win.win | a negotiating agent for mutual benefit

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1 PEAS MODEL

1.1 Performance measure

When creating a new agent, the first step is to determine what the performance measure is to which the newly created agent should aspire. [Russell and Norvig 2009, Ch. 2.3.1] The agent that will be created is a negotiation agent, so the most obvious performance measure should be the utility that is received after a negotiation.
One problem with the received utility as a performance measure however, is that the received utility differs from the domain that negotiations were made in and the agent that was negotiated with. Therefore, there are some other performance measures to keep in mind. One of those is the quickness of the agent.
In a time-based negotiation, (as opposed to round-based negotations) both parties can benefit a lot if the agents are able to accept and create bids quickly, since both parties are able to consider and create more bids than whenever both agents take a lot of time to consider bids.
The agent will also compete in an ANAC-like tournament. One of the lessons learned from these tournaments is that there exists no single strategy that outperforms all other strategies over all possible negotiation scenarios. If domain knowledge is available to the agent, said agent also performs better. [Baarslag et al. 2015]
The agents that participated in ANAC tournaments were able to reach very good results, so a good performance measure for a newly created negotiation agent should be its performance in a mini tournament against agents that participated in ANAC.

1.2 Environment

The agent is designed to be able to negotiate in a multi-agent environment. The goal of interaction is to reach a mutually acceptable agreement between two (or more) agents which all have conflicting interest and a desire to cooperate to reach an outcome. For simplicity, only entities bidding against each other and for a mutual deal are considered agents. For generalisation purposes, the notion of objects can still be considered while the agents will not be interacting with such objects or additional entities.

1.2.1 Competitiveness. As the tournament environment will never be a zero-sum game, it can be considered a cooperative environment even when certain competitive aspects are present in the form of different individual interest. In considered scenarios, agents' behaviour is best described as maximising a performance measure whose value depends on the other agents' behavior. For distinction, other agent(s) are furthermore deemed opponents.

1.2.2 Observability. Opponent's actions are known through bids which advances the word state for the agent. Communication emerges as rational behaviour. Even randomised action can be considered rational as it avoids the pitfalls of predictability. This adds to the agent's success certainty of achieving its goal. At the same time, this makes the environment only partially observable. Additionally, the negotiation session's length varies and is not predetermined. Overall, this makes the environment non-deterministic.

1.2.3 Adaptiveness. The environment can not change while an agent is deliberating, thus rendering the environment static for the agent. World state change is brought about in steps as a result of interaction between the agent and its opponent(s). There is no need for the agent to keep track of the state outside of the interaction. While every interaction is discrete in its own right, the world itself is continuous as the bids are not predetermined. As explained before, they can be rational even when randomised.

1.2.4 Summary. Some is known about the environment. For example, the fact that agent has an incentive to cooperate with its opponents as this is an inherent feature for all the parties in a negotiation session. On the other hand, much is left unknown. For example the exact way opponents interact during bidding, their strategy for accepting bids and making them. To conclude, we gather all the properties of the environment. We can say it is *partially observable, cooperative, non-deterministic, !sequential/episodic, static, continuous and unknown multi-agent environment.*

1.3 Actuators

In this model, the agents both can offer different strategies to the other agent. The other agent should act upon this strategy: the agent can accept the bid, or it can send another offer.

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