, reason and act (Winston, 1999). Or ‘the concept that computers can be programmed to assume capabilities such as learning, reasoning, adaptation, and self-correction’(www.atlab.com). And ‘The use of programs to enable machines to perform tasks which humans perform using their intelligence. Earlier AI avoided human psychological models, but this orientation has been altered by the development of connectionism, which is based on theories of how the brain works (www.filosofia.net).’

The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects (Russel & Novig, 2003).

Crux of all the above Definitions in various contexts is as follows:

(a) Intelligent Devices

- Devices for human intelligence related functions.
- Applications of non-naturally occurring systems.
- Ideas in Machines
- Mimicking
- Simulation
- Machines working like humans
- Tools exhibiting human intelligence

(b) Computers

- Making computers work for humans for intelligence
- Branch of Computer Science-Approximating human
- Branch of Computer Science creating computer systems

(c) Programs

- Making intelligent machines with computer programs
- Branch of computer science writing computer programs
- Study of computations
- Programming computers
- Programming for enabling machines to perform intelligence systems

This way we have seen that within a period of over 40 years it has drifted very fast and lost its originality: The drift stages are

- Original- Mechanical Device
- Drift 1: Simulating/imitating/mimicking original intelligence
- Drift 2: Machine process
- Drift 3: Computer
- Drift 4: Branch of Computer Science
- Drift 5: Programming.

Drawbacks Of These Definitions

- (a) Instability-drifting regularly
- (b) Narrow in scope. it is wavering between computer as a machine and as a program.
- (c) Cover only a minute portion leaving knowledge of 74% dark energy, 22% of dark matter and out of the visible 4% do not cover knowledge through biological sensors and knowledge through soul.
- (d) Out of knowledge through non-biological sensor cover only computers leaving, radars, mobiles, cameras, TV, Robots etc.
- (e) Ignores the other platforms like aircrafts, drones and satellites.
- (f) Care for only part of one process i.e., using language for processing (programming). Do not cater for other aspects of intelligence e.g., collection, collation, interpretation and dissemination

Keeping in mind these drawbacks, the new definition has to include the following

- (a) term Artificial intelligence
- (b) Actionable Intelligence
- (c) Role of Knowledge of entire universe
- (d) All simulating sensors with their platforms as a system
- (e) All processes-Collecting, collating, interpreting and dissemination.

Recommended Definition:

Artificial Intelligence is the mechanical simulation system of collecting knowledge and information and processing intelligence of universe: (collating and interpreting) and disseminating it to the eligible in the form of actionable intelligence.

II. Summary

Within a period of over 40 years the definition of AI has drifted very fast narrowing down its original scope: The original definition built on AI on mechanical devices (robots, Cameras, computers etc.). It then moved to simulating/imitating/mimicking original intelligence. It converted to machine process soon after. It was big change when it left the attire of machine and turned to Computer alone. The further narrowing down to a branch of Computer Science and now to Programming is not a real justice. It covers intelligence of only a part of the universe. The rudder needs to be corrected and the definition needs to be accepted as:

‘Artificial Intelligence is the mechanical simulation system of collecting knowledge and information and processing intelligence of universe: (collating and interpreting) and disseminating it to the eligible in the form of actionable intelligence.

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