Automated Negotiation League (ANL) 2024: Detailed Description

December 22, 2023

This document provides a detailed description of the Automated Negotiating Agents Competition (ANAC) Automated Negotiation League (ANL) 2024.

1 Overview

In the Automated Negotiation League (ANL), participants explore the strategies and difficulties in creating efficient agents whose primary purpose is to negotiate with other agent's strategies. Every year, the league presents a different challenge for the participating agents. This year's challenge is:

Design a negotiation agent for bilateral negotiation that has access to its own utility and its opponents utility, but not its opponent's reservation value. The agent that scores best on individual utility, wins.

If you already decided to participate in ANL 2024, it would be good to start by registering here to receive updates and later submit your agent.

After that, you can further read this document, that will lead you step by step through everything you need to know to successfully participate at ANL.

2 Tournament set up

Before going further into NegMAS itself, we will explain more about the set up of the tournament.

2.1 Protocol

In ANL, the Alternating Offers Protocol is used. Here, the starting agent makes an opening offer, which is followed by the other agent performing one of these three actions:

- Accept the offer of the opponent agent.

- Make a counteroffer (thus rejecting and overriding the previous offer).

- Walk away (i.e. ending the negotiation without any agreement)

This process is repeated in a turn-taking fashion until reaching an agreement or passing the deadline. The deadline that we use in the competition is variable, it could range from 10 to 1000. If an agreement is found, a score is calculated for both agents, which is the utility of the deal at the end of a session. If no agreement has been reached at time of the deadline or if one of the agents walks away, the negotiation fails. In that case, each of the agents receives a private reservation value, which can differ per agent.

2.2 Scenario

In a negotiation, two agents try to find an agreement in a specific scenario. The scenario consists of a discrete outcome space (also called domain) and a preference profile per agent. The preference profile of your own agent is fully known, and the preference profile of your opponent is partially known: the agent has access to the opponent's utility function, except for the reservation value.

In this competition, we will use three types of scenario's. All preference profiles have a corresponding reservation value.

Zero-sum scenario's

This scenario is also known as "Split the pie". The agents need to find an agreement on what part of the pie they receive. If agent A receives part x, then agent B receives part 1 - x of the pie, so the scenario is zero-sum. We assume linear preferences, such that the utility function u_A for bid x is $u_A(x) = x$, and the corresponding utility function of the opponent B is is: $u_B(x) = 1 - x$. Here, 0 and 1 are the worst and best utility, respectively.

To limit the number of possible agreements, we discretize the domain in m outcomes, which can vary from 10 to 100000, meaning that only bids $x = k \cdot \frac{1}{m} \in [0, 1]$ are allowed, with k a whole number. This scenario is drawn in the top left graph in Figure 1.

Curve

Instead of using a fixed zero-sum utility function, we can also use a more general utility function. Again imagine two agents dividing a pie. We can reason that receiving more pie is always better, thus resulting in a higher utility. However, not every increase in pie has to result in an equal increase in utility.

This corresponds to monotonic functions of the portion of the pie received. For example, it is not possible that the utility function of agent A of receiving half a pie is lower than receiving a quarter of the pie. However, the steps that the utility function increases from e.g. 0.4 to 0.5 does not have to be the same as e.g. from 0.5 to 0.6.

In Figure 1 you can see the shape of the pareto frontier in this second second scenario called "curve". Here, the shape of the pareto frontier is shaped like the bidding curve of a time-based conceder.

Piece-wise linear

In the last setting, the shape of the Pareto front can be any piecewise linear shape with negative slopes, as can be seen in Figure 1. That is a different way of having monotonically decreasing functions of the received portions as utility functions.

As you might have noticed in Figure 1, some graphs include (blue) outcomes under the (red) pareto frontier line. Including these extra outcomes results in a non-monotonic outcome space. Therefore in these domains the parallel to the pie falls short, since it is possible to generate any outcome space here.

2.3 Evaluation

When the submission period is closed, a final tournament with all agents is run. The tournament settings will cover a range of different reservation values, deadlines, and discretizations. If both agents in a negotiation reach an agreement, the outcome's utility is the agent's score. The reservation value is obtained if no agreement is reached, which can differ per agent. There are two different evaluation categories:

Individual utility At the end of the tournament, the average utility of every agent is calculated. The agent with the highest average utility wins this category.

Nash optimality The Nash point can be calculated by maximizing

$$(u_A - \mathbf{rv}_A) \cdot (u_B - \mathbf{rv}_B),$$

with u_A, u_B the utility, and $\mathbf{rv}_A$ and $\mathbf{rv}_B$ the reservation value of agent A and agent B, respectively. The agent with the smallest average distance to the $\mathbf{rv}$-adjusted Nash point wins. The goal of this measure is to emphasize the cooperative challenge that the negotiation agents face.
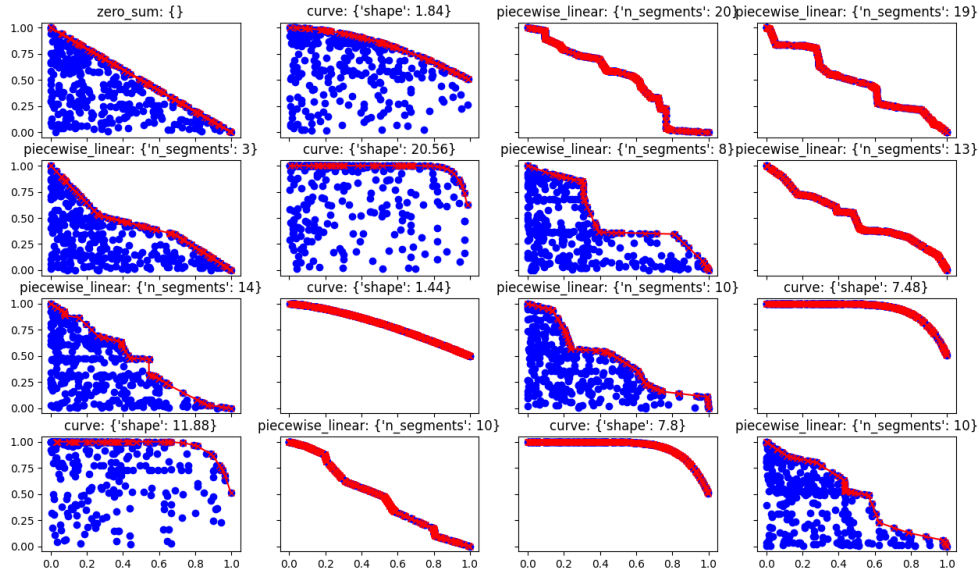
Figure 1: Examples of most of the six possible cases for zero-sum, curve and piece-wise linear scenario's.

3   Getting started

This year, the ANL will use the platform NegMAS, with a package called ANL. NegMAS supports submissions in Python.[1]

- **Tutorials:** You can follow simple tutorials how to use the package ANL on the ANL documentation website. Follow the steps there to **install** ANL and to **design your first negotiator**.

- **Negmas documentation:** There is a general documentation available for the platform NegmMAS here.

- **ANL Template:** If you installed ANL and NegMAS succesfully, and followed the tutorials (or decided you can do without them), you can download the ANL template for building an agent. The skeleton contains a number of files, including a READ ME and the files for the tutorials. In the README, you can find how to run your first tournament using the ANL template.

4   Rules of participation

- Agents need to follow the AOP protocol.

- Opponents are encountered multiple times, but it is strictly **not** allowed to save any information in memory or on HDD between negotiations (e.g. no change of global or class-level variables).

- Violating the spirit of fair play, e.g. exploiting bugs in the code, will result in disqualification. The ANAC board will be the judge in these matters.

- The competition rules allow multiple entries from a single institution but require each agent to be developed independently.

- No participant can be a co-author of more than three agents.

- The source code of agents must be submitted. This code will be included in the ANL package for future use after the competition is finished.

---

[1]If you prefer to submit your agent in JAVA, please get into contact with the organizers.

Figure 2: A pie cut into two pieces

5 Submissions

Participants submit their agent source code and academic report (optionally) to this submission portal. The deadline for submitting your agent is **April 3, 23.59 GMT**.

Academic report

Each participant should prepare a 2-4 page report describing the design of their agent according to academic standards. The best teams can give a brief presentation describing their agent depending on the available slots at AAMAS 2024.

Furthermore, the selected agent papers are planned to be published in the proceedings of coming AAMAS. The organizers of this league will evaluate the report. For eligibility, the design should contribute to the negotiation community. The report should address the following aspects:

- Bidding Strategy: How the agent generates bids each turn.

- Acceptance Strategy: How the agent accepts or rejects a bid.

- Reservation Value Modeling: How the agent estimates the opponent's reservation value.

6 Close off

Good luck!