Statement of Research Interest

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The main objective of my research activity is the development and the experimental analysis of efficient techniques of domain independent planning, which proposes to identify a partially ordered set of actions whose execution allows one or more agents to reach their goals starting from a specific initial situation. My research has been focused on generic algorithms that can be applied to a variety of situations in which the evolution of the external world makes it necessary to revise a plan which has been previously formulated or the generation of a new plan. In such a context I have developed the systems LPG, LPG-td and ADJ together with Prof. Alfonso Gerevini and other members of the AI group of the University of Brescia. In particular LPG is at present one of the best domain independent planners that exist in terms of execution times, quality of the plans produced and expressivity of manageable problems. LPG took part in the third International Planning Competition IPC3 obtaining the award "*distinguished performance of the first order*". LPG-td has been awarded in the fourth International Planning Competition IPC4 in the Suboptimal Metric Temporal Track.

LPG-td is an extension of the LPG planner (Gerevini, Saetti, & Serina 2003; 2004) that can handle most of the features of PDDL2.2, the standard planning language of the 4th International Planning Competition (IPC-4).

Like the previous version of LPG, the new version is based on a stochastic local search in the space of particular "action graphs" derived from the planning problem specification. In LPG-td, this graph representation has been extended to deal with the new features of PDDL2.2, as well to improve the management of durative actions and of numerical expressions. Our approach integrates constraint-based temporal reasoning into a recent planning framework based on action graphs and local search. The new plan representation is called TDA-graphs. We have developed a polynomial method for temporal constraint reasoning during search, which exploits the structure of the temporal information in the TDA-graph, and some new local search techniques for temporal planning through TDA-graphs.

All our techniques are implemented in the LPG-td planner. An analysis of the IPC-4 results show that our planner performs very well compared to other recent temporal planners supporting deterministic exogenous events and derived predicates, both in terms of CPU-time required to find a plan and quality of the best plans that can be generated by our system[1] (Gerevini, Saetti, & Serina 2005).

The ADJ system has been developed in order to address plan adaptation problems. Fast plan adaptation is important in many AI-applications requiring a plan reasoning module and it is the central component of a Case Based planning system. A typical plan adaptation task consists of modifying a previously generated plan in order to use it for solving a new problem which is "similar" to the original one, in the sense that only a few facts in the initial and goal states are different. This process can be either *off-line* (e.g., adapting a plan retrieved from a plan library before its execution), or *on-line* (e.g., adapting a plan during a "mixed-initiative" construction of it, or during its execution.

From a theoretical point of view, in the worst case adapting an existing plan is not more efficient than a complete regeneration of the plan. However, in practice, we expect that in many cases plan adaptation should be much easier than a complete replanning, because the adapted plan can be obtained by performing a limited amount of changes to the original plan. Our general goal is the development of plan adaptation methods that perform efficiently especially in such cases.

Experimental results using ADJ (Gerevini & Serina 2000) show that adapting a plan using our approach can be dramatically more efficient than a complete replanning (up to four orders of magnitude faster).

References

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[1] These results are available in the web page of LPG `http://lpg.ing.unibs.it`.