Multiagent Systems

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Exercise Sheet 9

Due: Friday, July 18, 2pm

Important: Each exercise sheet is to be solved in groups of **two students**. Thus, please note your names on each solution sheet and, if applicable, in the source code (as a comment on top of each source file). The solutions are to be handed in as pdf or plain text files (UTF-8 encoded) using the SVN. We strongly suggest the use of LaTeX for typesetting your solutions.
As always so far, you might solve the exercises in English or German.

Exercise 9.1 (Cooperative games, 1+3 points)
We consider the cooperative game $\mathcal{G} = \langle Ag, \nu \rangle$ to be given with:

- $Ag = \{1, 2, 3\}$,
- $\nu : \mathbf{2}^{Ag} \to \mathbb{R}$ its characteristic function, and
- the utilities $\nu(\{1\}) = 3$, $\nu(\{2\}) = 4$, $\nu(\{1, 2\}) = 10$, $\nu(\{1, 3\}) = 7$, $\nu(\{2, 3\}) = 8$, $\nu(\{1, 2, 3\}) = 14$.

(a) Which utility $\nu(\{3\})$ must be assigned to agent 3 so that it is a dummy player in this game?

(b) Calculate the Shapley values sh_1, sh_2, and sh_3 for all three agents (taking into account your choice of $\nu(\{3\})$ above). Explain the main steps of your calculations.

Exercise 9.2 (Warehouse robots, 4+6 points)
We consider a new situation for the warehouse robots introduced in exercise 5.1. Now, new boxes arrive at random intervals in the green entrance area of the warehouse. Your robots should collect them and deliver them to the blue storage area. Thus, your task is to:

- Extend the program of the "warehouse manager" agent, which is immobile and perceives the boxes as soon as they arrive at the entrance. The agents should share the world state, for example information about:
  - The state of each storage cell, either empty, reserved, or occupied.
  - The state of each entrance cell, either empty, allocated, or unallocated.

- Use the contract net protocol or an alternative method of your choice to let the warehouse manager be the proposer and the robots be the contractors:
  - Robots that are busy should actively reject the proposals.
  - As long as the warehouse manager has any unallocated box left (and no current cfp for that box running), it will start another cfp.

You may use the A^* implementation provided to you by Andreas Hertle, e.g., to calculate a reasonable value for a robot's offer.