

Multi-Agent Systems

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Exercise Sheet 4

Due: June 6th, 2016, 10:00

Exercise 4.1 (Matching Markets, 5+4)

- (a) Consider the market with buyers $\mathcal{B} = \{1, 2, 3\}$, sellers $\mathcal{S} = \{a, b, c\}$, and valuations

$$v_{ij} = \begin{array}{c|ccc} & a & b & c \\ \hline 1 & 6 & 5 & 4 \\ 2 & 5 & 2 & 3 \\ 3 & 4 & 3 & 2 \end{array}$$

Construct a set of market-clearing prices and find a perfect matching in the resulting preferred-seller graph, using the algorithms from the lecture. Your submission should include all intermediate steps.

- (b) Prove the theorem from slide 24 of lecture 7 (Market-Clearing Prices - Optimality II).

Exercise 4.2 (Sokoban Project Part I, 3+6+6)

On the last exercise sheet we implemented an allocation of boxes to agents for the case in which it is sufficient to assign a maximum of one box to each agent. Also, we did not care about goal fields yet. In this exercise we want to lift these restrictions. To simplify the problem, we divide its solution into two stages. In the first stage, a box is to be assigned to each goal field (some boxes may be left over). In the second stage, an agent is to be assigned to each box that has not been left over. Note that agents may now be assigned to an arbitrary number of boxes (including zero). Finally, we want the agents to move the boxes to their respective goal fields.

- (a) Implement the assignment of boxes to goal fields in a centralized manner (e.g., the agent with the lowest id computes it and then communicates it to the other agents). Your implementation should print out the final assignment to the console. Briefly document the idea behind your approach in your source code.
- (b) Implement the assignment of agents to boxes. You are free to choose your own (centralized or decentralized) approach. To achieve good assignments (note: it does not have to be optimal), consider also the goal fields the boxes were previously assigned to. Your implementation should print out the final assignment to the console. Make a short presentation (maximally 2-3 slides) for a three minute talk describing your approach and discussing its advantages and disadvantages. Be prepared to present it in the next exercise session.
- (c) Implement the transportation of the boxes to their goal fields. To get full points for this exercise, your agents should be able to complete all example levels from `ex04/sokoban-levels`. You can find detailed information on the push/pull actions in the documentation of the framework. Provide both an additional level `ex04/solved.lv1` that your agents can handle and a level `ex04/unsolved.lv1` that is yet too difficult for your agents (but solvable in general). The level file format should be self-explanatory. Make a short presentation (maximally 2-3 slides) for a three minute talk describing your approach and discussing its advantages and disadvantages. Be prepared to present it in the next exercise session.