Scrutinizing the use of Emergent Intelligence for Geometric Analogy solving

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Declaration

I declare that this dissertation does not incorporate, without acknowledgment, any material previously submitted for a Degree or a Diploma in any University and to the best of my knowledge and belief, it does not contain any material previously published or written by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organization.

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Dedication

This thesis is dedicated to my

Father & Mother, who had never failed to give me love & moral support.

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Abstract

As a natural quandary it is a question that who are humans? It is possible to justify those humans, who are taxonomically known as Homo-sapiens; are nothing but analogy making species. Analogy making is the fundamental practice of the human cognitive process that makes to understand new things or knowledge based on what have been already understood. Abstract reasoning, language, introspection, problem solving, etc. all are merely governed by the analogy making process. Even though this is an innate ability of humans, embedding this feature into a computational analogy solving model has been a research challenge. Various types of analogy related research has been started from Thomas G. Evans 'ANALOGY' program in 1964; and a number of sophisticated approaches have been published like; Structure Mapping Engine, Analogical Constraint Matching Engine, Incremental Analogy Machine, Associative Memory-Based Reasoning, etc. Nevertheless, most of these works mainly have been driven by heuristic search strategies with rule based approaches, which are fundamentally away from a general analogy making process; though successfully accounted for many applications.

Intelligence is the central property that can be inspected through any analogy making, and the main skill that differentiates human beings from all the other beings. Therefore, there is a core relation between analogy making and the intelligence. Intelligence can be considered as an emergent property with the holist view point that emerges when conditions met. Therefore, analogy making can be modelled through emerge intelligence by taking everything as conditioned phenomena. This approach has been enriched with five aggregates that explain in Buddhist Philosophy namely 'Form' (rūpa), 'Sensation' (vedanā), 'Perception' (saññā), 'Mental formations' (saṅkhāra), and 'Consciousness'(viññāna). First any phenomenon can be considered as a 'Form' consisting of receiving knowledge of the outside world through the senses; and through that 'Sensation' will be developed that bridges the internal sense organs with external sense objects. That event leads to 'Perception' that makes the assimilation of sensation with ideas that pre-exist. Through that 'Mental formations' will be activated that will develop thoughts; which is the core in conditioned phenomena finally to form 'Consciousness'. In analogy making too; a phenomena/problem can be considered as a form and through sensation that will be

mapped into the computer understandable form (a domain mapping) that will be contributed to relate with existing ontology to get the perceptions. That will be further reason out with concept formation techniques to emerge intelligence.

This approach has implemented with Multi Agent technology by utilising its emergent ability through communication and negotiation features. Furthermore, the approach suggested for analogy making in this research is general though it has been scrutinized only for geometric domain for evaluation purposes. The model assumed that it has been given an analogy in the form of first order logic through the abstraction. That will be bound with ontology to develop appropriate perceptions to interpret the analogy in various manners. Those interpreted data will be going through a formation process that will be empowered by various reasoning strategies mainly through relations. These independent actions communicate appropriately when needed consciously and make an analogy. Furthermore, this approach has been evaluated in the geometric analogy domain parallel with eight to nine year old students and it is found to be that the results obtained from the system is substantial.

Keywords: Analogy, Emergent Intelligence, Five Aggregates, Multi Agent System.

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