Argumentative agents for ethical regulation of urban transportation network

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Context, Motivation and Objectives

Ethics describe in relative way what is fair or unfair according to a set of values. An agent behaves ethically if she is able to justify and make her decision in accordance with a set of values. Modeling such an ethical decision making may consist in representing it with an argumentation process. This last one, is represented by a Dung's framework [1] which is a graph where nodes represent arguments and edges represent attacks between arguments. Dung's framework does not consider the notion of values, and it has been extended to value based argumentation framework which associates values with arguments [2]. However, since it is an abstract argumentation approach, no explicit mechanism to build this argumentation graph has been specified.

The global objective of this internship will be to implement a value-based argumentation framework enabling agents to make ethical decisions in a simulated environment. It will be applied to the domain of the regulation of urban traffic where we will design a responsible routing service for travelers. The theoretical objective is to delegate the decision process (here the argumentation process) of an agent, which is associated to the traveler, in order to define a decision as a compromise between the characteristics of the traveler (including her values) and the characteristics of the system (including global values). Classically, agent decision is constrained by the existing alternatives (i.e. his possible plans) and traveler features (e.g. does the traveler own a car ?), and it has to respect, as far as possible, the travelers' preferences. However to be sustainable, the agent decisions must also consider society objectives, as the decrease of pollution. These two points of view, i.e. travelers' preferences and society objectives, refer to distinct values: individual values and collective values.

A microscopic simulator embedded in the plateforme Territoire will be used to build the argumentation graph the agents will use to make decisions. Considering a car trip, this simulator computes alternatives by considering different modes (public transport, car, walking, etc.) or avoiding the regulated area. Because it simulates the car trip of the traveler, it may compute indicators about the state of the current traffic. It also computes indicators for evaluating the initial trip and the alternatives. Thus, these computed indicators will be used to validate arguments and attack relations between arguments. For instance, thanks to these indicators, we will be able to generate arguments as a couple (supports, conclusion) where supports would be "Taking the car at 5.30 pm to go from A to B will contribute to generate a CO2 emission rate of X" and a conclusion of this argument would be "therefore X is higher than the pollution threshold set by the policies". This argument may be associated with the value "Environmental Sustainability" and can attack all arguments that would defend the position "taking car".

Finally, agents will only make decisions that they can defend by at least one preferred set[1] of arguments calculated by the system. However enumerating all preferred sets of arguments takes too much time to be reactive for individual agent's decisions [5] and since we only need one set of arguments to defend the agent's decision, a challenge will be to propose a relevant heuristic to choose a good preferred set of arguments that respect the user's preferences as much as possible.

Expected results

- State of the art on how argumentation is currently used in a simulated environment.
- Application of the value based argumentation framework [3][5] for the transportation domain. Definition of agents' values shared in the system.
- Coupling the simulator with the argumentation framework.
- Evaluate the relevance of this argumentation mechanism to simulate and regulate urban traffic.

[1] A set of arguments S is preferred iff (i) no argument in S is in conflict with another argument, (ii) all arguments that attack one argument in S, is defended by at least one argument in S and (iii) there is no S' s.t. $S \subseteq S' : S \neq S'$ and S' verifies (i) and (ii) [7]

Bibliography

[1] Dung, P. M. (1995). On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. Artificial intelligence, 77(2), 321-357.

[2] Bench-Capon, T. J. (2003). Persuasion in practical argument using value-based argumentation frameworks. Journal of Logic and Computation, 13(3), 429-448.

[3] Souhila Kaci et Lendeert van der Torre (2007). Preference-based argumentation: argument supporting multiple values.

[4] Nir Oren (2013). Argument schemes for normative practical reasoning.

[5] Kröll, M., Pichler, R., Woltran, S. (2017). On the complexity of enumerating the extensions of abstract argumentation frameworks. In Proceedings of the 26th International Joint Conference on Artificial Intelligence (pp. 1145-1152).

[6] Governatori, G., Olivieri,F., Riveret, R., Rotolo, A., Villata, S. (2018). Dialogues on Moral Theories. In : DEON, 139-155.