Pacific Rim International Automated Negotiation Agents Competition (PRIANAC)

Organizers:

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Student Committee:

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Tomoya Fukui, Nagoya Institute of Technology
Ryohei Kawata, Tokyo University of Agriculture and Technology

Competition Setup

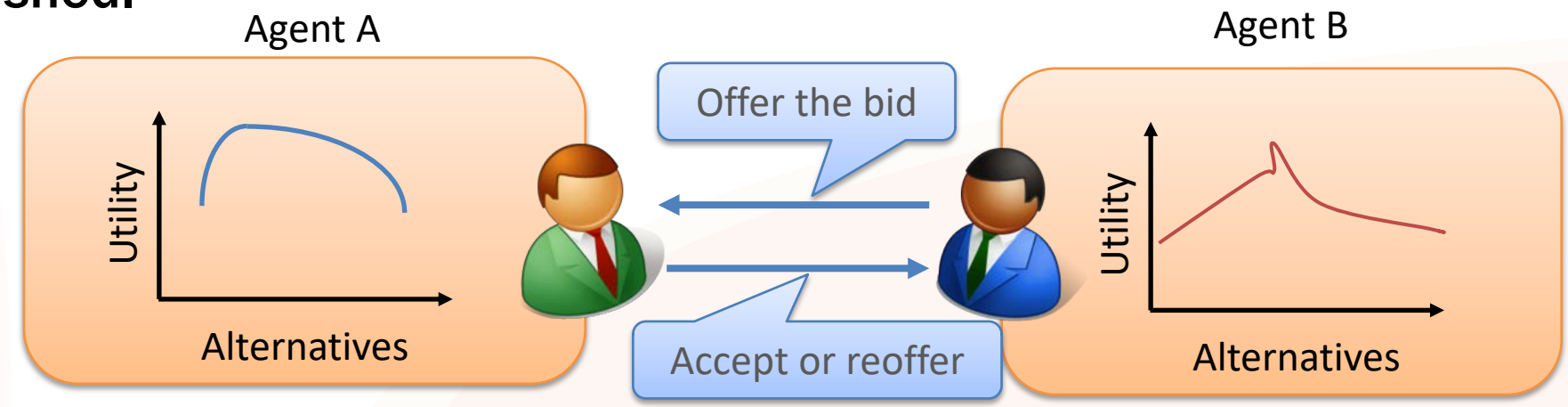
- Bilateral Closed Negotiation Protocol
  - Negotiation without any knowledge of the preferences and strategies of the opponents before the negotiation
- Real time deadline
- Discounting Factor
- Reservation value
- Utility functions are weighted additive
  - Agents negotiate about the large set of previously unknown preferences
- Repeated Encounters
- Best overall average of individual utility or Social Welfare = Winner !

Negotiation Setup

- Platform: Genius 9.1.1
- The number of agents: 2
- Protocol: Alternative Offer Protocol (AOP)
- Negotiation time: 10 sec.
- The number of negotiations on the same configuration: 100

Alternating Offers Protocol

- Two agents exchange offers in turns.
- Offer : Proposing a new bid.
  - If the agent doesn't accept, the agent returns the Offer.
- Accept : Accepting its opponent's last bid.
  - If the agent accepts the opponent's proposal, this negotiation will be finished.



Utility Function

- Let n be the number of issues and $\beta_i^w (\sum_{i=0}^{n} \beta_i^w = 1.0)$ be the weight of each issue i.
- Utility function $U(\omega)$ of bid ω is $U(\omega) = \sum_{i=1}^{n} \beta_i^w u_i(\omega_i)$

  where $\omega_i \in \{0, 1\}^{n_i}$ is a chosen value in issue i.

- For each issue i, let n_i be the number of values of the issue and utility function $u_i(\omega_i)$ be

$$u_i(\omega_i) = \sum_{j=1}^{n_i} \beta_j^v \omega_{ij}$$

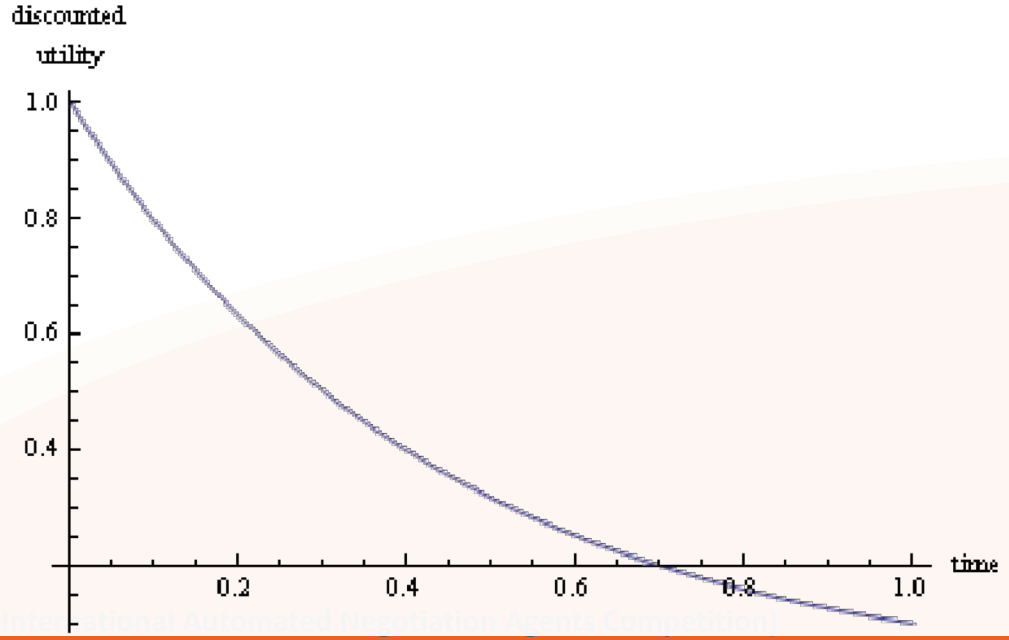
  where β_j^v is an evaluation value of j and normalized to satisfy $max(\{\beta_j^v \mid 1 \leq j \leq n_i, j \in \mathbb{N}\}) = 1.0$

- Agents have unique β^w and β^v to represent its preference.

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 = The score in failing the negotiation

Example of Discounted Factor ->



Repeated Encounters

Have agents repeatedly negotiate with each other in same domain so they can learn

- to save information during and after negotiation session
- to load it at the beginning of new session on the same domain and profile

Challenges

- Agents can make use of bids in previous negotiation sessions.
  - Use of local file and a popular machine learning library (scikit-learn)
    - To use the default functions of loading and reserving the previous negotiation sessions as STANDARD mode
    - To read/write the local file in order to take over the information on past negotiation sessions
    - The utility of bids, bids' information, time can take over
    - We won't permit taking over the preference information at all
    - The local file will be removed every time
  - To call a Python process

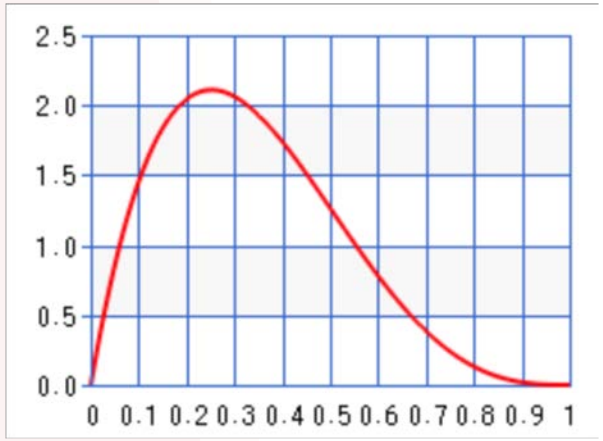
Participants

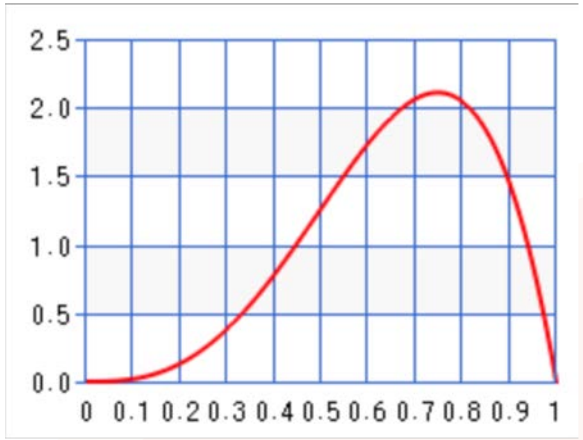
- 6 Participants
- 4 Institutions from 2 countries
  - Privateer - Japan
  - Nagoya Institute of Technology - Japan
  - Ozyegin University - Turkey
  - Tokyo University of Agriculture and Technology - Japan

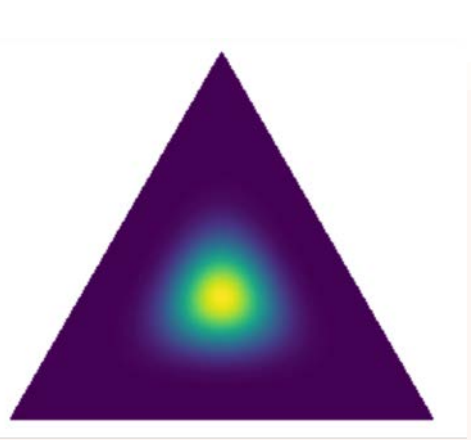
Preferences

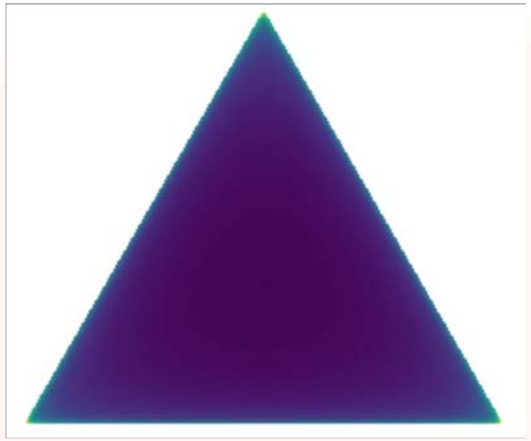
- The number of issues: $n = 5$
- The number of values for each issue: $n_i = 5$
- Reservation Value: *0.5*

Parameter	Distribution	Ver.A	Ver.B
β_j^v: Value	Beta	$\alpha=2, \beta=4$	$\alpha=4, \beta=2$
$\beta^{w:}$ Weight	Dirichlet	*[9,9,9,9,9]*	*[0.3, 0.3, 0.3, 0.3, 0.3]*
Discount Factor		*1.0*	*0.5*

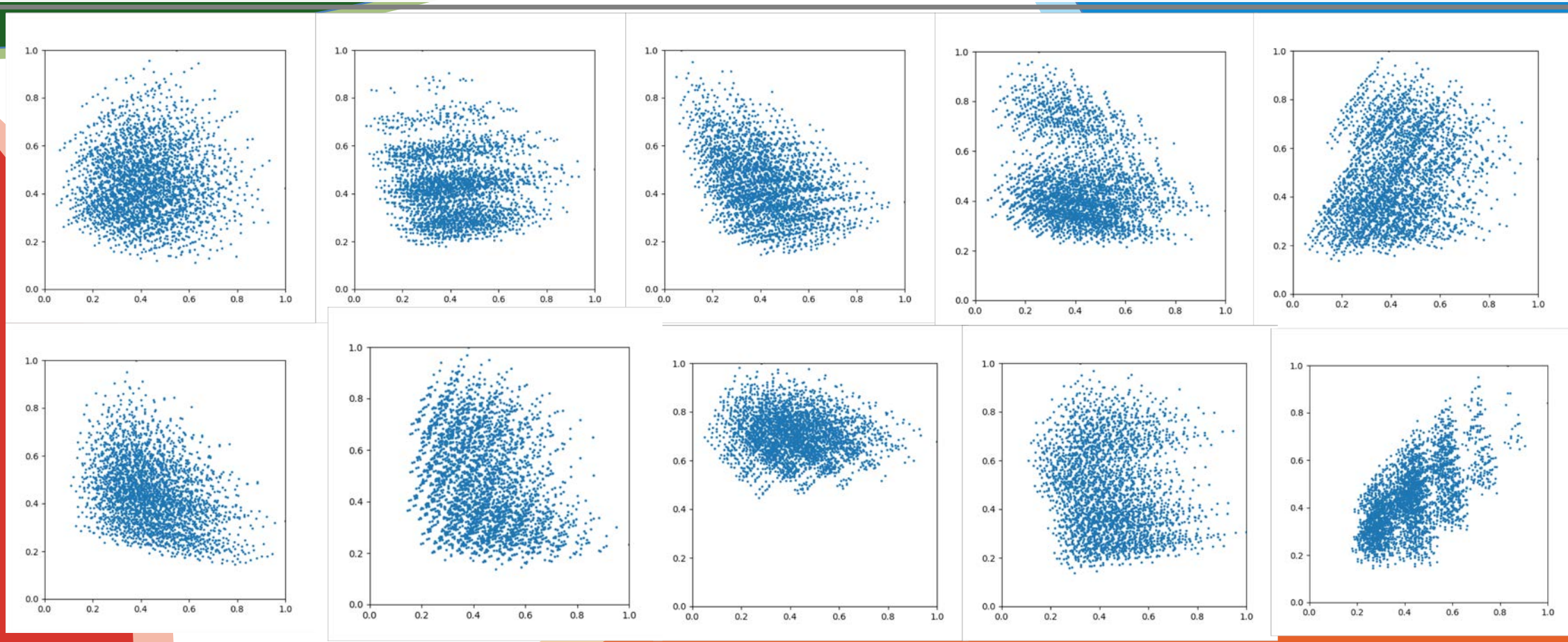








Examples of Scenarios

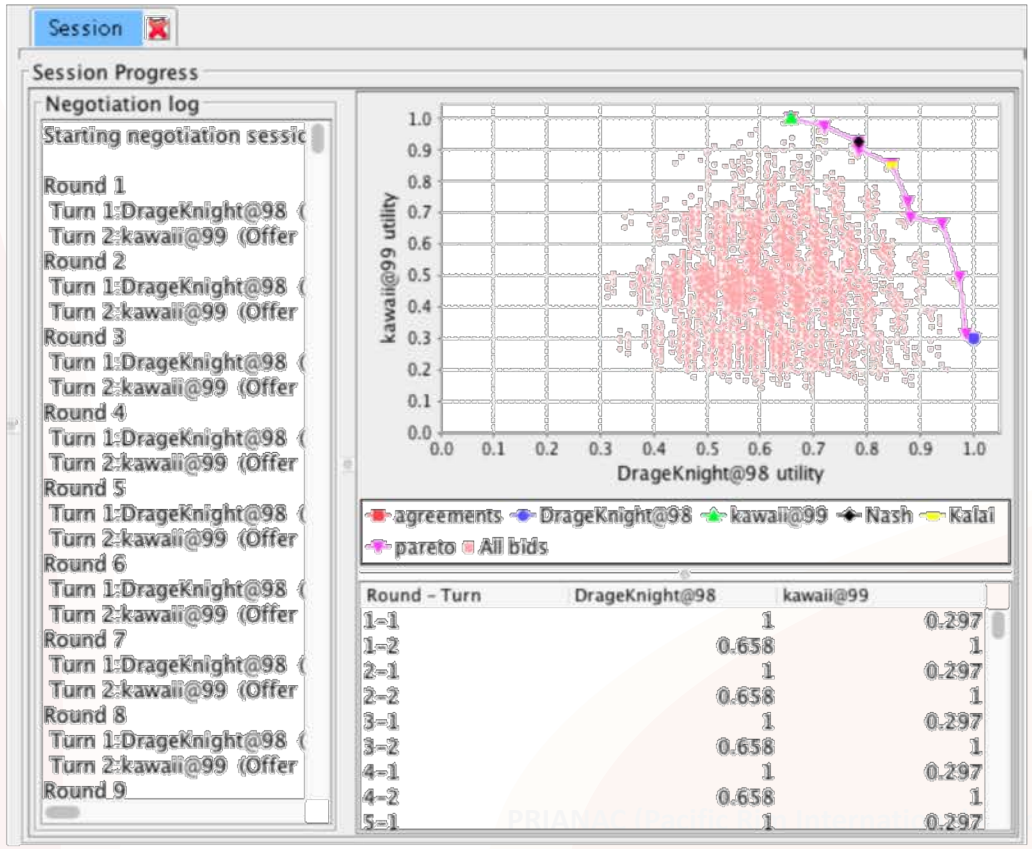


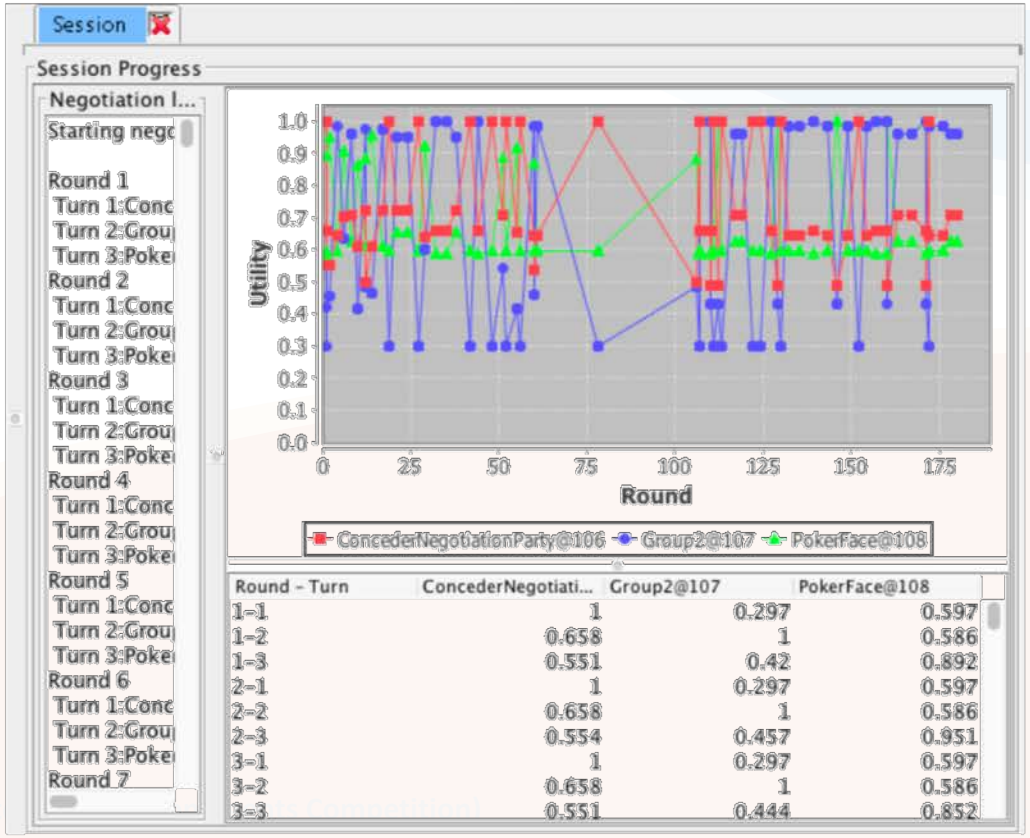
Environment

- OS: CentOS
- RAM: 64GB
- CPU: 3.6GHz
- Platform: Genius 9.1.1
- Java: version 1.8.0
- Python
  - Python 3.6.6
  - numpy 1.12.1
  - scipy 1.15.1
  - scikit-learn 0.19.2

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





PRIANAC RESULTS

Final Round

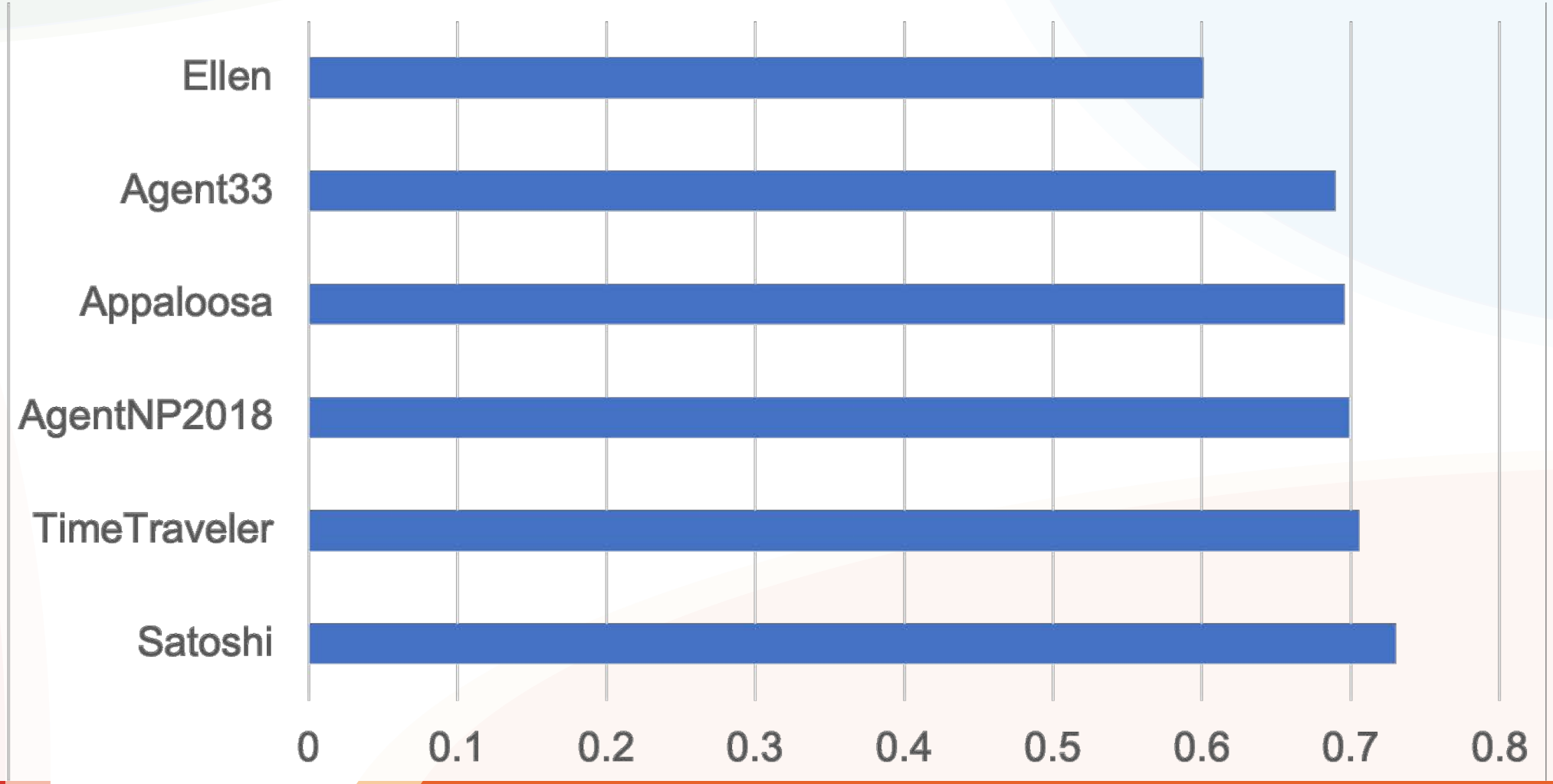
- The tournament among 6 agents
- 120 scenarios are generated by organizers
- We ran 12,000 sessions in each tournament

Prizes

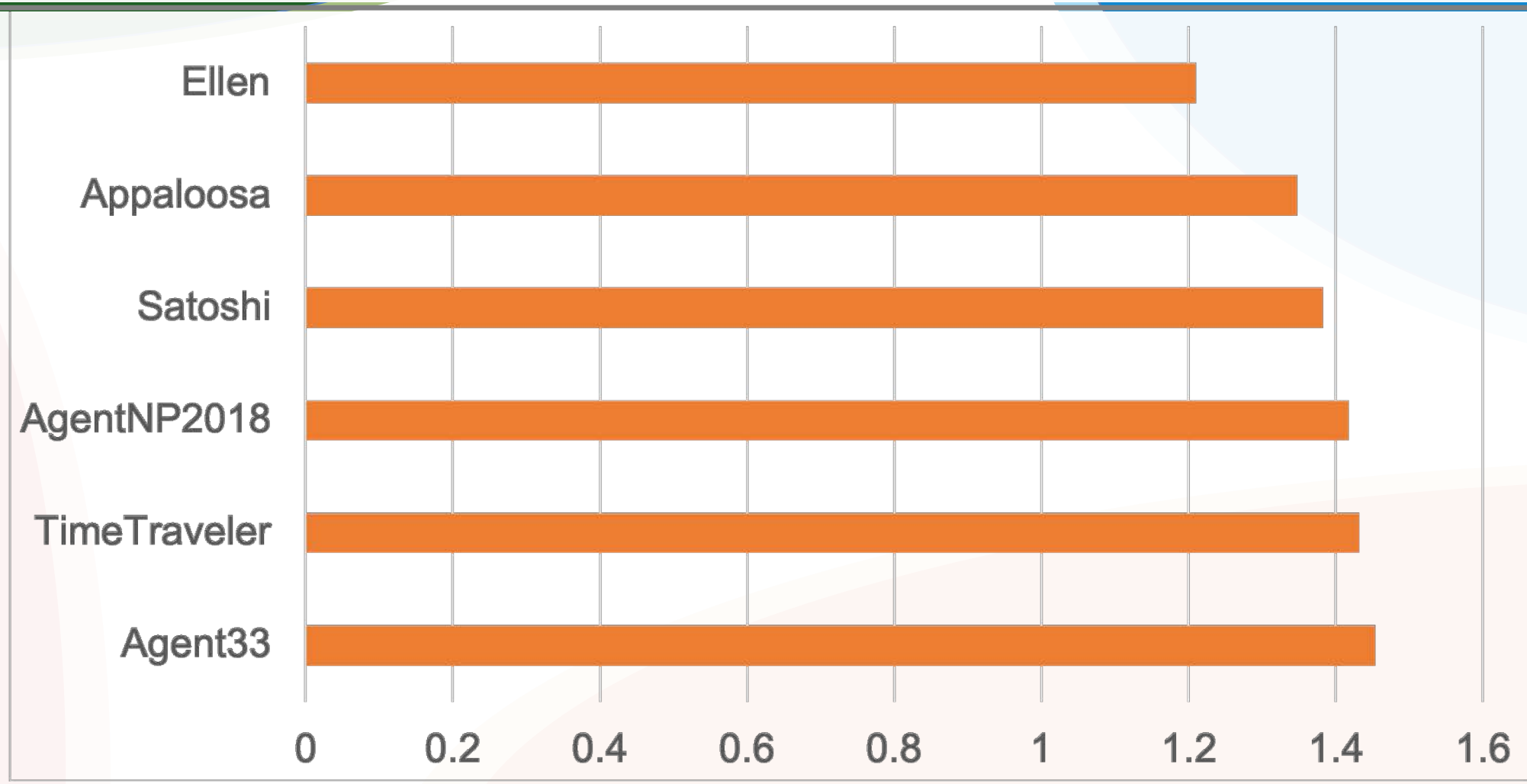
Individual Utility and Social Welfare Category

Winner	¥10,000

Overall Ranking (Individual Utility)



Overall Ranking (Social welfare)



Winners of PRIANAC

[Individual Utility Category]

Satoshi by Reyhei Kawata

(Tokyo University of Agriculture and Technology, Japan)

[Social Welfare Category]

Agent33 by Shan Liu

(Nagoya Institute of Technology, Japan)