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Bounded, Multidimensional, Integrated Memetic Evolution for Character Recognition Based on Predictive Elimination Theory and Optimization Techniques

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ABSTRACT

This article describes how inspired by the natural process of evolution in genetic algorithms, memetic algorithms (MAs) are a category of cultural evolution phenomenon. The very concept of MA has been discussed in the last few years and is adding newer dimensions to MA and computational skills of algorithms. There are many optimization algorithms which fully exploit the problem under consideration. This article presents a heuristic approach for an improvised algorithm which takes into consideration various optimization parameters in isolation and tries to integrate the self-learning technique of MA. A general structure of MA according to this article should be perfectly in-line with brain activities which are neurotically tested and given maximum emphasis on local search and context-based predictive approaches rather than mathematically computing every event and taking or picking solutions based on results of certain formula. This article goes one step beyond the conventional set of the variety of problem domains, ranging from discrete optimization, continuous optimization, constrained optimization and multi objective optimization in which MAs have been successfully implemented. These optimization techniques must be processed using outcomes of predictive optimization and using a method of elimination to make the search set smaller and smaller as we progress deeper into the search. There is a scarcity of literature and also lack of availability of comprehensive reviews on MAs. The proposed technique is a better approach for solving combinatorial optimization problems. This article gives an overview of various domains and problem types in which MA can be used. Apart from this, the problem of character recognition using predictive optimization and implementation of elimination theory MA is discussed.

KEYWORDS

Constrained Optimization Problem, Continuous Optimization Problem, Discrete Optimization Problem, Elimination Theory, Genetic Algorithms, Memetic Algorithms, Multi Objective Optimization Problem, Predictive Optimization

INTRODUCTION

Evolutionary algorithms (EAs) were introduced by various researchers in the later part of 1960 (Fogel et al., 1996; Holland, 1975; Rechenberg, 1973). Memetic algorithms the term coined by Pablo Moscato (Moscato, 1989), actually covers a broad range of meta heuristics. It started to denote a family of meta-heuristics that tried to bring together concepts from tightly separated at that time

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families such as EAs and Simulated Annealing (SAs) (Kirkpatrick et al., 1983). They deviate from the traditional Evolutionary approaches as they explore all available knowledge about the problem under consideration. MAs are gaining huge success in giving practical solutions in variety of problem domains specifically Optimization problems.

The history of MA has its origin associated with the term 'meme' coined by Richard Dawkins (Dawkins, 1976) where he defines 'meme' is a part of cultural evolution which mimics a gene in genetic evolution. But, as is said, there are two sides to every coin, there are certain points where some techniques of hardcore mathematics do help. In a book titled "Where Darvin Goes Wrong" 2010 book by cognitive scientist Massimo Piattelli-Palmarini, and Jerry Fodor discusses certain key issue in EA. According to the original concept of MA, memes in form of information packets are passed from one human brain to another wherein they can be modified before passing on. Examples of meme given by Richard Dawkins are "tunes, ideas, catch-phrases, clothes fashions, ways of making pots or of building arches". Another example of it can be the stories we tell to our children which we have heard from our parents which they have heard from their parents and so on. The contents can be modified from generation to generation and also, they can be modified for better. Genes are propagated as they are inherited from a parent to child which is not the case with memes. Memes inculcate a process of lifetime learning. As an example, the philosophy of Yoga is transmitted from generations to generations. When a person learns it, it becomes life time learning. A person can also enhance the process for better and some concepts which are not that interesting to that person can fade away. Memeticists argue that the memes most beneficial to their hosts will not necessarily thrive, rather, those memes that replicate the most effectively propagate. This is where there is a scope of introducing some mathematics. To improve meme locally, just as self-learning and observational skills are required, some mathematical skills too are most essential. Based on computational skill only, the meme can evolve or it may go absolutely wrong. For example, after observing fashion and without analyzing it in context with culture, weather, geographic and atmospheric conditions and cultural values, the evolution of meme could go absolutely wrong. Hence there is a strong need to provide bounded multidimensional integrated derivative outlining to evolution technique in frame of predictive optimization and method of elimination.

Background

In the language of computer science, the term, metaheuristic, can be defined a high-level mechanism to find, produce or identify a search algorithm which may generate a candidate solution to an optimization problem. The problem under consideration can have incomplete information. Advancements in this area can be found in (Dey & Ashour, 2017; Dey, 2018). The information sharing mechanism in particle swarm optimization, PSO or Memetic Logic is significantly different from Genetic Algorithm, (GA). PSO don't have genetic operators like crossover and mutation, particles update themselves with the internal velocity and they also have memory which is important to the algorithm, etc. Experimental results show that PSO has advantages over GA on those aspects and is preferred over GA when time is a limiting factor. Particle swarm optimization (PSO) is also an iterative, population-based optimization (Chatterjee et al., 2017; Jagatheesan et al., 2017; Kamal et al., 2017; Jagatheesan et al., 2016). PSO is used to solve many machine-related complex problems where high degree of accuracy is expected with minimal computational time (Chakraborty et al., 2013; Chatterjee et al., 2017; Chatterjee et al., 2017a; Chatterjee et al., 2017b). But the character recognition problem has a different dimension. Here we can adopt a predictive approach using elimination theory as the expected nth character after initial n-1 characters become predictive. Hence authors feel that memetic approach is relatively better choice over PSO blended with predictive optimization. Most often MAs are compared with GAs. A genetic algorithm (GA) is a search mechanism that imitates the process of natural evolution. Genetic algorithms belong to the larger class of EAs. This is generally used to solve optimization and search problems which generate solutions to optimization problems using techniques inspired by natural evolution, such as inheritance, mutation, selection, and crossover (Banzhaf et al., 1998). Memetic

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