

Multi-Agent Systems

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Exercise Sheet 11

Due: January 24, 2020, 14:00

Exercise 11.1 (Moral Planning, 3+3)

Your task in this exercise is to informally describe one of the variants of the trolley problem (https://en.wikipedia.org/wiki/Trolley_problem) as a planning task and analyze the moral permissibility of a plan.

- (a) Use natural language to describe the planning task: How does the initial situation look like? What is the timed exogenous action (e.g., the disaster waiting to happen)? Which actions does the agent have (e.g., means to save lives) and what are their effects? What is the goal of the agent?
- (b) Find a plan that achieves the goal. Discuss, according to the definitions from the lecture, whether the plan is morally permissible under the principles of *utilitarianism*, *do-no-harm*, and *do-no-instrumental-harm*.

Exercise 11.2 (Distributed Constraint Satisfaction, 2+4)

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

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

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.