Abstract

AND/OR graph formalism is widely used in AI problem solving. However, it was pointed out by Nilsson, way back in 1971, that cycles may create difficulty in AND/OR graph algorithms. Because of this inherent difficulty, all traditional algorithms, including the classic AO*, have assumed the implicit AND/OR graph to be acyclic. Acyclity, clearly, is too restrictive an assumption, since every logical equivalence results in a cycle in the corresponding AND/OR graph. Realising this, Chakrabarti (1994) and Hvalica(1996) have presented some algorithms for cyclic AND/OR graphs. None of these algorithms, however, obey the fundamental principle of Best First search, which is the hallmark of AO* and its variants.

This dissertation attempts to present the first truly Best-First Search algorithms for cyclic AND/OR graphs. It starts by generalizing the current framework for AND/OR graphs to incorporate the existence of cycles. Well-known concepts like potential solution graph etc. are defined in the presence of cycles, and formal relationships established between these generalized concepts. The concept of a Maximal Extendable Subgraph (MES) is an important new addition.

The dissertation then presents two Best First search algorithms, S1 and S2. Theoretical properties of S1 and S2, like termination, admissibility, complexity etc. are presented and proved. It is demonstrated how S1 and S2, in contrast to the previous algorithms, satisfy the Best First criteria.

Another important contribution of this dissertation is the computational performance. The AND/OR graph algorithms S1, S2, REV* and AO* have been extensively tested on random problems, and the computational results presented here should be of interest. It is shown that algorithms S1 and S2 (in keeping with their Best First nature) far outperform the other algorithms on counts like CPU time, number of nodes evaluated etc.

To sum up, the dissertation presents a framework for cyclic AND/OR graphs, two Best First search algorithms S1 and S2, and an implementation experience of these algorithms.