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A Study in Knowledge Acquisition in AI Systems through Genetic Algorithms

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***Abstract*— Knowledge Base in an integral part of any AI system. Knowledge Acquisition refers to purposeful addition or refinements of knowledge structures to a knowledge Base. However knowledge acquisition is a complex and difficult task for AI researchers.Machine learning is the autonomous/mechanical procedure involving computers through which an AI. System itself enriches its knowledge Base.A useful taxonomy for machine learning is one that is based on the behavarioul strategy employed in the learning process. Some important conventional methods depending upon the degree of inference procedure are memorization, Analogy Inductive &Deductive inference.Attempts to develop machine learning systems began in 1950s. These design included self Adaptive system which modified their own structures in an attempt to produce an optional response to some input stimuli.Genetic Algorithms (GA) are based on population genetics. GAs learn through crossovers and mutations to provide optimum results. Higher performing knowledge structures can be mated (cross-over) to give birth to offsprings which possess many of their parent traits. Generations of structures are thus created until an acceptable level of performance has been reached. The following paper presents a study in different aspects of implementation of GAs for knowledge Acquisition in AI systems.**

I. INTRODUCTION

The following paper is divided into four sections and subsequent subsection.

The section 1 relates to knowledge acquisition & machine learning.

The section 2 relates to the Soft Computing approach of Genetic Algorithms.

The section 3 is related to the issues involved in implementation of GA for knowledge Acquisition.

The section 4 provides conclusion.

Section 1 : - KnowledgeAcquisition

1.1 Introduction to knowledge Acquisition

The capability of an AI system or knowledge based system depends upon. The quality and volume of the knowledge available to the system. Acquiring and validating large amount of consistent and corelated knowledge is not an easy task. This has given knowledge acquisition process especially important role in design and implementation of those systems. Effective knowledge acquisition methods have become one of the important challenges for AI research community. The goal is this discovery and development of efficient methods of knowledge acquisition.

1.2 Knowledge Acquisition& Machine learning

The definition of knowledge acquisition involves expanding the capacity and/or improving the performance at some specified task. Therefore we will think acquisition as goal oriented creation and refinement of knowledge. Taking a broad view (of the definition of knowledge acquisition) which includes autonomous acquisition supplementary to the conventional methods is the concept of machine learning.

Machine learning is a specialized form of knowledge acquisition. It is any method of knowledge creation or refinement through the use of computer programs.

1.3 Taxonomy of knowledge acquisition methods

The acquired knowledge consist of -

* Facts
* Rules
* Concepts
* Procedures
* Heuristics
* Formulas
* Relation ships
* Statistics

Irrespective of forms of knowledge. The learning process involves different methods of learning, materials to be learned, amount of relevant material already being possessed and the environment of learning.

We can develop taxonomies based on -

Knowledge representation (Predicate logic, productions, frames, scripts)

Type of knowledge (Concepts, Game, Playing, Problem solving)

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Area of application (medical diagnosis, Robotics)

However taxonomy should be independent of knowledge domain and representation methods used. It is more appealing to the Researchers in the field of Machine learning. The Non-autonomous methods in this taxonomy are -

* Role/Memorization
* Direct Instruction
* Analogy
* Induction
* Deduction

In addition is the above mentionedtaxonomywe will refer to autonomous (mechanical) methods of Machine learning. These are general purpose methods not tied to any domain or representation scheme.

This machine learning taxonomy includes -

*Artificial Neural Networks
* Learning Automata
* Genetic Algorithm

Section 2:- Genetic Algorithm

2.1 Introduction

In 1975 Holland [1] forwarded the idea of GA. GAs are adaptive algorithms based on the evolutionary ideas of population Genetics Nature has robust way of evolving successful organisms. It can be considered as finding more fit individuals from the past ones. The species reproduce by mating (cross-over) and sometimes mutating resulting in more adaptive and fit individuals.

2.2 Basic Idea

The gene pool of a given population potentially contains solution to a given adaptive problem. The solution is to be found by association of GENOMES. During the reproduction new genetic combinations are formed and finally a subject inherits a better gene. This concept of GA is called crossover.

Holland's algorithm is effectives because it not only considers cross over but also the mutation. Mutation may improve the capability of a subject and my find more fit subject.

Pseudocode of GA :-

Step 1 : Generate random
Population of n chromosomes
Step 2 : Select a pair from the population
Step 3 : Crossover
Step 4 : Mutation
Step 5 : Evaluate Fitness? It fitness satisfied stop
elsego toStep 2.

2.3 Fitness Function of G.A.

The principleof GAs are simple - Copy genetics and natural selection by a computer program.

The Data structures are DNA (Vector strings). The set of all the strings makes the population. Start with a pair of vectors randomly selected and proceed according to the algorithm.

The fitness function of GA selects the best solution from the candidates and deletes the rest.

It turns out that what is good for nature is also good for AI system. GA starts with a set of individuals and applies crossover and mutation operators to evolve an individual that is successful as mentioned by the fitness function. There are several choices for what the individuals are,They can be entire agent functions i. e. in the case fitness fraction is reward function. They can be component of an agent in which fitness function may be an entity.

However the important question arises how to allocate the searching resources. We spend most of the time for promising individuals we ignore the lowscoring ones thus getting stuck in local maxima.

Section:-3Knowledge Acquisition, and GA

3.1 Structures of knowledge : Crossover and mutation

For knowledge Acquisition GA starts with a fixed size population of data structures which used to perform some given tasks. After requiring the structure to execute the specified tasks some number of time, the structures are rated on their performance, and a new generation of data structures are created. The new generation is created by mating higher performance using structures to reproduce. These off springs and parents are then retained for the next generation while the poorer are discarded. This basic cycle continues.

Mutations are also performed on the best performing structures to insure that the full space of possible structures is reachable. This process continues for number of generations until the resultant population consists of only the highest performing structures.

Data structures which make up population can represent suitable type of knowledge structure. For example it may be fixed length binary stringers of eight bits 11010001.

An initial population of these eight bit strings will be generated randomly with use of heuristics at time zero. These strings which might be simple condition and action rules (productions) would be assigned some tasks to perform.

After multiple attempts at executing the tasks each of the participatory structure would be rated and tagged with a utility value say in commensurate with its performance . The next population would be generated using the higher performing structures as the parents and the process would be repeated with newly produced generation. After may generation the remaining population structures should performance desired tasks well.

3.2 Issues/Problems in Knowledge Acquisition through GA

The use of knowledge Acquisition or Machine learning process have been mitigated by several issues and problems.

The 1st problems is that problem solving & learning process one considered different activities[2]. The learning is considered a more general task than problem solving that is a specific task.

The 2nd problem is that the representation used by the learning tools/methods and those of problem solving are incompatible. Therefore an additional transformation of the knowledge that has been acquired during learning has to be performed before its can be used for problem solving.

3.3 Genetic Engineering

Genetic Engineering provides optimality to the GAs. The technology is based on the assumption that the genetic changes that occur during the evolution can be studied and indentified. For features wanted and unwanted.

This the Genetic Engineering can be made of two components -

a) Methods of Genetic Analysis yielding beneficial or detrimental genetic features.

b) Methods to genetically engineer populations

In the above scenariomachine learning depends upon genetic encoding employed in problem. For order based genetic encoding sequence based methods [3] give best results and for attribute value based genetic encoding decision tree [4] andneural networks [5] should be tried.

Section 4:- Conclusion

As standard AI system performance is strongly dependent on the level and quality of knowledge.Thus the acquisition of knowledge is of paramount importance. Knowledge acquisition in AI. Systems also contribute to the field of Genetic Engineering which is beneficial for the survival of organisms.

Thus to build a machine that can learn and continues to improve its performance has been long time dream of mankind.

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