The Ninth International Automated Negotiating Agents Competition (ANAC2018)

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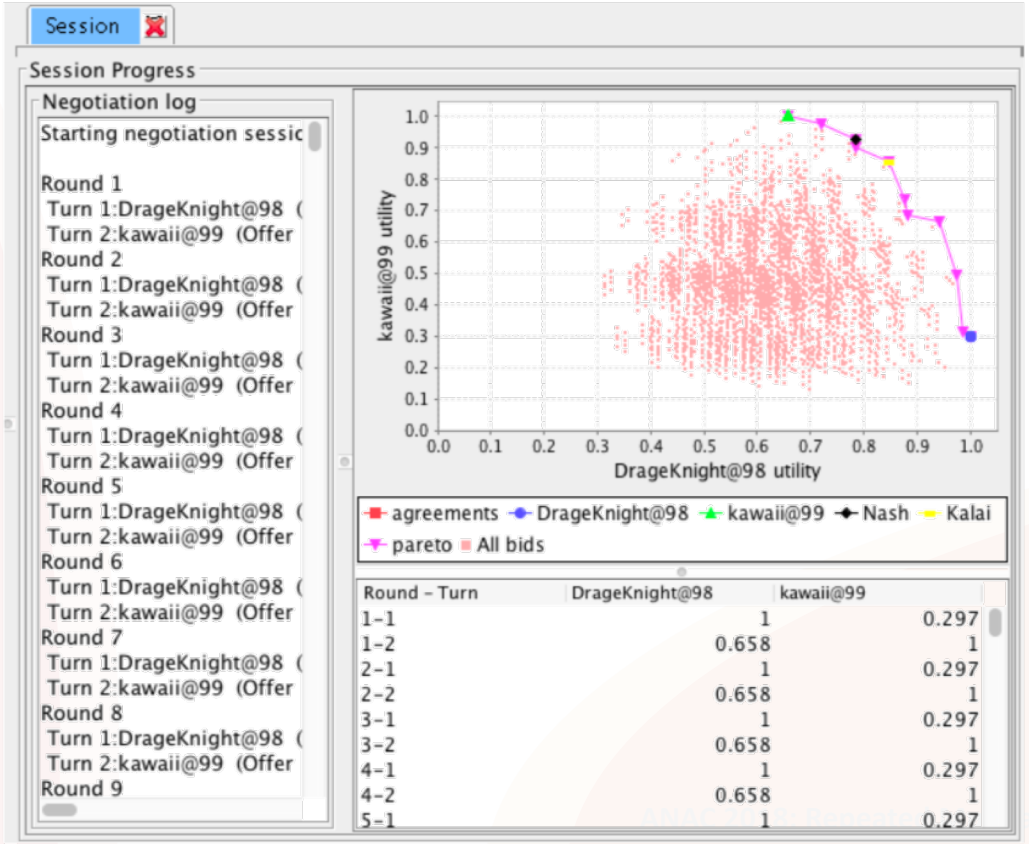
ANAC REPEATED MULTILATERAL NEGOTIATION LEAGUE

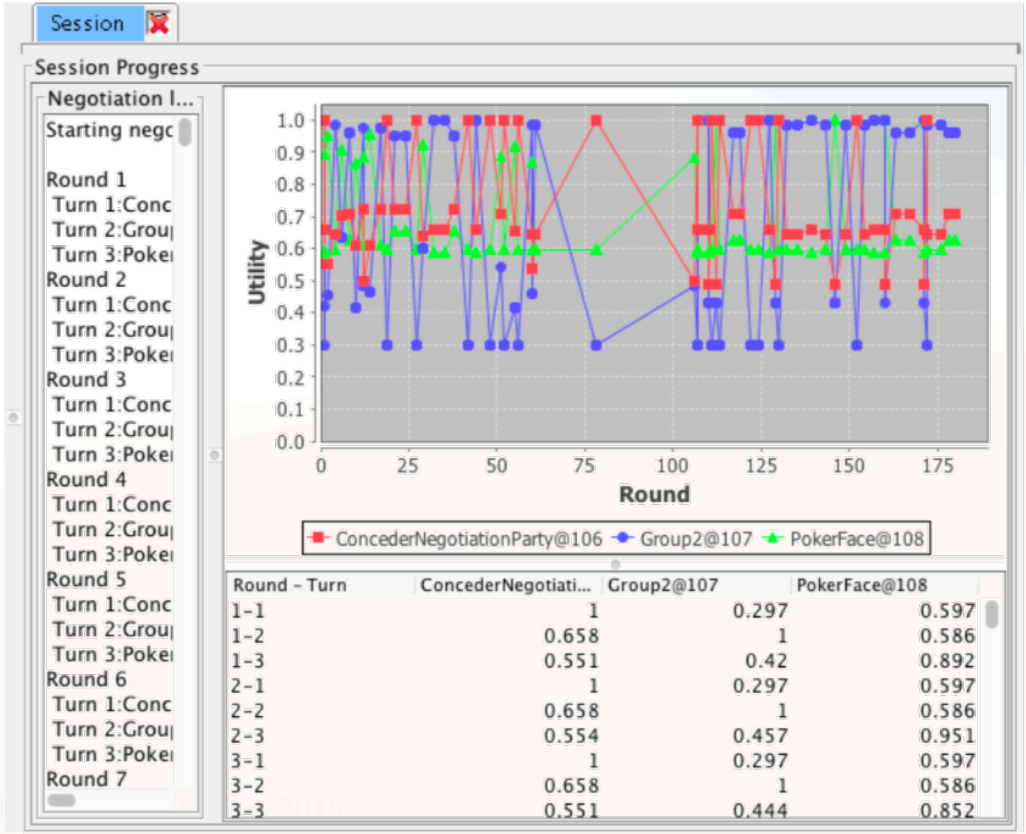
Competition Setup

- **Multi-party** Closed Negotiation
  - Stacked Alternating Offers Protocol (SAOP)
  - Negotiation among three agents
  - Negotiation without any knowledge of the preferences and strategies of the opponents.
- Real time with a deadline after 3 minutes
- Reservation value (from 2012)
- Each negotiation is repeated five times
- Utility functions are linear
  - Agents negotiate about the large set of previously unknown preferences

GENIUS

- GENIUS is a research tool for automated multi-issue negotiation
- Tournaments: negotiation agents compete with many others in different scenarios
- Repository of negotiation domains and agents





Preferences of Negotiating Parties

- **Weighted-Summing Utility Function: Preference information**
  - Each agent has its own utility function.
  - The utility function is expressed as follows:

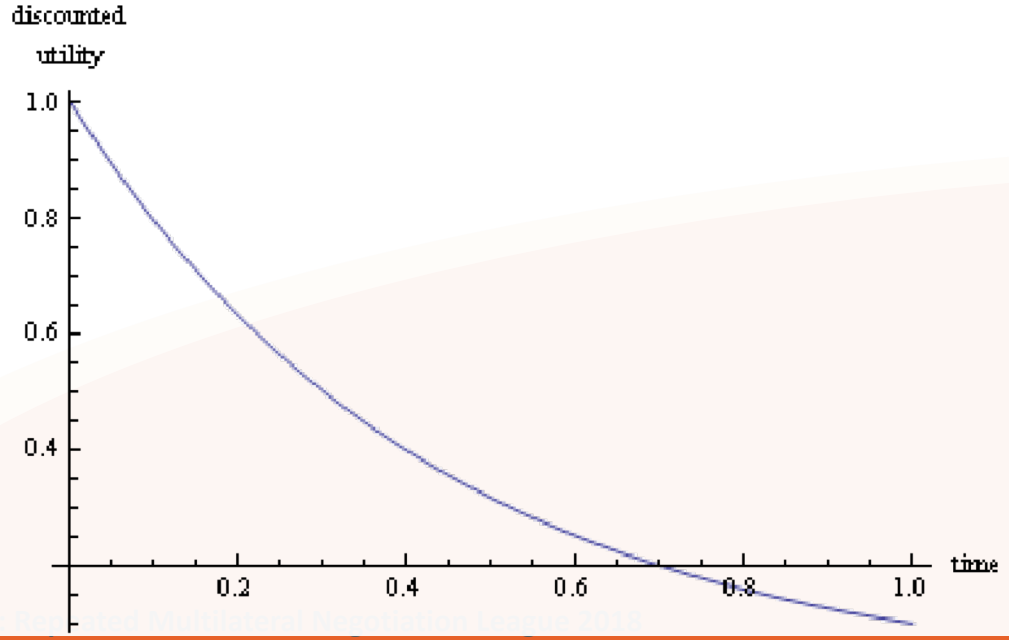
$$u_a(b^t) = \sum_{j \in I} V_a(b_j^t) \cdot w_{a,j}$$

- Each issue $j \in I$ can take a value v_j from a predefined set of valid values for that issue denoted by D_j (i.e., $v_j \in D_j$).
- Each agent can access this domain information.
- A bid $b = (b_1,\ldots,b_{|I|})$ is an assignment of values to all issues where $b_1 \in D_1$.
- $V_a(v_j)$ denotes agent a's valuation of the value for the issue j

Time Pressure

- Deadline
  - Offers are exchanged in real time with a deadline after specific minutes
  - If agents can't make an agreement by the deadline, their utility is the reservation value
- Discount factor
  - An agreement decreases over time
- Reservation Value = Disagreement Point

Example of Discounted Factor ->



Stacked Alternating Offers Protocol (SAOP)

- All participants around the table get a turn per round
  - Turns are taken clock-wise around the table
- The first party starts the negotiation with an offer that is observed by all others immediately.
- Whenever an offer is made the next party in line can take the following actions:
  - Make a counter offer (rejecting and overriding the previous offer)
  - Accept the offer
  - Walk away (e.g. ending the negotiation without any agreement)
- This process is repeated in a turn taking clock-wise fashion until reaching an agreement or reaching the deadline.
  - To reach an agreement, all parties should accept the offer.
  - If at the deadline no agreement has been reached, the negotiation fails.

New Challenge in ANAC2018

- Learning and Adaptation in Multilateral Negotiations
  - Agents can access data from their past negotiation sessions.
  - The name and order of the agents involved in all their previous negotiations.
  - The utilities of the exchanged offers in any previous negotiation session (according to its own utility space).
    - They cannot see the utilities of the other agents in any previous negotiation sessions.
  - The agreement that is reached by the agents it negotiated with.

Participants

- 21 Participants
- 10 Institutions from 8 countries
  - Bar Ilan University - Israel
  - TU Delft - NL
  - Tianjin University – China
  - Privateer - Japan
  - Nagoya Institute of Technology - Japan
  - Ozyegin University - Turkey
  - University of Tehran – Iran
  - Tokyo University of Agriculture and Technology - Japan
  - Technical University Of Crete - Greece
  - University of Southampton - UK

4 Negotiation Scenarios

Name	# of Issue	# of Values	Scenario Size
Meng wan	6	4,4,4,4,3,4	3072
Beta One	3	4,4,4	64
IQSon	7	7,6,5,3,4,4,4	40320
Hamada	4	5,5,5,5	625

*We selected four scenarios considering the scenario size from the submitted scenarios.

QUALIFYING ROUND RESULTS

Qualifying Round

- 21 agents are divided by three pools, randomly
  - **PoolA:** meng wan, AgentHerb, IQSun2018, PonPokoRampage, FullAgent, Seto, Lancelot
  - **PoolB:** Beta One, Yeela, SMAC_Agent, AgreeableAgent2018, ConDAgent, Shiboy, Libra
  - **PoolC**: AgentNP1, GroupY, ATeamAgent, Sontag, Agent33, Agent_Hama, Exp-Rubick
- The top 3 performing agents in each pool can proceed to the final (9 finalists out of 21 agents in each category)

Qualifying Round Setup

- GENIUS 8.0.4
- Allocating the entire matches to 8 computers in Japan
  - For finishing the qualifying round, it took for about a week

Qualify Round Result (Pool A)

Agent Name	Individual Utility	Social Welfare
meng wan	0.586923478	1.632116151
AgentHerb	0.49193542	1.854380384
IQSun2018	0.583185484	1.759158992
PonPokoRampage	0.567184966	1.547263306
FullAgent	0.549039084	1.766976108
Seto	0.551805443	1.449438396
Lancelot	0.517828051	1.53437244

Qualify Round Result (Pool B)

Agent Name	Individual Utility	Social Welfare
Beta One	0.482887311	1.404794645
Yeela	0.399430418	1.422654384
SMAC_Agent	0.464635439	1.325276881
AgreeableAgent2018	0.505584897	1.505251211
ConDAgent	0.471002153	1.518896956
Shiboy	0.502585371	1.411124211
Libra	0.445786573	1.227738202

Qualify Round Result (Pool C)

Agent Name	Individual Utility	Social Welfare
AgentNP1	0.512177707	1.52976242
GroupY	0.485323479	1.33874982
ATeamAgent	0.345297603	0.980979189
Sontag	0.484535782	1.515047114
Agent33	0.428666974	1.419233621
Agent_Hama	0.469592183	1.393009022
Exp-Rubick	-	-

FINAL ROUND

Final Round

- The tournament among 9 finalists in each category
- 4 selected scenarios submitted by the participants
- For each scenario, we ran 2520 negotiations

Prizes

Individual Utility and Social Welfare Category

1st Place	€300
2nd Place	€200
3rd Place	€100

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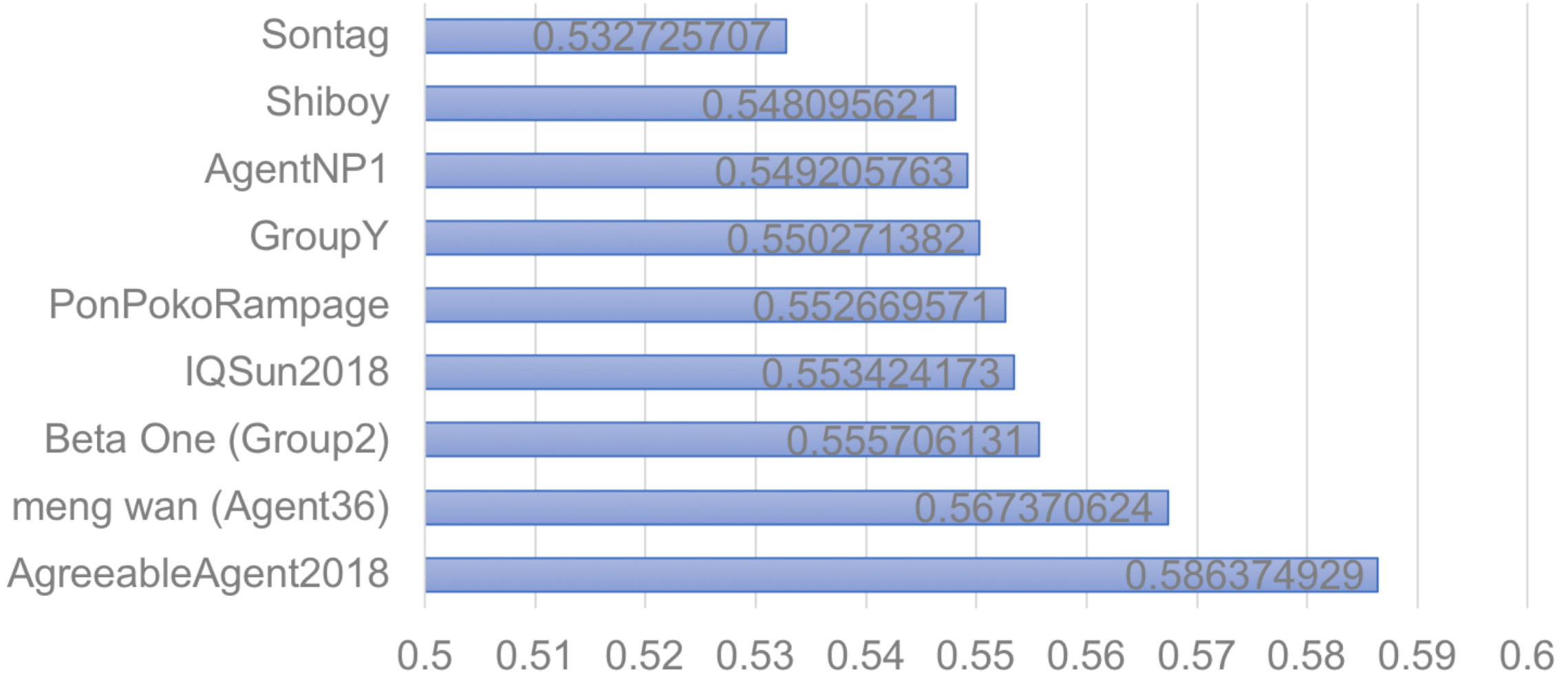
Overall Ranking (Individual Utility)



Overall Ranking (Social welfare)