02285 AI and MAS
Project Automated Planning
Due: *Wednesday 20 May at 12.00 (noon)*

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This project concerns the use of planners for solving the game Sokoban. The Sokoban game is described here:

`http://en.wikipedia.org/wiki/Sokoban`

Sokoban is quite challenging from a planning perspective, and have a large combinatorial complexity.

The goal of the present project is to explore the use of automated planning in the Sokoban domain. The project should include both an analysis of the problem from a planning perspective and at least one implemented planner for solving the problem.

You are free to decide on the details of your project—including where you want to put your primary focus—but you should as a minimum address the following specific problems:

1. Describe the Sokoban problem as a STRIPS planning problem.

2. Argue that even very simple Sokoban problem instances are inappropriate to solve by uninformed search.

3. Explain how informed search using $A^\star$ can improve the solving of Sokoban puzzles.

4. Implement a simple progression planner to solve Sokoban puzzles. Implement in the planner at least one of the generic heuristics described in the subsection "Heuristics for state-space search" of section 11.2 in Russell & Norvig. Implement also a domain-specific heuristics that you define yourselves. Make tests to show the performance difference between the 3 versions of the planner: the basic one with no heuristics, the one with a generic heuristics, and the one with your own heuristics. Analyse your findings.

5. Discuss whether regression and/or POP planning is expected to be more efficient than progression planning for the problem at hand.

6. Is there a difference between the problem instances that are easy for a human to solve and the instances that are easy for the automated planner? Discuss the possibility of improving planners for Sokoban by seeking inspiration in the human strategies for solving the problem.

7. Consider different extensions of the Sokoban problem, e.g.:

   - using colored boxes that are required to be pushed into squares of matching colors;
   - using several pushers (multi-agent version);
   - allow the pusher(s) to push an entire row of adjacent boxes;
   - add traps or doors.

   Dicuss how such extensions will affect the STRIPS description of the planning problem. Dicuss how they will affect the choice of planner and heuristics. Implement one of the extensions in your progression planner, if time permits.

8. *Optional*: Consider using GraphPlan in the Sokoban domain. Do you expect it to perform better than the planners considered above? If time permits, apply one of the many GraphPlan implementations available online to the problem or implement your own GraphPlan algorithm.

   You are encouraged to search the Internet for relevant articles and/or implementations. Please make references in your final report as necessary.