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INTELLIGENCE WITHOUT REASON

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ABSTRACT: - Computers and Thought are the two categories that together define Artificial Intelligence as a discipline. In this paper we also make the converse claim; that the state of computer architecture has been a strong influence on our models of thought. Intelligence in biological systems is completely different. Recent work in behavior based Artificial Intelligence has produced new models of intelligence that are much closer in spirit to biological systems. An extensive collection of literature covering applications of fuzzy logic, expert systems, neural networks, and genetic algorithms in power quality is included.

KEY WORDS: - Fuzzy logic, expert systems, power quality, situatedness, embodiment, emergence, cybernetics, knowledge, parallelism, neuroscience, ethology, psychology, problem-solving agents.

ARTIFICIAL INTELLIGENCE

A broad definition of AI can be the automation of activities that are associated with human thinking, such as decision making, problem solving, learning, perception, and reasoning. There is a temptation to then go ahead and define intelligence, but that does not immediately give a clearly grounded meaning to the field. The AI tools of interest to the electric power community include fuzzy logic (FL), adaptive fuzzy logic (AFL), expert systems (ESs), artificial neural networks (ANNs), and genetic algorithms (GAs). Expert systems are an attempt to emulate the human thought process through knowledge representation and inference mechanisms. Within a bound domain of knowledge, ESs are capable of decision making on a level comparable in quality to human experts.

FL is a more powerful variation of crisp logic, where knowledge representation is more closely related to the way humans think. FL possesses the strong inference capabilities of expert systems as well as the power of natural (linguistic) knowledge representation. FL has been successfully implemented in control applications where system models do not exist or where the models are mathematically complex and computationally intense. AFL is a fuzzy-logic-based paradigm that grasps the learning abilities of ANN or the optimization capabilities of GAs to enhance the intelligent system's performance using a priori knowledge. ANNs mimic the neural brain structure of humans. This structure consists of simple arithmetic units connected in a highly complex layer architecture. ANNs are capable of representing complex (nonlinear) functions, and they learn these functions through example. GAs use the techniques of human genetic evolution to generate optimal solutions. GAs may be considered as a multidimensional optimization technique based on a genetically random search engine.

Category-1 Thinking Humanly	Category-2 Thinking Rationally
Category-3 Acting Humanly	Category- 4 Acting Rationally

Fig.1 Four perspective of Artificial Intelligence

APPROACHES:-Traditional Artificial Intelligence has tried to tackle the problem of building artificially intelligent systems from the top down. It tackled intelligence through the notions of thought and reason. The field has adopted a certain modus operandi over the years, which includes a particular set of conventions on how the inputs and outputs to thought and reasoning are to be handled, and the sorts of things that thought and reasoning do. Recently there has been a movement to study intelligence from the bottom up, concentrating on physical systems (e.g., mobile robots), situated in the world, autonomously carrying out tasks of various sorts. In fact it suggests that despite our best introspections, traditional Artificial Intelligence offers solutions to intelligence which bear almost no resemblance at all to how biological systems work.

OUTLINE: - The body of this paper is formed by five main sections: The theme of the paper is how computers and thought have be intimately intertwined in the development of Artificial Intelligence, how those connections may have led the field astray, how biological examples of intelligence are quite different from the models used by Artificial Intelligence, and how recent new approaches point to another path for both computers and thought. The field of Cybernetics with a heritage of very different tools from the early digital computer provides an interesting counterpoint, conforming the hypothesis that models of thought are intimately tied to the available models of computation. Ideas - introduces the two cornerstones to the new approach to Artificial Intelligence, situatedness and embodiment, and discusses both intelligence and emergence in these contexts. Thought - approach shares much more heritage with biological systems than with what is usually called Artificial Intelligence.

POWER QUALITY (PQ):- has been a research area of exponentially increasing interest particularly in the past decade. The proper diagnosis of PQ problems requires a high level of engineering expertise. Areas of electric power where the use of AI has been researched include: alarm processing, systems diagnosis, protection, system security, system restoration, system control, operational aid devices, generation scheduling, power system planning, power system stability, power system analysis, load forecasting, and fault diagnosis and location. Power electronics and motion control are another area where expert systems, fuzzy logic, and neural networks have been applied.

FL APPLICATIONS: - FL and AFL are emerging as very powerful AI techniques. Some applications of fuzzy logic in PQ have been developed in the literature. Such applications include

- *diagnosing PQ problems.*
- *Managing data and data mining.*
- *educating utility personnel and customers.*
- *classifying PQ disturbances.*
- *Adaptive metering of power, rms voltage, and rms current.*
- *estimating power quality indices using fuzzy constraints.*
- *locating sources of disturbances in power systems.*
- *automating the identification of abnormal system operation using adaptive fuzzy techniques.*
- *predicting system abnormal operation.*

EXPERT SYSTEMS APPLICATIONS:-Although expert systems are expensive and time consuming in their development, some research involving the application of expert systems in PQ has been documented. Such applications include

- *analyzing harmonics using expert system technology.*
- *developing procedures for PQ problem solving in an expert system framework.*
- *measuring and analyzing electromagnetic compatibility.*
- *automating fault analysis and fault location.*
- *identifying PQ events through a scalable system.*
- *managing PQ data.*
- *educating personnel involved with power quality.*

NEURAL NETWORKS APPLICATIONS:-ANNs are among the oldest AI techniques; they have been around the power research arena for quite some time. Neural networks have been applied extensively in PQ. Main applications include

- *identifying PQ events from nonpower quality ones.*
- *modelling the patterns of harmonic production from individual fluorescent lighting systems.*
- *estimating harmonic distortions and PQ in power networks.*
- *identifying high-impedance fault, fault-like load, and normal load current patterns.*
- *analysing harmonic distortion while avoiding the effects of noise and sub harmonics. 'behaviour- based robots'.*

There are a number of key aspects characterizing this style of work.
- [*Situatedness*] The robots are situated in the world they do not deal with abstract descriptions, but with the here and now of the world directly influencing the behaviour of the system.
- [*Embodiment*] The robots have bodies and experience the world directly their actions are part of a dynamic with the world and have immediate feedback on their own sensations.
- [*Intelligence*] They are observed to be intelligent but the source of intelligence is not limited to just the computational engine. It also comes from the situation in the world, the signal transformations within the sensors, and the physical coupling of the robot with the world.
- [*Emergence*] The intelligence of the system emerges from the system's interactions with the world and from sometimes indirect interactions between its components it is sometimes hard to point to one event or place within the system and say that is why some external action was manifested.

Prehistory:- During the early 1940's even while the second world war was being waged, and the first electronic computers were being built for cryptanalysis and trajectory calculations, the idea of using computers to carry out intelligent activities was already on people's minds. Alan Turing, already famous for his work on computability had discussions with Donald Michie, as early as 1943, and others less known to the modern Artificial Intelligence world as early as 1941, about using a computer to play chess. He and others developed the idea of minimizing a tree of moves, and of static evaluation, and carried out elaborate hand simulations against human opponents. In a paper titled Intelligent Machinery, written in 1948, but not published until long after his death, Turing outlined a more general view of making computers intelligent. Turing argued that it must be possible to build a thinking machine since it was possible to build imitations of "any small part of a man". He made the distinction between producing accurate electrical models of nerves, and replacing them computationally with the available technology of vacuum tube circuits, and the assumption that the nervous system can be modelled as a computational system. Turing concludes that the best domains in which to explore the mechanization of thought are various games, and cryptanalysis, "in that they require little contact with the outside world". Although Turing had conceived of using chess as a vehicle for studying human thought processes, this notion has largely gotten lost along the way (there are of course exceptions, e.g., Wilkins describes a system which substitutes chess knowledge for search in the middle game usually there are very few static evaluations, and tree search is mainly to confirm or deny the existence of a mate).

Cybernetics: - There was, another discipline which could be viewed as having the same goals as we have identified for Artificial Intelligence-the construction of useful intelligent systems and the understanding of human intelligence. This work, known as Cybernetics, had a fundamentally different flavour from the today's traditional Artificial Intelligence. It is the study of the mathematics of machines, not in terms of the functional components of a machine and how they are connected, and not in terms of what an individual machine can do here and now, and but rather in terms of all the possible behaviours that an individual machine can produce. The tools of analysis were often differential or integral equations, and these tools inherently limited cybernetics to situations where the boundary conditions were not changing rapidly. In contrast, they often do so in a system situated in a dynamically changing world-that complexity needs to go somewhere; either into discontinuous models or changed boundary conditions. Much of the work in Cybernetics really was aimed at understanding animals and intelligence. Animals were modelled as machines, and from those models, it was hoped to glean how the animals changed their behaviour through learning, and how that lead to better adaptation to the environment for the whole organism.

Knowledge: - By this point in the history of Artificial Intelligence, the trends, assumptions, and approaches had become well established. One problem with micro-worlds is that they are somewhat uninteresting. The blocks world was the most popular micro-world and there is very little that can be done in it other than make stacks of blocks. After a flurry of early work where particularly difficult 'problems' or 'puzzles' were discovered and then solved (e.g., it became more and more difficult to do something new within that domain. The knowledge representation systems described receive their input either in symbolic form or as the output of natural language systems. Everything the system is to know is through hand-entered units of 'knowledge', although there is some hope expressed that later it will be able to learn itself by reading.

Parallelism: - Parallel computers are potentially quite different from Von Neumann machines. One might expect then that parallel models of computation would lead to fundamentally different models of thought. The story about parallelism, and the influence of parallel machines on models of thought, and the influence of models of thought on parallel machines has two and a half pieces. The first piece arose around the time of the early cybernetics work, the second piece exploded in the mid-eighties and we have still to see all the casualties. The last half piece has been pressured by the current models of thought to change the model of parallelism.

Biology:-We have our own introspection to tell us how our minds work, and our own observations to tell us how the behaviour of other people and of animals works. We have our own partial theories and methods of explanation. Sometimes, when an observation, internal or external, does not fit our pre-conceptions, we are rather ready to dismiss it as something we do not understand, and do not need to understand. This is important to realize because traditional Artificial Intelligence has relied at the very least implicitly, and sometimes quite explicitly, on these folk understandings of human and animal behaviour. The most common example is the story about getting from Bangalore to Delhi (or vice-versa), which sets up an analogy between what a person does mentally in order to Plan the trip, and the means-ends method of planning.

(1)**Ethology:-**Ethology, the study of animal behaviour, tries to explain the causation, development, survival value, and evolution of behaviour patterns within animals. There is no completely worked out theory of exactly how the decision is made as to which behavioural pattern (e.g., drinking or eating) should be active in an animal. A large number of experiments give evidence of complex internal and external feedback loops in determining an appropriate behaviour.

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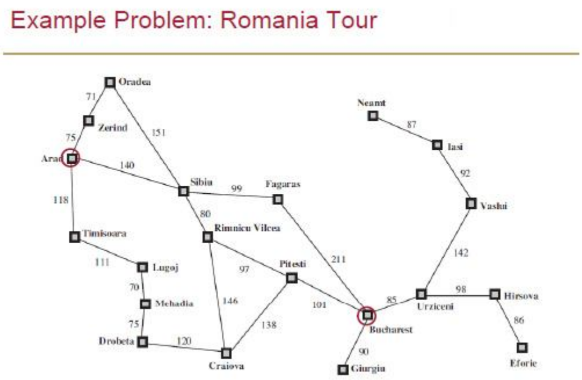
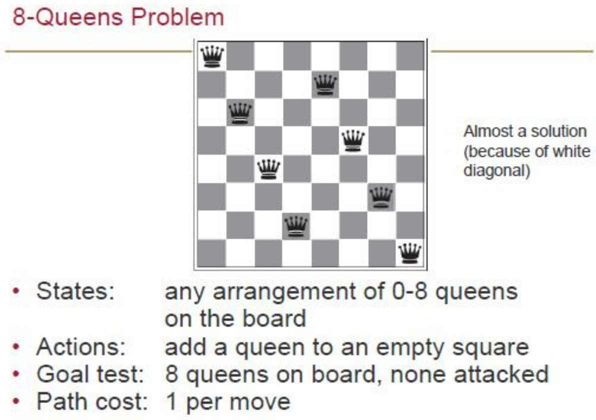
(2)**Psychology:-**The way in which our brains work is quite hidden from us. We have some introspection, we believe, to some aspects of our thought processes, but there are certainly perceptual and motor areas that we are quite con dent we have no access to. To tease out the mechanisms at work we can do at least two sorts of experiments: we can test the brain at limits of its operational envelop to see how it breaks down, and we can study damaged brains and get a glimpse at the operation of previously integrated components. In fact, some of these observations call into question the reliability of any of our own introspections. We are all aware of so-called optical illusions where our visual apparatus seems to break down. The journal Perception regularly carries papers which show that what we perceive is not what we see. Neuroscience The working understanding of the brain among Artificial Intelligence researchers seems to be that it is an electrical machine with electrical inputs and outputs to the sensors and actuators of the body. Real biological systems are not rational agents that take inputs, compute logically, and produce outputs. They are a mess of many mechanisms working in various ways, out of which emerges the behaviour that we observe and rationalize.

Ideas:-
(1)**Situatedness:-**Traditional Artificial Intelligence has adopted a style of research where the agents that are built to test theories in intelligence are essentially problem solvers that work in an symbolic abstracted domain. The symbols may have referents in the minds of the builders of the systems, but there is nothing to ground those referents in any real world. Furthermore, the agents are not situated in a world at all. Rather they are given a problem, and they solve it. Then, they are given another problem and they solve it. They are not participating in a world as would agents in the usual sense. A situated agent must respond in a timely fashion to its inputs. Modelling the world completely under these conditions can be computationally challenging. But a world in which it is situated also provides some continuity to the agent. That continuity can be relied upon, so that the agent can use its perception of the world instead of an objective world model. The representational primitives that are useful then change quite dramatically from those in traditional Artificial Intelligence. The key idea from situatedness is:
The world is its own best model.

Problem-Solving Agents:-We first need a goal formulation, based on the current situation and the performance measure.
• Problem formulation is the process of deciding what actions and states to consider, given a goal.
• In general, an agent with several options for action of unknown value can decide what to do by first examining different possible sequences of actions that lead to states of known value, and then choosing the best sequence• A search algorithm takes a problem as input and returns a solution in form of an action sequence.





(2)**Embodiment:-**There are two reasons that embodiment of intelligent systems is critical. First, only an embodied intelligent agent is fully validated as one that can deal with the real world. Second, only through a physical grounding can any internal symbolic or other system find a place to bottom out, and give 'meaning' to the processing going on within the system. Without an on-going participation and perception of the world there is no meaning for an agent. Everything is random symbols. Arguments might be made that at some level of abstraction even the human mind operates in this solipsist position. However, biological evidence suggests that the human mind's connection to the world is so strong, and many faceted, that these philosophical abstractions may not be correct. The key idea from embodiment is:

The world grounds regress.

(3)**Intelligence:-**The sorts of activities we usually think of as demonstrating intelligence in humans have been taking place for only a very small fraction of our evolutionary lineage. The 'simple' things to do with perception and mobility in a dynamic environment took evolution much longer to perfect, and that all those capabilities are a necessary basis for 'higher-level' intellect. It is hard to draw the line at what is intelligence, and what is environmental interaction. In a sense it does not really matter which is which, as all intelligent systems must be situated in some world or other if they are to be useful entities. The key idea from intelligence is:

Intelligence is determined by the dynamics of interaction with the world.

(4)**Emergence:-**In discussing where intelligence resides in an Artificial Intelligence program Minsky points out that "there is never any 'heart' in a program" and "we find senseless loops and sequences of trivial operations". It is hard to point at a single component as the seat of intelligence. There is no homunculus. Rather, intelligence emerges from the interaction of the components of the system. The way in which it emerges, however, is quite different for traditional and behaviour-based Artificial Intelligence systems. It is hard to identify the seat of intelligence within any system, as intelligence is produced by the interactions of many components. Intelligence can only be determined by the total behaviour of the system and how that behaviour appears in relation to the environment. The key idea from emergence is:

Intelligence is in the eye of the observer.

Thinking: - Can this approach lead to thought? How could it? It seems the antithesis of thought. But we must ask first, what is thought? Like intelligence this is a very slippery concept. We only know that thought exists in biological systems through our own introspection. At one level we identify thought with the product of our consciousness, but that too is a contentious subject, and one which has had little attention from Artificial Intelligence. Thought and consciousness are epiphenomena of the process of being in the world. As the complexity of the world increases, and the complexity of processing to deal with that world rises, we will see the same evidence of thought and consciousness in our systems as we see in people other than ourselves now. Thought and consciousness will not need to be programmed in. They will emerge.

Conclusion: - The following interpretations all encapsulate important points.

- Intelligence without Reason is thus complementary, stating that intelligent behaviour can be generated without having explicit reasoning systems present.

-Intelligence without Reason can be read as a statement that intelligence is an emergent property of certain complex systems-it sometimes arises without an easily identifiable reason for arising.

-Intelligence without Reason can be viewed as a commentary on the bandwagon effect in research in general, and in particular in the case of Artificial Intelligence research.
-Intelligence without Reason is also a commentary on the way evolution built intelligence-rather than reason about how to build intelligent systems, it used a generate and test strategy.
We are a long way from creating Artificial Intelligences that measure up to the standards of early ambitions for the field. It is a complex endeavour and we sometimes need to step back and question why we are proceeding in the direction we are going, and look around for other promising directions.

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