ABSTRACT

Evolutionary and Parallel Approaches to NP Problems

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Some of the most difficult problems in Mathematics and Computer Science belong to a class called NP. There are two general approaches to such problems, deterministic and non-deterministic. This thesis studies two algorithms, one from each approach.

The first approach is an evolutionary algorithm which is based on principles from the field of genetics. Ideas about the propagation of hereditary material are used to incrementally push a potential solution to a problem toward an accurate solution.

The evolutionary algorithm which was developed was targeted to a sub-class of NP which constitutes problems whose solutions are dependent on finding permutations of a set.

Several such permutation-based problems were experimented upon using the evolutionary algorithm. For the majority of the problems considered, the success rate of the algorithm was 100%.

The second approach is a parallel ternary-intersection algorithm which targets a canonical problem of the class NP, the Boolean Satisfiability Problem.

Comprehensive experiments on uniform randomly generated problems were conducted and the results showed that even for large problems instances of 512 variables and 1000 disjunctions, the execution time of the algorithm remained under 12 seconds.

Further experiments were conducted on a subset of satisfiability problems, 3SAT. The results obtained correspond to established trends for a region of the problem parameters considered, that is, up to a k/n value of 4.2. Performance of the algorithm degrades beyond this point.

Overall results indicate that both the evolutionary and parallel approaches to NP problems are feasible, efficient and practical for special subsets of the general problems under consideration.

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