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CORRELATION OF ARTIFICIAL INTELLIGENCE TECHNIQUES WITH SOFT COMPUTING IN VARIOUS AREAS

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Abstract: Artificial Intelligence (AI) is a part of computer science concerned with designing intelligent computer systems that exhibit the characteristics used to associate with intelligence in human behavior. Basically, it define as a field that study and design of intelligent agents. Traditional AI approach deals with cognitive and biological models that imitate and describe human information processing skills. This processing skills help to perceive and interact with their environment. But in modern era developers can build system that assemble superior information processing needs of government and industry by choosing from large areas of mature technologies. Soft Computing (SC) is an added area of AI. It focused on the design of intelligent systems that process uncertain, imprecise and incomplete information. It applied in real world problems frequently to offer more robust, tractable and less costly solutions than those obtained by more conventional mathematical techniques. This paper reviews correlation of artificial intelligence techniques with soft computing in various areas.

Keyword. Artificial intelligence; Soft computing; Correlation; Engineering and science.

INTRODUCTION

Artificial Intelligence (AI) [1], [2] is intelligence exhibited by machines. It is a human-like intelligent models for decision making. It perceives its own environment and takes actions that maximize its chance of success at some goal. According to the father of AI, John McCarthy, it is the science and engineering of making intelligent machines, especially intelligent computer programs. It is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. The most important element of AI is an agent that perceives its environment and takes actions to maximize its chances of success and reduce the complexity of system. It helps to solve real world problems by coping uncertainty of reasoning into incomplete knowledge to make strong analytical and planning systems. During solving the problem its deals with several phases such as planning, learning, perception and ability to move and manipulate target entity. Whereas Soft Computing (SC) [3], [4] is a sub-discipline of AI. It is used in unpredictable situation where uncertainties related to information is more. It is tolerant of imprecision, uncertainty, partial truth, and approximation. Correlation of AI techniques with SC is a broad class of statistical relationships that involves dependency though in common usage of constituent elements of AI with SC techniques.

MOTIVATION

Several surveys have been illustrated in last few decades. Each survey deal with either AI or SC, no proposal deals with combination of AI techniques with SC. This paper discussed both applications AI as well as SC.

CONTRIBUTIONS

In this survey paper, we illustrates the application of AI and SC in science and engineering. The key contributions of this paper are as follows:

- It gives general concept of AI.
- It also gives basic idea of SC.
- It describes relation between AI and SC.
- It illustrates several problem domains where techniques of AI and SC are used.

ORGANIZATION OF THE PAPER

The remainder of this paper is organized as follows. In Section 2, illustrates working principle of AI. Section 3 provides correlation of AI with SC technique. Mathematical modelling for correlation of AI techniques with SC

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given in Section 4. Several AI techniques with SC in various areas shown in Section 5. Finally, conclusion and directions for future scope are outlined in Section 6.

WORKING PRINCIPLE OF AI

Computers making decisions in real-world problems by the helps of AI. It has an intelligent behaviour with perception. We perceive the world around us by the helps of five basic senses shown in Fig. 1. But in AI first three are the main elements. When we perceive some signal may be sound or light then we properly respond that signal. To generate proper response we must categorize or analyse that signal. Machine do same as human by applying and formulating design information with human intelligence and finally solve the real world problem. This process illustrates in Fig. 2.

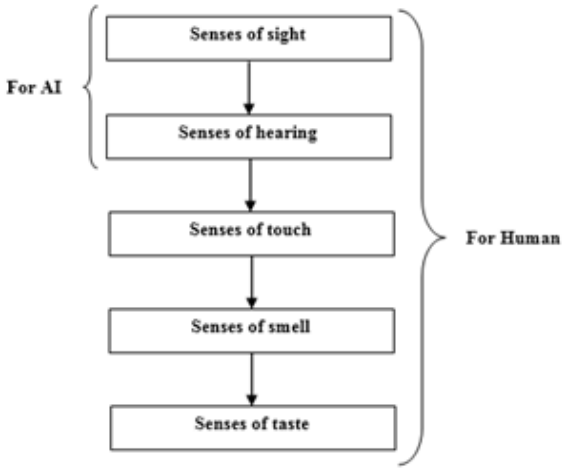

Figure 1. Relation of different senses of human and AI.

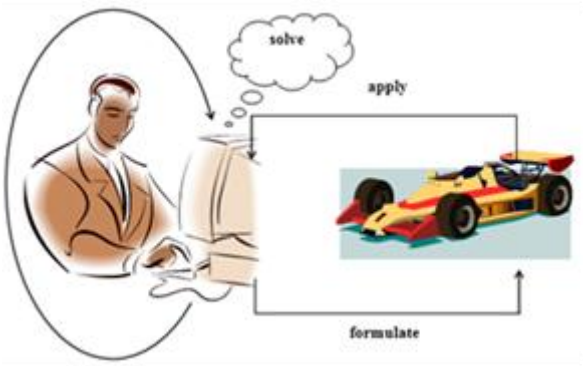

Figure 2. How AI relates with human intelligence.

CORRELATION OF AI TECHNIQUES WITH SC TECHNIQUE

Correlation of AI with SC become a tool that has strong ability to deal any real world problem efficiently. A major thrust of this correlation in industrial and engineering applications that it associated with computer function with human intelligence, such as reasoning, learning, and problem solving. In modern era, it become most growing part of our societies. It's rapidly growing areas which illustrates in Fig. 3. The application areas of AI increases day by day. In Fig. 3 the dotted line indicates that its area expanded in future also.

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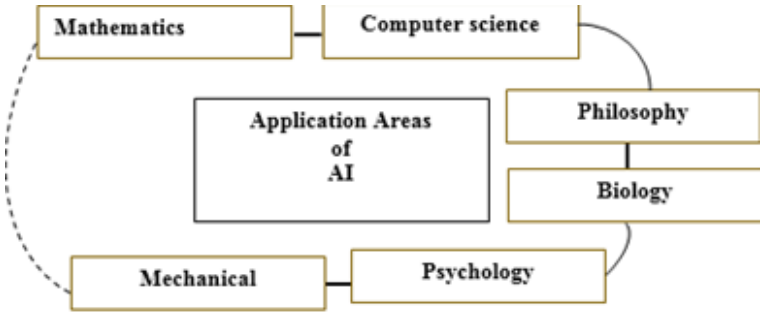

Figure 3. Growing application areas of AI.

MATHEMATICAL MODELLING FOR CORRELATION OF AI TECHNIQUES WITH SC

Mathematical model for correlation of AI techniques with SC is illustrated in Fig. 4. Description of this model is given below.

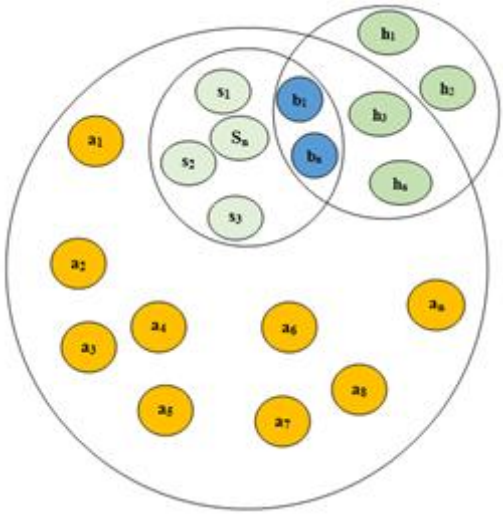

Figure 4. Mathematical modelling of correlation of AI with SC.

Let AIT, SCT, HCT and HBT are different sets for Artificial Intelligence Techniques, Soft Computing Techniques, Hard Computing Techniques and Hybrid Computing Techniques. All sets and its correlation are given in Eq. 1 to Eq. 4.

$AIT = \{a_1, a_2, a_3, \ldots\ldots\ldots, a_n\}$ (1)

$SCT = \{s_1, s_2, s_3, \ldots\ldots\ldots, s_n\}$ (2)

$HCT = \{h_1, h_2, h_3, \ldots\ldots\ldots, h_n\}$ (3)

$HBT = \{b_1, b_2, b_3, \ldots\ldots\ldots, b_n\}$ (4)

Relation among four sets are given as Eq. 5 to Eq. 8.

$SCT \subseteq AIT$ (5)

$HBT \subseteq HCT$ (6)

$HBT \subseteq SCT$ (7)

$HBT \subseteq HCT \cap SCT$ (8)

The above correlation highlight that area of HBT increases based on new domain problems. Hence, area of SCT and AIT.

SEVERAL AI TECHNIQUES WITH SC IN VARIOUS AREAS

The correlation of AI techniques with SC components helps to solve the complex problems in more human like fashion and in relatively very less time than a human takes. This technique are increases rapidly in numerous

areas such as Agriculture, Civil engineering, Computer engineering, Industrial automation and manufacturing, Management and finance, Medical computing, Robotics, Short term load forecasting, Transportation, Water resource management, Material science, Fault diagnosis, Signal processing etc. Some constituent techniques are defined below.

EXPERT SYSTEM

Expert system is also known as decision maker. It is computer program that attempts to act like a human expert on a particular subject area to solve particular unpredictable problem. Sometime it is often used to advise non-experts in situations where a human expert in unavailable. The core elements of decision maker are knowledge based system and inference engine. It is used in various purpose given in Table 1.

Table 1: Some problem domain of expert system.

Sl. no.	Problem domain	Ref.
1	Detecting nearly dangerous situations	[5]
2	Enhance data interpretation	[6]
3	Multistage optimization	[7]
4	Bone age determination	[8]

NATURAL LANGUAGE PROCESSING

Natural Language Processing (NLP) is a process to interpret natural language spoken by humans into computer. It is a very active and rapidly evolving area of AI that deals with the comprehension and analysis of human-produced texts by computers. It enables machines to derive meaning from human language input. It is used in various purpose given in Table 2.

Table 2: Some problem domain of natural language processing.

Sl. no.	Problem domain	Ref.
1	Automated content analysis for construction safety	[9]
2	Text mining	[10]
3	Automated coding of motivational interviewing	[11]
4	Big data streaming	[12]

FUZZY LOGIC

Fuzzy logic [13 is a multi-value logic which deal with partial true and false. In modern era, it become mathematical discipline to express human reasoning in rigorous mathematical notation. It allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, small/big, short/long etc. [14], [15]. Notions like rather long or very long, small or very small can be mathematically formulated and processed. It provides a simple way to arrive at definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information. It is used in various purpose given in Table 3.

Table 3: Some problem domain of fuzzy logic.

Sl. no.	Problem domain	Ref.
1	Intelligent routing in wireless ad-hoc network	[16]
2	Multipath routing in ad-hoc network	[17]
3	Multicast routing in ad-hoc network	[18]
4	Power consumption scheme in wireless sensor network	[19], [20]

EXTENDED FUZZY SET

Extended fuzzy set is also known as vague set or intuitionistic fuzzy set. Fuzzy set deals with point based membership function between true and false, but extended fuzzy set deals with interval based membership function by the help of three membership functions such as true, false and hesitation. Interval based membership function is more expressive to capture vagueness of data. It is used in various purpose given in Table 4.

Table 4: Some problem domain of extended fuzzy set.

Sl. no.	Problem domain	Ref.
1	Energy efficient routing in mobile ad-hoc network	[21], [22]
2	Medical diagnosis	[23]
3	Plant location selectio	[24]

4	Image steganography	[25]

COMPUTATIONAL INTELLIGENCE

Computational intelligence is used to make a machine intelligent that it behave like human. It has strong ability to solve complex problem in a minimum time. In modern era, it uses in various sector of life such as E-commerce [26] and Science and engineering fields. It is used in various purpose given in Table 5.

Table 5: Some problem domain of computational intelligence.

Sl. no.	Problem domain	Ref.
1	E-commerce	[27]
2	Ontology-based data integration	[28]
3	Marketing retention strategies	[29]
4	XML-related attacks in e-commerce	[30]

INTELLIGENT MATHEMATICAL MODELING

Models defines our beliefs about how the world functions. In mathematical modelling [31], we converts these beliefs into term of mathematics. Intelligent mathematical modelling indicate model some problem in term of mathematics that has ability like human intelligence. It is used in various purpose given in Table 6.

Table 6: Some problem domain of intelligent mathematical modelling.

Sl. no.	Problem domain	Ref.
1	Agent based modelling	[32]
2	Woven fabric engineering	[33]
3	Modelling of elastic robotic arm	[34]
4	Workload modelling in cloud computing	[35]

MACHINE LEARNING

Machine learning indicates to the changes in systems that perform tasks associated with artificial intelligence technique. It learn any problem by the helps of some phases then convert into a model which helps to solve the specific problem. It is used in various purpose given in Table 7.

Table 7: Some problem domain of machine learning.

Sl. no.	Problem domain	Ref.
1	Medical images analysis	[36]
2	Detection of malicious office documents	[37]
3	Demand estimation	[38]
4	Time series analytics	[39]

GENETIC ALGORITHM

Genetic algorithm is a heuristic search and optimization technique that imitate the process of natural evolution. It simulating evolution of species by the helps of natural selection and select best element and discard the rest part. It is used in various purpose given in Table 8.

Table 8: Some problem domain of genetic algorithm.

Sl. no.	Problem domain	Ref.
1	Human action recognition	[40]
2	Multi-station time-sharing	[41]
3	Image defogging	[42]
4	Collaborative filtering problem	[43]

ARTIFICIAL NEURAL NETWORK

Artificial neural network is a collection of simple processing units which communicate by sending signals to each other over a large number of weighted connections network based on biological neurons. It is used in various purpose given in Table 9.

Table 9: Some problem domain of artificial neural network.

Sl. no.	Problem domain	Ref.

1	Nonlinear convex programs	[44]
2	Sparse signal reconstruction	[45]
3	Short-term load forecasting	[46]
4	Condition monitoring of planetary gearbox	[47]

OPTIMIZATION

Optimization is the act of obtaining the best result under given circumstances. It can be defined as the process of finding the conditions that give the maximum or minimum of a function. It is used in various purpose given in Table 10.

Table 10: Some problem domain of optimization.

Sl. no.	Problem domain	Ref.
1	HCV treatment	[48]
2	Teaching Learning	[49]
3	Geotechnical foundations in granular soil	[50]
4	Digital holographic setup	[51]
5	Unicast and Multicast	[52], [53]

CONCLUSION AND FUTURE SCOPE

Artificial intelligence is broad area and soft computing is a sub area of AI. Soft computing deals with uncertainty, approximation, imprecision and partial truth. Artificial intelligence deals with intelligence features including interference parameters. In last few decades, application of both increases rapidly. Because, in real world problem has uncertainties related to information where human intelligence is fails, and it perceives by machine with helps of several components of artificial intelligence and soft computing. They are both correlates to each and other. Future scope include, to select any real life-world problem and solve it with combination of both artificial intelligence and soft computing.

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