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RESEARCH ARTICLE

CONVERGENCE OF, INTELLIGENCE IN HUMAN, USING NEURAL NETWORK AND ARTIFICIAL INTELLIGENCE

***,1Prof. Amar Nath Singh and 2Er. Deepak Gantayat**

1Department of Computer Science, Gandhi Institute of Education and Technology, Bhubaneswar
2Jain School of Engineering and Technology, Jain University, Bangalore, India

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ABSTRACT

This paper presents a new perspective of Artificial Intelligence (AI). Although, number of attempts has been made to make an artifact intelligent, including evolution theory, neural network etc and a number of problems have been solved using these concepts but each of this theory covers only some aspect of human intelligence. Still there is a large gap between artificial intelligence agent and human being. In this paper I have discuss the extended version of Artificial Intelligence by augmenting it with emotions, and inheritance of neural architecture from parent generation to child generation that can make an artificial agent to match the intelligence and behaviour of a human being. At the same time it adds the power of two well knows Artificial Intelligence techniques viz. Neural Computing and Genetic Computing or Evolutionary Computing. The paper gives an idea of an artefact which is supposed to match the intelligence and behaviour of a human being. Paper also discusses some natural phenomenon and how they can be confirmed by the revised definition of artificial intelligence. The paper does not claim that existing definition of artificial intelligence has some faults. The paper just augments the existing definition by some other features that can make it more close to natural intelligence. The features augmented are naturally inspired similarly as AI, Neural Network and genetics all are naturally inspired.

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INTRODUCTION

Artificial Intelligence (AI)

Although, artificial intelligence is a very general term but defining it precisely is very difficult. And the design of an artificially intelligent agent totally depends on the fact how we define the term ‗Artificial Intelligence'. Possibly, the right definition can lead us to develop a successful intelligent artifact. There are a number of definitions to define artificial intelligence. As discussed in (StartRussel and Peter Norvig 3rd edition) the successful definitions are along two dimensions: firstly, whether it is with respect to reasoning (thought) or behavior (action) and secondly, whether it is with respect to human or ideal (i.e. rational) as shown in the fig-1. If we consider the category-1 or category-3 definition of AI then we try to develop an artifact that can think like and can act like human being respectively. Further, if we consider category-2 or category-4 definition of AI then we try to develop an artifact that thinks or acts optimally respectively. Even development of optimal agents (based on definition from category-2 and category-4) could be really useful for solving problems and Category-4 definition (i.e. Acting Rationally) is the standard and modern definition of artificial agent (SturtRussel and Peter Norvig 3rd edition). Definitions given by Haugeland (1985) and Bellman (1978) belongs to the first category. Definitions given by Charniak (1985) and Winston (1992) falls under second category. Definitions given by Kurzweil (1990) and Rich and Knight (1991) belongs to third category. Finally, definitions given by Poole et al. (1998) and Nilsson (1987) give support to forth category. Brief discussion of all these definition is covered in (SturtRussel and Peter Norvig 3rd edition). A lot of research work has been done among all the dimensions depending upon the need. As a result we have different model of artificial agent following the definitions from different category. In this paper, we would be considering definitions from category 1 and 3 only, means we will be defining the intelligence in terms of human only. The motivation behind this is that rational agent is supposed to take rational decision but human is not expected to do so. And here the main objective is to design and develop an artefact that can match thinking and acting process of a human being. So, first obvious thing is that what is the factor that differentiate between human being and a rational agent. And second thing is—is that factor plays any important role? So the first question is before us: What are the

****Corresponding author:*** **Prof. Amar Nath Singh,**
Department of Computer Science, Gandhi Institute of Education and Technology, Bhubaneswar

factors that blocks the human from taking rational decision? Discovering these factors and incorporating these in design of intelligent artifact can solve some of the problems, which we are encountering in AI, immediately. We will discuss in Section-III that Emotion is a one of the factor because of which human is far from rational agent. If we somehow can incorporate emotions in artificial intelligent agent then it can be expected to be more close to human being. Till now emotions are consider to be an auxiliary feature of agent that can make it more realistic (natural) and that‘s all. But in this paper we would be discussing that emotions must be consider as one of the important aspect of agent as it is related with intelligence. So, the first big theme of this paper is “Emotions and Intelligence are co-related phenomenon. And hence emotions must be taken into consideration for designing true intelligent agent.” The second big issue addressed in this paper is related with transferring of intelligence from one generation to next child generation. Here we consider intelligence as problem solving capability. We generally experience in nature that child inherits some of the problem solving capability of its parent. Now the issue is how to incorporate the same in artificial agent. Till now this is done by something called genes transfer (after mutation etc) as genetic computing is based on. But is this enough, is the scenario is really so easy? Ok, we can solve optimization problem using this assumption, but, Can we can accomplish agent development using this strategy? I think not.

Category-1 Thinking Humanly	Category-2 Thinking Rationally
Category-3 Acting Humanly	Category-1 Acting Rationally

Fig.1. Four perspective of Artificial Intelligence

Suppose we are given two agents and are supposed to develop a new agent to be the child of these agents. Then can we use the genetic computing based approach (i.e. genes transfer) to develop new agent matching the intelligence of parent agents. Obviously not, because genes have nothing to do with intelligence, actually they are just a means to transfer intelligence from one generation to other and intelligence is realized by something else. Indeed neural network (brain architecture) is the main parts of an agent (and human too) that governs the problem solving power i.e. intelligence of an agent (or human). So in order to match the intelligence of an agent to its parent its neural architecture must be similarly to its parent (entire architecture need not to be similar as discussed in later Section). So the second big theme of the paper is “An agent should inherit its parent’s neural architecture as a result of crossover (reproduction) to match the intelligence of its parent.” Section-II gives a brief introduction of some of the concerned computing techniques (biologically inspired computing techniques). Section-III refines first issue as discussed above. In section-IV the second issue is addressed. Section-V further explores the section-IV.

Biologically inspired soft computing domains

Soft Computing

The idea of Soft Computing was initiated in 1981 and was first discussed in (Zadeh, Lotfi 1999) by Dr. Zadeh 1997. DrZadeh defined Soft Computing in its latest incarnation as the combination of the fields of Fuzzy Logic, Neuro-computing, Evolutionary and Genetic Computing, and Probabilistic Computing into one multidisciplinary system. The main goal of Soft Computing is to develop intelligent machines and to solve nonlinear and mathematically un-modeled system problems (Zadeh, Lotfi 1993). Out of these main five fields Neuro-computing, Evolutionary Computing and Genetic Computing are biologically inspired fields (i.e. they are developed on the basis of some biological phenomenon). Following paragraphs give a brief introduction of each field one by one. Neuro-Computing or Neural Networks As per discussion in (Aleksander et al., 1990) and (Anderson and Rosenfeld, 1988) by Morton, ―Neural computing is the study of networks of adaptable nodes which, through a process of learning from task examples, store experiential knowledge and make it available for use‖. ANNs (Artificial Neural Networks) were actually realized in the 1940s. Warren McCulloch and Walter Pitts designed the first ANNs (McCulloch et al., 1943). The first learning rule for ANNs was designed by Donald Hebb in McGill University (Hebb, Donald 1949). Back-Propagation, Hopfield Nets, Neocognitron, and Boltzmann Machine were the most remarkable developments of that era (Fausett, Laurene 1994).

Artificial Neural Network (ANN)

ANN is a computational structure designed to mimic biological neural networks. It consists of computational units called neurons, which are connected by means of weighted interconnections. The weight of an interconnection is a number that expresses the strength of the associated interconnection. The main characteristic of ANNs is their ability to learn. The learning process is achieved by adjusting the weights of the interconnections according to some applied learning algorithms. Therefore, the basic attributes of ANNs can be classified into Architectural attributes and Neurodynamic attributes. The architectural attributes define the network structure, i.e., number and topology of neurons and their interconnectivity. The neurodynamc attributes define the functionality of the ANN. But, despite of successful implementation of ANN in solving various problems, if we consider it from the perspective of artificial intelligence it lacks one very important aspect of human brain. The aspect is, after finishing the learning a neural network gives the same output to same input without referencing the current context unlike human brain that takes decision according to the problem as well as according to the context (here context means emotional state) the problem arose in. If we talk about human brain, it takes the decision depending upon the current conditions (sensed by five senses), experience and state of mind (something related with emotions). While, if we talk about ANN, it takes decision on the basis of current conditions (as in human brain) and training quality (somewhat similar to experience) only. It does not take emotions into consideration while taking a decision. Think about a human being without emotions.Now following are some question that will help us to realize the importance of Emotions in an intelligent agent: Is there any relation between intelligence and emotion? Is there any relation between decision taken by human and emotional state of the human at that time? These are some questions that we would be addressing in this paper.

Evolutionary Computing and Genetic Computing

In nature, evolution is mostly determined by natural selection or different individuals competing for resources in the environment. Those individuals that are better are more likely to survive and propagate their genetic material. The encoding for genetic information (genome) is done in a way that admits asexual reproduction, which results in offspring that are genetically identical to the parent. Sexual reproduction allows some exchange and reordering of chromosomes, producing offspring that contain a combination of information from each parent. This is the recombination operation, which is often referred to as crossover because of the way strands of chromosomes cross over during the exchange. The diversity in the population is achieved by mutation operation. Usually found grouped under the term evolutionary computation or evolutionary algorithms (Fausett, Laurene 1994), are the domains of genetic algorithms (GA) (Holland, John 1995), evolution strategies (Rechenberg, 1965; Schwefel, 1965), evolutionary programming (Fogel, 1995), and genetic programming (Koza, 1992). These all share a common conceptual base of simulating the evolution of individual structures via processes of selection, recombination, and mutation reproduction, thereby producing better solutions. This cycle is shown in figure 2.

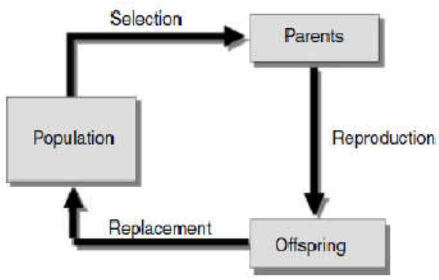

Fig.2. Flow Chart of Evolutionary Algorithms

Now, Let we see the genetic computing from the perspective of artificial intelligent agent. The main key concept behind evolutionary algorithm is that the next-generation exhibits the intelligence or quality (capability to solve problem) better than parent or at least equal to parent generation. If it is not then it has got less probability for surviving. Now, question is what makes a human capable to solve problems? Obvious answer is brain (i.e. Neural network). So if we say that child exhibits its parent's problem solving capability then (possibly) it is because it has got neural-architecture somewhat similar to its parent. Although medical science has proven that the genes of child match with those of parent but it does not say that this is the only similarity between parent and child. I argue that like genes, each child inherits neural-network from its parent (especially in case of artificial agents). Genes is the way through which the process of inheritance is possible but the actual reason behind the fact that new generation is expected to have some inherent problem solving capability from birth is due to Inheritance of neural-architecture (brain architecture) from parent generation. We will give more stress over this in Section-IV.

Artificial intelligence and emotions

In this section the main emphasis will be given on- Should we give emphasis on creating emotional effect in artifacts to make them behave intelligently like human being? Even a number of attempts has been made to design an intelligent artifact and some have been developed but with very limited functionally. They are generally used where complex computation, problem solving capability, formal decision taking is required. But, they can not be matched with human; even the way of solving problem is not as same as followed by human. Moreover, very few attempts have been made to develop a emotionally intelligent artifact. Now the question is: Are emotions play any role in human decision taking? The answer can easily be answered by natural phenomenon. A person feeling pain can't solve a problem as fast as a physically fit person. We can't solve a problem easily while we are either physically not feeling good or surroundings are not comfortable i.e. we are not emotionally fit e.g. a person cannot solve a problem easily when some bad-happening happens with him (or with someone close to him). The moral of this discussion is ―(possibly) emotions are connected with a person's problem solving capability.‖ Now the second question arises- Is there any relation between intelligence and emotion? There is a very common saying that IQ(Intelligent Quotient) depends upon EQ (Emotional Quotient) i.e. someone emotionally fit is expected to be more intelligent (more efficient at taking decision and actions) than the one not fit emotionally. This fact can also be demonstrated by natural phenomenon like discussed above. So, after this discussion I would like to argue that, “(possibly) in order to develop really intelligent artifact like human, emotions should be considered as non-avoidable specification (i.e. we must take into consideration the emotions associated with artifacts).” The moral of this discussion is ―(possibly) emotions are connected with a person's problem solving capability.‖ Now the second question arises- Is there any relation between intelligence and emotion? There is a very common saying that IQ(Intelligent Quotient) depends upon EQ (Emotional Quotient) i.e. someone emotionally fit is expected to be more intelligent (more efficient at taking decision and actions) than the one not fit emotionally. This fact can also be demonstrated by natural phenomenon like discussed above. So, after this discussion I would like to argue that, “(possibly) in order to develop really intelligent artifact like human, emotions should be considered as non-avoidable specification (i.e. we must take into consideration the emotions associated with artifacts).”

Inheritance of neural network

After discussing about the importance of emotions for designing intelligent agent in Section-III, in this Section we would see that instead of inheriting only genes if neural network is also inherited from parent generation to child generation then it can immediately solve some of the problems. Although, medical science has found a number of diseases that a child inherits from its parent due to genes. But, as far as I know medical science has not discovered any genes responsible for transferring intelligence of one generation to another. We can see the fitness of the argument that child inherits its parent neural architecture by considering some natural phenomenon. Generally, if parent generation is intelligent, good at solving problem etc then the child generation also exhibits somewhat similar properties. But, some time it does not happen---Even the genes of child match with parent. Why so? The question can easily we answered by considering the theory that child inherits its parent's neural-architecture. If child does not exhibit parent intelligence then it is because it has not inherited the neural architecture properly (although it has inherited the genes). So the moral of the discussion is, instead of giving emphasis on only inheriting the parent's genes as in Evolutionary Computing the emphasis should be given on inheriting the neural-architecture too. This could solve a number of problem and limitations we are facing with evolutionary computing, especially when applying these to design intelligent systems i.e. artificial agents (of course, optimization problems can be solved just by considering inheritance of genes only).

Do we need to inherit entire the neural architecture from parent to child

Now, if we assume that child must inherit its parent‘s neural architecture to match the intelligence of previous generation. But still, the fact is child is rarely as intelligence as parent. Child is more intelligence than parent in only some of the quality (that makes it fit for survival). But generally parent always found to be having more wide range of intelligence than child. So, if we copy the entire neural architecture than child will become intelligent exactly like parent which does not happen in nature. Further it would incur more cost as copying the entire neural architecture is not so easy. Therefore, in order to take into account all these facts we should divide the neural architecture of an agent into two parts: 1. Inheritable Neural Architecture 2. Non-Inheritable Neural Architecture Inheritable Neural Architecture is that part of neural architecture in an agent that is copied (after some mutation) into child during crossover. While, Non-Inheritable Neural Architecture is that part which is not copied to next generation and remains local to that generation only. In this paper I tried to present a new view of artificial intelligence from scratch. No doubt, the tradition view (rational agent approach) that we are following from very long time is also successful up to some extent, but it lacks the feel of actual intelligence. In this paper the main emphasis is given on two things. Firstly, emotions must be takes into account while developing an intelligent agent. Secondly, instead of inheriting only genes as a result of crossover as in Evolution Computing, we should inherit some part of neural architecture of the parent generation for applying evolutionary computing on artificial agents. At the core, this paper extends the concept of intelligence by augmenting it with emotions and extends the concept of Evolution Computing by augmenting it with neural-inheritance.

Conclusion

Finally, although there is no formal proof of the concept I have introduced in this paper, I have realized them by explaining some natural phenomenon. And since, these are nature inspired computing they must be able to confirm maximum possible natural phenomenon.

RESULTS AND FUTURE

There is no as such result to discuss here except that newly introduced concepts discussed in this paper make the artificial agent more close to natural agent with respect to intelligence. In this paper we discuss these concepts only by theoretical discussion without giving any architecture for agent or anything that can be used directly in designing the agent. In the near future I or some other one might be developing some agent architecture based on these specifications.

About the author

Prof. Amar Nath Singh, is a Reader in the department of Computer Science and Engineering, GEC, Bhubaneswar, Odisha. He received his master degree in the year of 2007 form BPUT, Rourkela, Odisha, India. He is perusing his PhD in the field of Mines area. His research are includes Underground Mines, Artificial Intelligence, Wireless Sensor Network and Expert system, Fuzzy Logic Network, HCL, Algorithm, Web logic, etc.

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