Abstract

Heuristic search has been applied to a wide range of domains including scheduling, planning, routing, transportation, constraint satisfaction, VLSI, etc. In the recent past the research community has been exploring options for generating good quality solutions that can be obtained within feasible time and can present a desired demography of the solution space to the user. Recent research directions also include the development of new algorithms for handling multiobjective costs and their applications. Another important problem representation model involves AND/OR graphs. Apart from the traditional application of the AND/OR graphs, over the last decade there has been a renewed research interest towards applying AND/OR structures in a wide variety of other areas like planning with uncertainty, graphical models, web service composition, solution sampling and counting, model based programming, etc. However, some of the widely studied topics, like generating alternative solutions, in ordinary graphs have not been deeply investigated for AND/OR graphs and the approaches related to these topics are often not obvious. Under the purview of the above mentioned research directions we address some of the problems that we feel important. Below we briefly mention about the problems studied in this thesis and outline our contributions.

- **_Generating alternative solutions for AND/OR structures:_** We present a best first search algorithm, named _Alternative Solution Generation_ (ASG) for generating an ordered set of solutions. We also present extensions of ASG algorithm for generating the alternative solutions for implicit AND/OR graphs.
- **_Solving AND/OR graphs with failure probabilities:_** We present _an algorithm_ for finding the optimal sequence of executing the tasks in a solution graph which minimizes the expected penalty. Also, we present _an algorithm, named CR-REV*_, that uses a user defined parameter k and generates solution graph whose quality increases with the increase of k.
- **_Optimizing one objective under constraint on the other objective:_** Our primary contribution is _an admissible algorithm, BOA*_, which uses path selection and expansion as the basic operations and finds the desired solution directly using a suitable lexicographic ordering. We prove that our algorithm, BOA*, is _optimal_ with respect to the search space made explicit.
- **_Quality-time trade-off for biobjective optimization problems:_** We present an anytime heuristic search framework named "Anytime Biobjective Search (ABS)" for biobjective optimization problems whose state spaces are OR-graphs.
- **_Quality-time trade-off for biobjective AND/OR graphs:_** In this contribution, we use our alternative solution generation algorithm for AND/OR graphs, _ASG_, coupled with our proposed anytime algorithmic framework for biobjective optimization problem for handling AND/OR graphs with biobjective costs.

For all of the above mentioned problems we present experimental results on relevant domains.

Keywords: AND/OR Graphs, Biobjective Optimization, Multiobjective Optimization, Anytime Algorithms