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A Survey on Memetic Algorithm and Machine learning Approach to Traveling Salesman Problem

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ABSTRACT: Artificial Intelligence (AI) is a broad framework covering a broad spectrum of building systems approaches that emulate human intelligence, such as reasoning, behavior, machine vision. Soft Computing is characterized as a class of artificial intelligence and natural selection based computational techniques that provide a rapid and cost-effective solution to very complex problems, which are not solved by analytical approach. This type of problem is considered as NP-Hard problem. i.e TSP, Vehicle routing problem, scheduling problem etc. the algorithm comes on the umbrella of soft computing is nature inspired algorithms such as Genetic Algorithm, Memetic algorithm and other Machine learning algorithms etc. This paper presents a short overview about the machine learning, i.e. the grouping, regression, clustering and emerging topics, including combinatory optimization problems. Also, this paper provides a review of the hybrid evolutionary algorithms (i.e. Memetic Algorithms) and their applicability for TSP. The paper also addresses existing challenges and future views of memetic algorithms and Machine learning methods for solving Traveling salesman problem.

Keywords: Memetic algorithm, Machine learning, Traveling salesman problem, NP-Hard.

I. INTRODUCTION

The objective of the Traveling Salesman Problem (TSP) is to find the cheapest way to visit all the elements in a given set of cities where, between each pair of them, the cost of travel is provided and return to the starting point. The TSP is a very strong representative of a broader class of problems known as problems of combinatorial optimization. Therefore, if a best algorithm (i.e. an algorithm that guarantees to find the optimal solution in polynomial number of steps) can be identified for the problem of the travelling salesman, then effective algorithms could be created for all other problems in the class of the NP (non-deterministic polynomial time), So TSP is most studied problem in the class of NP-hard problems [1].

TSP and its derivative problems that can be equally modelled draw the interest of many scientists working on mathematics, artificial intelligence and physics. The most well-known optimization concern is to study travelling salesman problem. Besides the fact that their computer-based methods take a long time to solve this type of problem, or even impossible to solve by hand [2].

II. LITERATURE REVIEW

We include a brief memetic algorithm and machine learning solution to the issue of travelling salesmen in this section.

Memetic Algorithm

According to the philosophic principle of Dawkins, human society may be decomposed into basic units, including memes. Thus, a meme is a 'brick' of information that can be duplicated in human minds, changed, and merged with other memes in order to create a new meme [3]

The concept of meme is borrowed from the philosophy and is expressed as cultural transmission unit [4]. The name Memetic Algorithm (MA) is devised by Pablo Moscato [5] but as always, the same idea was also given under the name of Baldwinian GA [6], local searchers [7], Hybrid GA [8] , Lamarckian GA [9]. The working low chart of basic memetic algorithm is shown in Fig. 1.

Following are the steps used in the Memetic Algorithm

Step1: Generate an initial population of individual

Step2: While stopping criteria not met repeat the following

steps

Step2: Select the best individuals for making matting pool

Step6: Appling crossover operation with a certain crossover probability P_c to create offspring.

Step7: Appling mutation operation certain crossover probability P_m.

Step8: Perform local search Step9: Replacement Stop10: End

There are many schemes to describe a candidate solution for a TSP instance: binary representation, path representation, adjacency representation, ordinal representation, and matrix representation. There are various genetic operators i.e. crossover and mutation operators have been proposed by the researchers to solve the TSP and optimize the algorithm. The list of operator's listed in the Table 1 [10] .

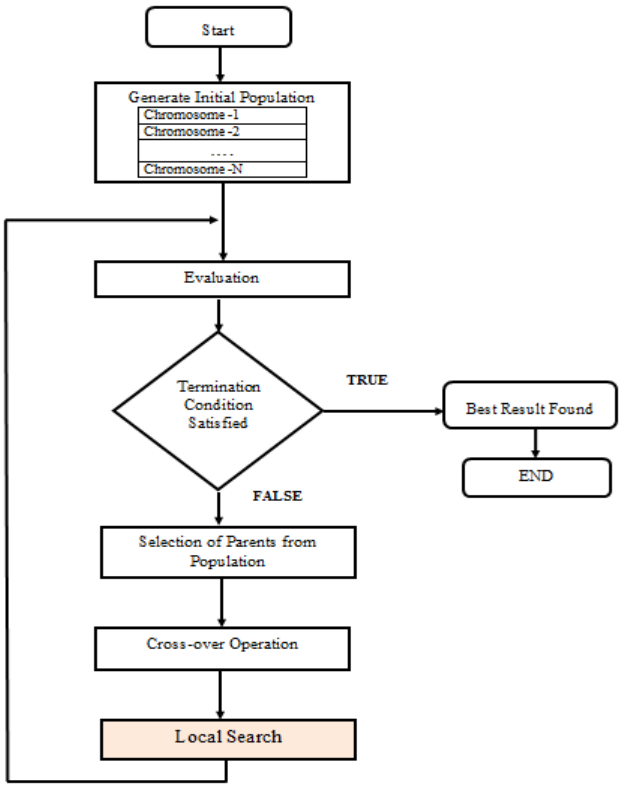

Fig. 1. Memetic Algorithm.

Table 1: Various crossover and mutation operators used to solve the TSP [10].

Alternating Position Crossover	(1999) Larranaga, Kuijpers, Poza and Murga
Cycle Crossover	(1987) Oliver, Smith and Holland
Distance Preserving Crossover	(1996) Freisbein and Merz
Edge Assembly Crossover	(1997) Nagata and Kobayashi
Edge Recombination Crossover	(1989) Whitley, Timothy and Fuquay
Heuristic Crossover	(1987) Grefenstette
Inver-over Operator	(1998) Tao and Michalewicz
Maximal Preservative Crossover	(1988) Mühlenbein, Schleuter and Krämer
Position Based Crossover	(1991) Syswerda
Order Crossover	(1985) Davis
Order Based Crossover	(1991) Syswerda
Partially mapped Crossover	(1985) Goldberg and Lingle
Voting Recombination Crossover	(1989) Mühlenbein
Displacement Mutation	(1992) Michalewicz
Exchange Mutation	(1990) Banzhaf
Insertion Mutation	(1988) Fogel
Inversion Mutation	(1990) Fogel
Scramble Mutation	(1991) Syswerda
Simple Inversion Mutation	(1975) Holland

Machine Learning

Machine learning is about the creation of algorithms that enable a computer to learn. Learning does not actually require consciousness, but learning is a question of discovering statistics Regularity or other trends in the results. As a consequence, many machine learning algorithms can hardly resemble how humans would approach a learning specific or nonspecific task. However, learning algorithms may offer insight into the relative complexity of learning in various environments [11].

Types of popular machine learning algorithms include:

— **Supervised learning** - Where the algorithm produces a function that maps inputs to the desired outputs. The classification problem is one of the standard formulations of the supervised learning task : a learner is expected to understand (to estimate the action of) a function that maps a variable to one of many groups by looking at a variety of function input-output instances.

— **Unsupervised learning** is a type of machine learning algorithm used to draw inferences from datasets consisting of input data without a labelled answer. The most popular unsupervised learning approach is cluster analysis, which is used for exploratory data analysis to identify secret trends or data clustering.

— **Reinforcement learning** Where the algorithm discovers a strategy on how to behave by watching the universe. Each behaviour has certain environmental

effects, and the environment offers input that drives the learning algorithm.

Various other machine learning algorithms are also available, Such as Semi-supervised learning, Transduction, Learning to learn etc [11]. Fig. 2 shows the basic architecture of multilayer neural network which are used to develop to learn the system.

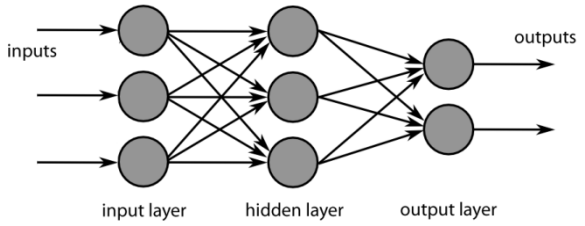

Fig. 2. Multi-layer neural network.

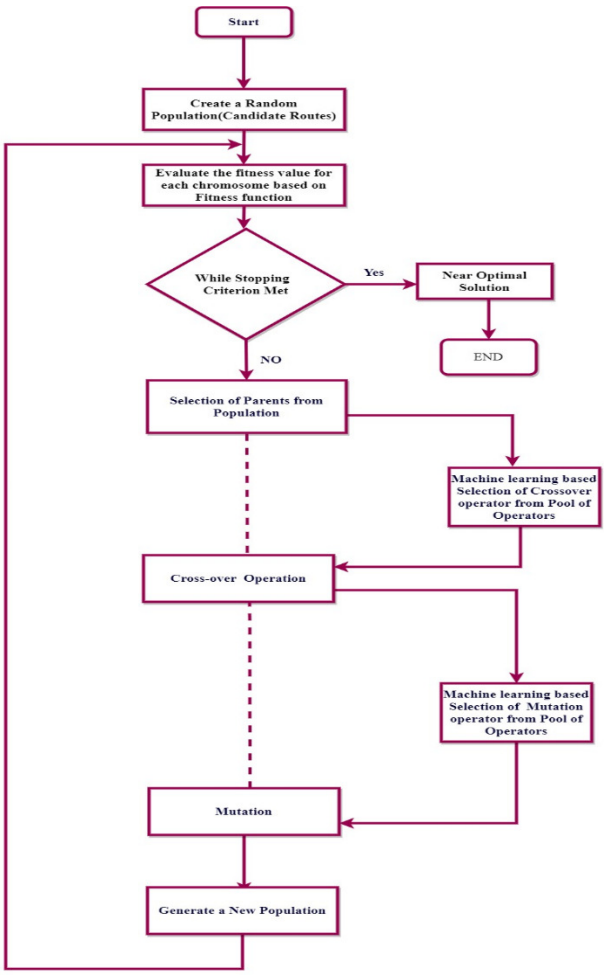

Fig. 3. Machine learning combine with Evolutionary algorithm.

The creation of ML approaches for the TSP has placed a strong emphasis on improving the learning process. The search process was only carried out using basic techniques, although there is a number of more refined search procedures in the literature, such as simulated annealing, tabu search, large neighbourhood search and many others [12].

Machine learning can be combined with the evolutionary algorithm to optimize the algorithm. Fig. 3 show the the new approach of machine learning to solve the TSP problem. It creates a new type of memetic algorithm which get the advantages of machine learning. The search process will be guided by the machine learning approach.

III. CONCLUSION

After a detailed study of the traveling salesman problem, memetic algorithms and machine algorithms. Machine learning and evolutionary algorithms were found to converge to create the effective memetic algorithm to solve the traveling salesperson problem. In order to solve a combinatorial problem such as TSP, scheduling and other routing problems the machine algorithm may be used to discover new facts. Machine learning algorithm will evaluate the historical knowledge of the evolutionary algorithm to enable the algorithm to determine whether to use the necessary genetic operators to solve the traveling salesmen problem.

IV. FUTURE SCOPE

This paper allows one to think about the machine algorithms and investigate the strength of the evolutionary algorithm. This study can be expanded by designing an appropriate memetic algorithm focused on the approach of machine learning to solve the traveling salesman problem.

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Conflict of Interest. There is no conflict of interest, according to the authors. This work is being done at Uttaranchal University, Dehradun, India.

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