Comparative Assessment of Human Intelligence and Artificial Intelligence

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Abstract— Artificial Intelligence has become a prominent area of interest for researchers from past few years. There has been lot of debates over the point whether machines should be given thinking and decision capabilities like human beings. Developing and imposing human mental features and phenomenon over robots and similar kinds of machines can prove to be a boon or a bane for the human beings. Besides these arguments, researchers continue to bring out interesting facts about the phenomenon of human brain functionality and keep proposing new approaches for developing artificial intelligence in machines as close to human intelligence as possible. Cognitive science has also emerged as an area of research in recent years to imitate human brain power by using the concepts and theories related to the fields of psychology, neuroscience, philosophy, computer science, artificial intelligence, humanities and linguistics. Human Alike intelligent computer systems (HAICS) having the best of machine intelligence and human intelligence abilities will give birth to a superior intelligence capability for which research is ongoing. This paper presents a comparative assessment of human intelligence versus artificial intelligence. The intent of the paper is to bring out the scope and benefits of using artificial intelligence over human intelligence and vice-versa.

Keywords— Artificial Intelligence, Robots, Human Intelligence, Cognitive Science, Super-intelligence, HAICS

I. INTRODUCTION

Ever since the advancements in technology, developments in the area of Artificial intelligence (AI) that is imbibing intelligence into machines. Humans have invented lot of smart devices like calculator, computer and robotic devices which intend to work same and even better than individuals in certain specific areas or for some specific tasks. However, this doesn't make machines intelligent than human beings. Intelligence is not just about mathematical calculations, countering moves in online games, storing and retrieving huge information in memory, speed of performing a task or behaving in a pre-defined way all the time. Intelligence is far beyond the things that we actually feel [1]. Intelligence can be defined as an expression of high mental activity involving learning, reasoning, understanding, memorizing, interacting, and experimenting with one's surrounding and finding solutions to real-time problems. Different fields of study like psychology, computer science, neurology and others may categorize intelligence into further different branches. However, every intelligent system whether natural or artificial has certain key features that accounts for the

intelligibility in it. The paper therefore figures out these significant features of human brain and machine exhibiting an intelligent behaviour and evaluating human and artificial intelligence on these features.

II. CHARACTERISTIC FEATURES OF INTELLIGENCE

Human brain processing power and capabilities are undoubtedly the best of all living things. However, computer scientists and researchers have been trying really hard to simulate the same functioning into machines, even with better computational and problem-solving capabilities. There are certain characteristic features on the basis of which we decide whether one individual is more or less intelligent than the other [2]. Several IQ (Intelligent Quotient) tests have been designed to assess the intelligence of people based on linguistics, logical reasoning, computational capabilities, creativity, lateral thinking, mental agility, technical aptitude and various other characteristics. Similarly Turing test [3], Captcha and various other challenge-response tests have been proposed over time to adjudge machine and human intelligence. In this section, different characteristic and distinctive features of intelligence as a whole have been discussed. On the basis of these distinguishing and inter-related features, further assessment of machine intelligence and human intelligence capabilities is done.

A. Numerical Computation ability-

The ability to solve mathematical problems using basic arithmetic operations (addition, subtraction, multiplication, division) and other quantitative methods (fraction, ratios, percentage etc.) is considered a vital feature of the intelligent system. The faster and more accurate one makes the numerical computations and solves mathematical equations and problems is assumed to be more intelligent than the one taking longer time or lacking accuracy.

B. Logical Reasoning-

Logical reasoning can be defined as a combination of three things- deductive reasoning, inductive reasoning and abductive reasoning. Deductive reasoning means determining the conclusion based on some premises (or pre-conditions) and a rule. Inductive reasoning is determining rule for the provided conclusion and premises. Abductive reasoning implies finding out premises from the conclusion and rules provided.

C. Linguistics/ Natural Language Processing [4]-

Linguistics is the study of natural language (which human beings use for communication) in the context of its form, its meaning and context. Sometimes same word can mean different in different contexts. Speech characteristics (sound, speed, stressing on word) can also help in determining the context of the language. Understanding the right form, meaning and context of language is considered one of the features of intelligence.

D. Auditory & Visual Processing [2]-

Auditory and Visual processing is the ability to interpret the audio information and visual information as received from outside world (through ears and eyes respectively). Psychologists believe that different believe exhibit different level of intelligence for audio and visual information. Some people can understand and remember information for longer time if they have heard it while others tend to forget it easily and remember the information that they see through pictures or videos for longer times.

E. Reaction time/speed-

As per Newton's third law, for every action there is an equal and opposite reaction. In real-time, we face lots of random situations that call for reactions from our side. All routine

activities like driving, playing, cooking, teaching etc. requires an alert mind. However, the timeliness of response is what is important. Hence, the capability of reacting appropriately and in minimal time, in any particular situation, can be assumed to be feature of brain intelligence.

F. Short-term and Long-term memory-

All the information that is received by human brain or a machine needs processing either immediately or may be later. Every type of information that we see, hear, feel, sense or perceive is stored in the memory for further establishing relationship with other objects, entities and situations that we face in future and helps in decision-making process. However, some kind of information is of lesser or no use in later cases. The characteristic ability of human brain or machine to decide which information to store in short-term memory and which in long-term memory is also a sign of intelligence.

G. Rational decision making[4]-

Rational decision making is the ability to take a decision which is derived from logics and is not influenced by any favouritism, self-interest or any biasing. Rational thinking process provides a simplified and efficient approach of problem solving or solution finding. Though, decisions taken by human beings are widely affected by their surroundings and other external factors. Such decisions results in irrational behaviour and inappropriate solutions.

H. Multi-issue Negotiation-

Negotiation is a dynamic process where two agents make their own bids evaluating their recent bid and the opponent's recent bid. Majorly two properties of the negotiations are important: those that concern the negotiators' performance in the negotiation, and those that concern the steps in their bidding behaviour [5]. Negotiation skills are indeed a sign of intelligence.

I. Creativity-

One of the interesting features of intelligence is creativity [2]. Creativity is the phenomenon of perceiving older things in new ways and producing new tangible and intangible solutions which are not influenced by a priori knowledge.

J. Multi-tasking-

Another interesting behaviour of intelligence is multi-tasking ability. It is the phenomenon of executing more than one task at the same time. This unique capability of processing multiple inputs from different systems and processing them differently and correctly at the same time is truly an intelligence trait.

K. Intuitive behaviour-

Intuition is an inexpressible aspect of human intelligence. There are certain situations where computations and logics fail. Intuition enables a decision to be taken in the confusing scenarios without even telling why and how that decision was attained [4]. Psychologists suggest that any decision taken with first intuition turns out to be a good decision.

L. Artistic ability-

Artistic ability is another interesting feature of intelligence which makes use of skills and imagination to create fine works of art such as painting, dancing, sculpting and music composing. Harold Cohen's [6] designed computer program, AARON, to create ART is a significant contributor of this capability for artificial intelligence.

M. Information retrieval speed and accuracy-

It is significant to retrieve stored memory information in breadth of relevancy and depth of accuracy within minimal time possible. This characteristic feature is critical to intelligence of a system.

N. Memory storage capacity-

Storage capacity of memory is another feature that attributes to intelligence. Large amount of information storage capacity along with faster retrieval capability makes an ultimate combination for intelligent systems.

O. Exception handling ability [4]-

The ability to deal with completely unimaginable and unforeseen problems in similar or different ways so as to express erroneous happening or to recover from a fatal situation, is termed as exception handling. It can be considered as a combination of creativity along with reasoning ability.

P. Autonomous thinking-

Psychologists have given proof through experiments that human brain is an autonomous [7] entity which does take input from external factors but the representation, computation and analysis of the stored information and acquired input is completely independent and diverse. Autonomous thinking enables multi-tasking ability and provides rational solutions.

Q. Experimental Learning-

It is the ability to learn from experimentation [8]. Experimental learning results in finding alternate ways of achieving a goal. It is another way of acquiring hidden information and knowledge for the intelligent ones.

R. Deliberational ability [8]-

It can be defined as the ability to discover and establish correlation between formerly unrelated concepts or things. It also implies deriving concepts from other concepts.

S. Emotional Quotient-

Emotional Quotient can be also be termed as emotional intelligence. Emotional quotient defines the ability of an individual to understand and relate to the emotional state of others, to differentiate between various feelings and to use emotional information for guiding thinking and making decisions [9].

III. FINDINGS OF COMPARATIVE ASSESSMENT

Based on the characteristic features of intelligence, as discussed in previous section, the comparative assessment of current intelligent machines and human beings is presented in the following table.

TABLE I
HUMAN INTELLIGENCE VS ARTIFICIAL INTELLIGENCE ASSESSMENT

Intelligence Feature	Assessment of features for human beings and machines		
	Human Intelligence	**Artificial Intelligence**	**Remarks**
Numerical Computation ability	Less	More	Computers/ machines perform mathematical computations faster because of more hardware processing power.
Logical Reasoning	High	Medium	Human beings find it easy to apply logics and establish correlation between concepts.

Linguistics/ Natural Language Processing	High	Low	Computers understand high level language or machine language but natural language processing seems difficult for them.
Auditory & Visual Processing	High	Medium	Human god gifted senses such as hearing, vision, smell, taste and locomotion outperforms machine intelligence.
Reaction time/speed	Variable	Stable	Under stress condition, sleepy and tired state human beings tend to show slow reactions than otherwise.
Short-term and Long-term memory decision	Unpredictable	Programmed	Human brain phenomenon of keeping information in short-term or long-term memory is still unidentified.
Rational decision making	Medium	High	Human decisions are mostly influenced by external factors.
Multi-issue negotiation	Better individual performance	Fairness in negotiation	Different experiments reveal different results
Creativity	High	Poor	Computers are programmed to behave in certain ways, making use of available information.
Multi-tasking	Medium	High	Better memory and processing power makes it easier for computer systems.
Intuitive behaviour	Yes	No	Interesting behaviour of human brain, not found in machines.
Artistic ability	Good	Poor	Computers lack creativity and thus artistic ability can't be much.
Information retrieval speed and accuracy	Low	High	Data retrieval speed of modern computers is approx.1000 times faster that human's ability [8]
Memory storage capacity	Medium	High	Computer memory storage is huge and can be further expanded.
Exception handling ability	Good	Poor	Machines can handle exceptions in case they have been coded earlier with the exception scenarios.
Autonomous thinking	Medium	High	Every process executes independently on computers.
Experimental Learning	Medium	Poor	Computers/ robots are unable to do generic experimentations.
Deliberational ability	High	Poor	Computers lack the ability of deriving or correlating concepts.
Emotional Quotient	High	Rare	Non-living things do not have emotions.

IV. CONCLUSIONS

Artificial intelligence, neural networks and newly emerged field of cognitive science is opening new horizon for decades of research focused on the study of human brain and understanding the phenomenon behind intelligence. We tend to believe that the current and upcoming generation of robots will be far more intelligent and organized than the human beings. However, the findings in the paper shows that artificial intelligence lags behind human intelligence on numerous features/ parameters that contribute to ultimate intelligence. It is also suggested that variation in the intelligence of similar age human beings is much more than machines of similar type. The unpredictable and hidden features of human brain, its working and intelligence will remain a matter of interest for researchers in the years to come.

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