2nd Annual Human-Agent Negotiation track, ANAC 2018

Motivation:

The Human-Agent Negotiation (HAN) competition is conducted to further explore the strategies, nuances, and difficulties in creating realistic and efficient agents whose primary purpose is to *negotiate with humans*. Previous work on human-agent negotiation has revealed the importance of several features not commonly present in agent-agent negotiation, including retractable and partial offers, emotion exchange, preference elicitation strategies, favors and ledgers behavior, and myriad other topics. To understand these features and better create agents that use them, this competition is designed to be a showcase for the newest work in the negotiating agent community.

Please note the submission deadline: **Tuesday, May 21st, 2018**. (to the IAGO website)
We encourage you to submit early to test your code compilation.
Notification of finalists: **Friday, June 1st, 2018**.
Competition special session: **Friday, July 13th – Thursday, July 19th @ IJCAI**

Summary:

The HAN competition requires each author or group of authors to submit an agent that will be tested in competition against human subjects in a study run through the University of Southern California. Based on the performance of the agent, we will determine which agent strategies are most effective. The subject pool will be taken from the standard populace available on Amazon's Mechanical Turk (MTurk) service, with normal filtration done for participants who are ineligible (see "Subject Selection", below).

All agents must be compliant with the IAGO (Interactive Arbitration Guide Online) framework and API, which will allow standardization of the agents and efficient running of subjects on MTurk. The most up-to-date version of IAGO is required, and will be available for download in February. The version of IAGO used in the 1st Annual HAN is available for download now, for researchers interested in getting a head-start.

Agents will all be run on the same set of multi-issue bargaining tasks, examples of which are included below ("Domain Example"). Agents will be allowed to communicate on several channels, including a set of natural language utterances that have been pre-selected and curated by the ANAC committee. Other channels include the exchange of offers through visual cues and natural language, preference statements, and emotional displays.

2018 Challenge:

This year's challenge will focus on the idea of repeated, multi-issue negotiations. Human participants will compete against each submitted agent in three back-to-back negotiations.

In each negotiation, the agent and the human participant will have the same preference and utility structure*, although these preferences will be unknown to the opposing side at the beginning of the three negotiations. In this way, agents that do a good job of learning opponent's preferences will likely outperform agents that do not.

More fundamentally, this approach allows us to capture which agent strategies successfully account for human behavior. While an aggressive strategy in the first negotiation may prove effective, it could have such a backfire effect by the last negotiation that it is not the right choice overall. This year's challenge will provide insight into these and more choices when designing agents whose primary purpose is to negotiate with humans over time.

*Note: The preference **structure** will remain the same, but the exact preferences may not remain constant. See "Additional Rules".

IAGO API:

IAGO is a platform developed by Mell and Gratch at the University of Southern California. It serves as a testbed for Human-Agent negotiation specifically. IAGO is a web-based servlet hosting system that provides data collection and recording services, a human-usable HTML5 UI, and an API for designing human-like agents.

A full documentation of IAGO is available from the download site, available at http://people.ict.usc.edu/~mell/IAGO. A brief summary is included here.

All agents may use the API to send and receive Events. Events are interpreted by the UI in preset ways that allow a human user to interpret an agent's intentions. Human users also generate Events that are passed to the agent developer to interpret as desired. Example Events include:

SEND_MESSAGE – sends a natural language utterance to be displayed on the chat log. Agents may send any language they wish, while human participants are restricted to sending from a preset list of utterances.

SEND_OFFER – sends an encoded offer for the multi-issue bargaining task wherein all items are assigned to either the human player, the agent, or an "undecided" section of the offer table. Also sends a pre-coded, descriptive message when sent from the agent to the human player.

SEND_EXPRESSION – sends an emoticon (either Happy, Angry, Surprised, or Sad) to the chat log, and also briefly shows the corresponding emotion on the visual avatar of the agent.

All Events may be sent with a delay, to allow chaining of related events (for example, an agent designer could send a message, then wait 2 seconds, then follow-up with an offer and an expression simultaneously). Flood protection will prevent messages from being sent too frequently.

Further detail may be found in the IAGO documentation.

Subject Selection and Data Treatment:

Competition subject participants will be selected from the MTurk subject pool. Subjects will be adults in the US (18 years or older), and will assert that they are permanent residents of the US (this will be verified with IP address tracking). Restriction to the US will be done to reduce cross-cultural effects. Each agent will be tested against 25 participants. Participants will not be re-used or be matched against more than one agent.

Due to the fact that MTurk participants will be US-restricted and natural language statements are used in the utterance set of the competition, participants will also be asked to affirm that their first language is English.

Basic demographic information of subjects will be collected, and the subjects may be asked a set of verification questions/attention checks to ensure they comprehend and are engaged in the negotiation. Subjects who fail these questions will be removed from the competition and the resulting data set. If a subject is removed due to failing an attention check, an additional subject will be run against that agent (to ensure a 25-person subject count). Subjects whose data is not captured due to agent malfunctions will not be rerun (see "Testing", below).

The data set collected by the competition organizers may be released to the organizing committee, and all agent developers/researchers may request access to the data after the organizing committee releases it. All submitted source code may be released and/or reused by the organizing committee. Researchers not wishing to release source code should contact the organizers directly.

Competition Winners and Evaluation:

A set of prizes will be awarded to the winners of the competition according to the highest score achieved by the agent. The winner will be the researcher whose agent has achieved the highest score at the end of the bargaining time. Non-significant differences will be tie-broken by the highest score. All differences, including differences between the control agent and submitted agents, will be reported.

Note that since there will be a series of negotiations, aggressive strategies may backfire.

Note: The 2018 Challenge does not have a Likeability Prize. Please see "2018 Challenge" for how likeability indirectly affects outcome.

We maintain the opportunity to examine other categories for "bonus" prizes.

Testing

Like the 2017 competition, we will provide automated compilation testing for all submissions. We will also provide a guide for manual runtime testing with internal subjects (so that you may test your own agents before submitting).

Note: Agents that experience malfunctions during runtime will have incomplete data excised, and additional subjects will not be re-run.

Domain Example:

We present here an example domain. A domain similar to this will be used in the actual competition.

This negotiation is a multi-issue bargaining task, which means both the agent and the human participant will negotiate over the same set of items. Items may have differing values to each side. A "full offer" means that all items are assigned to either the agent or the human participant. A "partial offer" means that some items remain on the table and undecided. _No offer is considered binding until both players accept the same full offer._

A negotiation will only end when such a full offer is accepted, or the 8-minute time limit for the negotiation has expired. Human participants will have a warning shown when there is only 1 minute remaining. Agents will have continuous access to the current negotiation time, accurate within approximately 5 seconds. In the case that time expires with no full offer, each player will take points equal to their respective Best Alternative To Negotiated Agreement (BATNA).

Note that the IAGO API allows agent designers to read the natural language descriptions of the issues at runtime (e.g., "Issue1" can be understood to be something like "Lumber" or "Luxury Cars"). However, agents will make use of domain-agnostic calls.

The following example challenge is a simple multi-issue bargaining task over resources between two countries. There will be four distinct resources, with five items in each category. The items will have images and descriptions identifying them as either "Oil", "Iron", "Foodstuffs" or "Lumber". The human player is assigned a value of 4 points to each Oil, 3 points to each Iron, 2 points to each Lumber, and 1 point to each Foodstuff. The agent player is assigned a value of 4 points to each Foodstuff, 3 points to each Lumber, 2

points to each Iron, and 1 point to each Oil. Each player's BATNA is equal to 4, i.e., the value of a single one of their highest item.

In the second negotiation, the values are swapped, but the structure is identical. The human player is assigned a value of 2 points to each Oil, 1 point to each Iron, 4 points to each Lumber, and 3 points to each Foodstuff. The agent player is assigned a value of 2 points to each Foodstuff, 1 point to each Lumber, 4 points to each Iron, and 3 points to each Oil. The third negotiation follows a similar pattern.

Note than in both domains, the human's point values and BATNA will NOT be revealed to the agent designers prior to the competition.

Natural Language Utterances:

Please see the IAGO website for the most up-to-date version of the following utterances. At the time of this writing, these represent the complete list of utterances the human player may send to the agent:

It is important that we both are happy with an agreement.
I gave a little here; you give a little next time.
We should try to split things evenly.
We should each get our most valuable item.
Accept this or there will be consequences.
Your offer sucks.
This is the last offer. Take it or leave it.
This is the very best offer possible.
I can't go any lower than this.
We should try harder to find a deal that benefits us both.
There's hardly any time left to negotiate!

Additional Rules:

Competition participants will be given a test scenario to practice with their agents. However, to prevent hard-coding preference data into agents, a different set of utilities will be used for the actual competition.

There will be no fewer than 3 distinct issues, and no greater than 5. Each issue will have fewer than 20 items.

Issue utilities will adhere to the following rule:

$$\sum_{i=1}^{k} \text{Agent\_utility}(i) * (\text{num\_levels}(i) - 1) = \sum_{i=1}^{k} \text{Human\_utility}(i) * (\text{num\_levels}(i) - 1)$$

where k is the total number of issues.

Succinctly, this relationship means that the total for each side would be the same if that side obtained every item.

Additionally, the total points and structure of utilities will not change <u>between</u> negotiations for either side. Formally:

$$\sum_{i=1}^{k} \text{Utility\_nego1(i)} * (\text{num\_levels(i)} - 1) = \sum_{i=1}^{k} \text{Utility\_nego2(i)} * (\text{num\_levels(i)} - 1)$$
$$= \sum_{i=1}^{k} \text{Utility\_nego3(i)} * (\text{num\_levels(i)} - 1)$$

It is highly encouraged that researchers use any technique by which an agent can successfully store information within the three negotiations for a given participant. This includes methods by which the agent may learn preferences in one negotiation and then subsequently passes that information back to itself in future negotiation. Use of the IAGO API's database storage functions must be used for this purpose. However, the intent of this competition is not to learn an entire domain, and therefore data may not be stored across participants--all 25 participants are to be treated as fresh instances against which the same agent will be run.

Note: Participation in this competition is done in good spirit and for the furtherance of academic knowledge. Attempts to circumvent the rules described herein or as they are described by the ANAC organizers will not qualify for prizes.

<u>**Reference:**</u>

Mell, J., Gratch, J. (2016) "IAGO: Interactive Arbitration Guide Online", In *Proceedings of the 2016 International Conference on Autonomous Agents and Multiagent Systems.* International Foundation for Autonomous Agents and Multiagent Systems.

Mell, J., Gratch, J. (2017) "Grumpy & Pinocchio: Answering Human-Agent Negotiation Questions through Realistic Agent Design", *Proceedings of the 2017 International Conference on Autonomous Agents and Multiagent Systems International Foundation for Autonomous Agents and Multiagent Systems.*