Research Project

Automated Reformulation and Pruning in Factored State Spaces

Third-party funded project

Project title Automated Reformulation and Pruning in Factored State Spaces
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Organisation / Research unit
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Project Website http://ai.cs.unibas.ch/research/
Project start 01.01.2015
Probable end 31.07.2016
Status Completed

Automated planning is the problem of finding a sequence of state transitions (plan) that transforms the initial state of a transition system into a desired goal state or proving that no such plan exists. It is a fundamental problem in artificial intelligence, where it is studied by the planning and scheduling and heuristic search communities. We focus on (domain-independent) classical planning which is concerned with algorithms that are generally applicable, rather than being tailored towards one particular class of transition systems. Classical planning is challenging due to the state explosion problem: transition systems of interest frequently include 10100 or more states. The last decades have seen several breakthroughs in the scalability of classical planning algorithms, chiefly through the development of accurate distance estimators for general search methods such as the A* algorithm. However, there is mounting evidence that this line of research is reaching a saturation point, and that further improvements in the scalability of classical planners will have to be reached through other means than better distance estimators. In the project "Safe Pruning in Optimal State-Space Search" (SPOSSS), we targeted this challenge for the case of optimal planning with a focus on partial-order reduction, a method for eliminating redundancies due to transitions that can be interleaved in many ways. This follow-up project widens the scope to also include satisficing planning and to a much more general class of pruning and problem transformation methods than partial-order reduction. The objectives of the project are: to advance the theory and practice of symmetry elimination for planning. While previous work on symmetries focused on pruning symmetric states within a search algorithm, we will apply a rigorous theory of symmetry elimination to other aspects of state-space search, such as grounding, invariant synthesis, and the automatic computation of abstractions. to develop general and efficient methods for dominance pruning in transition systems. SPOSSS focused on equivalence pruning, which ignores transition sequences σ that can be shown to have exactly the same overall effect as another sequence τ. We will investigate more general methods that can also detect and exploit situations where σ is strictly less useful than τ. to develop soft pruning methods for satisficing planning. Existing pruning methods designed for optimal planning are hampered by the necessity to be absolutely certain that a pruned transition is not useful. Instead of all-or-nothing pruning decisions, soft pruning methods may decide to deprioritize transitions that are very unlikely to be important for reaching a solution but cannot be ruled out completely. to develop problem reformulation methods that automatically enrich the description of a transition system to make it more amenable to the distance estimation techniques used in modern planning algorithms, and to abstract away parts of the system that can be solved without search.

Keywords pruning techniques, symmetries, automated planning, problem reformulation, artificial intelligence
Financed by

Swiss National Science Foundation (SNSF)

Follow-up project of 1380111 Safe Pruning in Optimal State-Space Search

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ID	Kreditinhaber	Kooperationspartner	Institution	Laufzeit - von	Laufzeit - bis
2811774	Helmert, Malte	Hoffmann, Jörg	Universität des Saarlandes	01.05.2012	31.12.2030
2811778	Helmert, Malte	Fox, Maria	King's College, London	01.11.2012	31.07.2016
2811782	Helmert, Malte	Domshlak, Carmel	Technion	01.01.2015	31.12.2030

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