

Chapter 6

Conclusion and Future Work

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6.1 Overview

This chapter reviews the main contributions of this dissertation as well as some future lines of research emerging from this research work. The chapter is organized in the following manner: Section 6.2 summarizes the contributions of the research; Section 6.3 briefs future scope of work.

6.2 Summary of Contribution

The thesis intended to contribute to ACO algorithm in several aspects. The present work has proposed some new variants of ACO algorithms, new formulae to update pheromone trail and a multivariant model to solve train scheduling problem using ACO. The following are the significant contributions of this research work.

- Developed a methodological framework to incorporate punishment mechanism in ACO algorithms. The punishment mechanism was successful in restricting the ants movement in the promising region of search space thereby enabling them to report the optimal results.
- Developed a mechanism to select the elite ants dynamically using ML philosophy. The dynamic ant selection mechanism, also called as influential ant selection mechanism selects optimal number of ants for pheromone updation, so that only promising paths get updated with the intention to find the optimal result.
- A methodology to incorporate the intelligence in ants pheromone updation mechanism has been proposed based on the observation that, best solutions are located near the optimal solutions. In order to exploit the neighborhood

regions of optimal solution in a search space, an unconventional reinforcement strategy is suggested. The unconventional reinforcement strategy is unsupervised in nature and reinforces the nearby tour performance with same amount of pheromone trail. The thesis has laid a foundation to incorporate the element of intelligence, so that ants can search in a smarter way.

- Some new results on pheromone updation and evaporation have been derived. A new formula for evaporation is expressed in terms of time. The runtime distribution analysis done could help in understanding the behavioral impact of ant mechanism and also might reveal a more informative comparison of other evolutionary algorithms. The formulae could help in understanding the influence of parameter variations and facilitate the determination of desired parameter value, thereby increasing the efficiency of various ant variants.
- A framework to solve the train scheduling problem using ACO has been proposed. The proposed model is robust in nature i.e., capable of handling any number of constraints without any change to the model. The proposed model was tested with existing ant algorithms as well as with proposed ACO algorithms and observed that proposed ACO algorithms provide the superior results.

6.3 Future Work

The work presented in the thesis emphasizes on two major aspects: improvising the performance of the ACO algorithms and application of ACO to real world problems like train scheduling problem. In chapter 2, we have seen the incorporation of punishment mechanism to some of the basic ant variants and analyzed the algorithms performance. A further extension can be done by incorporating the Local Search (LS), as in general it is claimed that ACO provides a better starting points for LS. The another area that needs the immediate attention is the

refinement of intelligence factor in ants, so that they are well equipped with the knowledge about the search space that leads to the exploration in promising region of search space. This researcher would like to investigate the effect of learning mechanism on the performance of ACO algorithm and to extend the application of heuristic algorithms especially ACO to many other real life problems. The railway transportation problem is rich in terms of problems and many classical OR models have been proposed. In literature, one can find the absence of deep effort to get the heuristic solutions. Therefore, this is the fertile area to continue the work; solving CO problems using heuristic and metaheuristic techniques in the context of reducing the time complexity. The railway planning is a complex process and the whole process can be organized in a hierarchical fashion and an integrated solution using variety of heuristic techniques can be tried by the researchers.

Finally, the introduction of new simple concepts to ACO literature in this research work will definitely encourage a deeper study of success of ACO.