## Multi-Agent Systems

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# Exercise Sheet 10
### Due: January 16, 2019, 16:00

**Exercise 10.1** (DominationWorld III, 3+2+2)

We want to improve coordination between our agents in the Domination World. E.g., important observations should be relayed to other agents and the agents should agree upon which agent is responsible for which checkpoints (they even might agree to change this assignment over time). As a starting point, we provide a working implementation containing agents that already perform practical reasoning with the ability to explore the map and activate known checkpoints. However, you're also allowed to extend your own implementation from Exercise 4.1.

(a) Design a communication protocol to negotiate which agent is responsible for which checkpoint. Make a short presentation (maximally three or four slides for a three to five minute talk) describing your protocol and discussing its advantages and disadvantages. Be prepared to present your protocol in the exercise session.

(b) Implement the communication as defined in your protocol.[1] If you decide to base your implementation on your submission for Exercise 4.1, you are nevertheless allowed to use arbitrary parts of our implementation (e.g., the shortest path implementations in `utils.pl`).

(c) Adapt the agents' practical reasoning to comply with the assignment of checkpoints as agreed on with the other agents.

**Exercise 10.2** (Distributed Constraint Satisfaction, 2+4)

Consider the following distributed constraint satisfaction problem $\mathcal{P} = (A, X, C, D)$ with

$$A = (0, 1, 2, 3)$$
$$X = (x_0, x_1, x_2, x_3)$$
$$D = (\{1, 2, 3\}, \{1, 3\}, \{2, 4\}, \{3, 4\})$$
$$C = (x_0 > x_1, x_0 \neq x_2, x_0 \neq x_3, x_2 \neq x_3).$$

Remember that $A$ is the list of agents, $X$ is the list of variables s.th. $X_i$ is the variable of agent $A_i$, $D$ is the list of domains s.th. $D_i$ is the domain of variable $X_i$, and $C$ is the list of constraints.

(a) Build a communication graph for the agents that is appropriate for the application within the asynchronous backtracking search.

(b) Solve the CSP using asynchronous backtracking. Your submission should be a chronological log containing all sent and received messages for all of the agents as well as all corresponding changes of the agent's variables `current_value`, `agent_view`, and `constraint_list`. Your solution should contain nogood messages for at least two of the agents.

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[1] Look into the GOAL manual for information on how to implement communication in GOAL.