

Automated Negotiation League 2024

Tamara Florijn (CWI & Utrecht University)

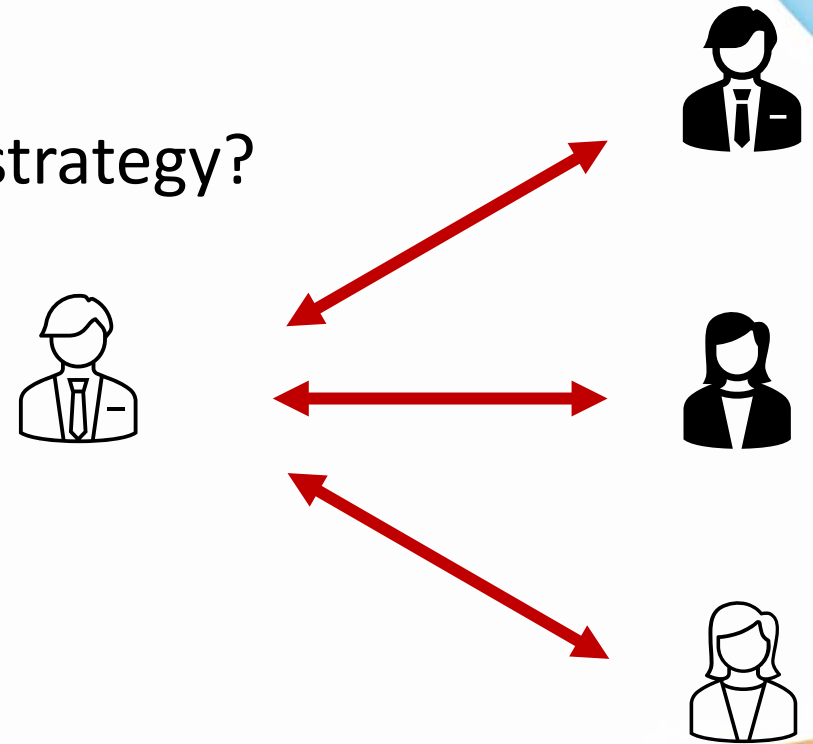
Yasser Mohammad (NEC-AIST, Japan)

Tim Baarslag (CWI & Utrecht University)

ANAC board members

Plan B

- Salary negotiation with a possible new employer
- You still have your current job
- How does that influence your negotiation strategy?



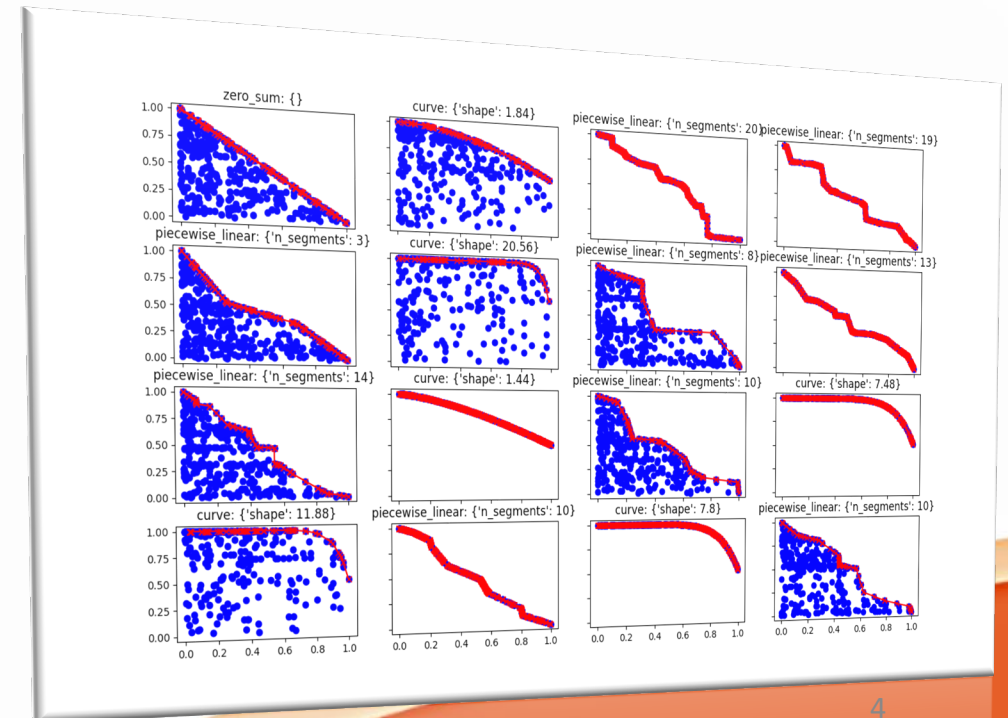
This year's challenge

- Bilateral negotiation
- With private reservation values
 - If the negotiation fails, each agent gets a private reservation value



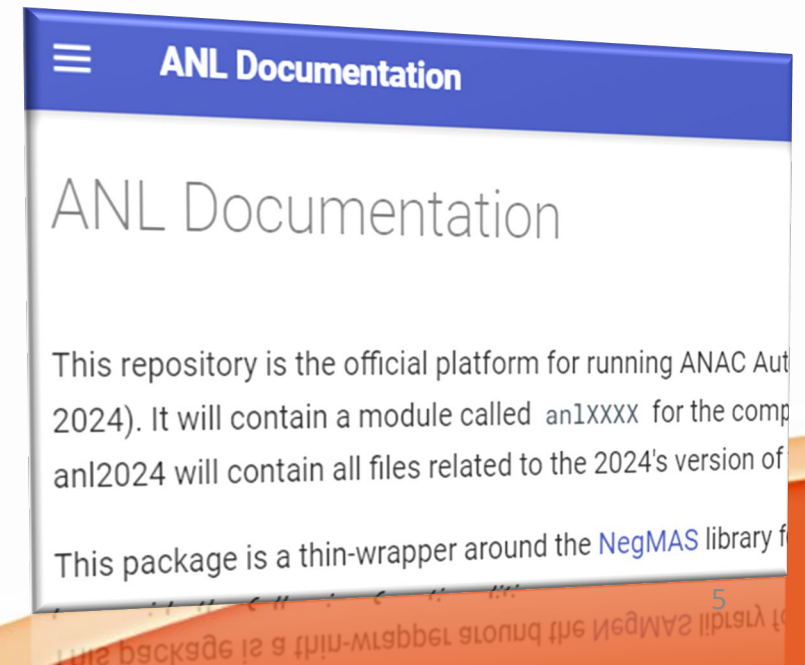
This year's challenge

- Shared utility function
 - Only the shape of the pareto frontier defines a scenario

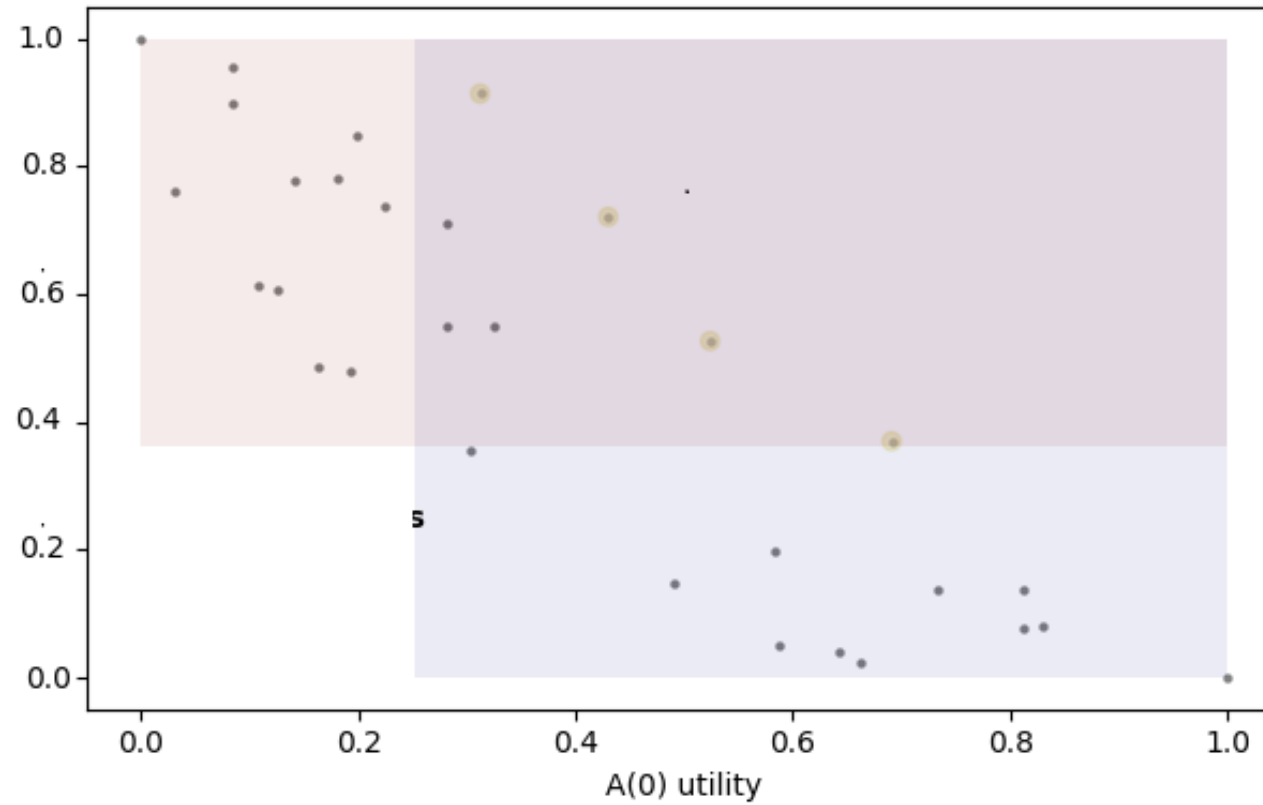


This year's challenge

- NegMAS
 - Advantage: A joint platform for SCML and ANL league
 - Python-based
 - Separate module for ANL and upcoming ANL-agents

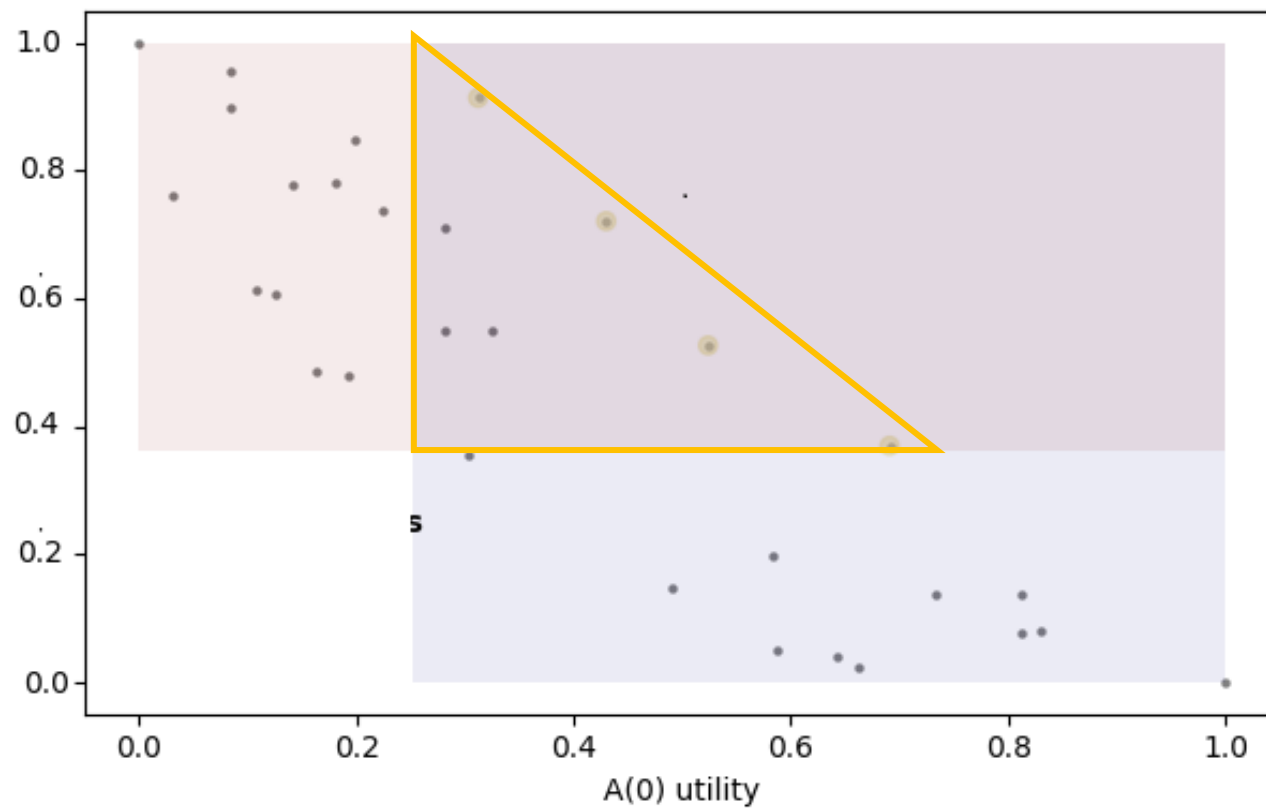


Our reservation
value



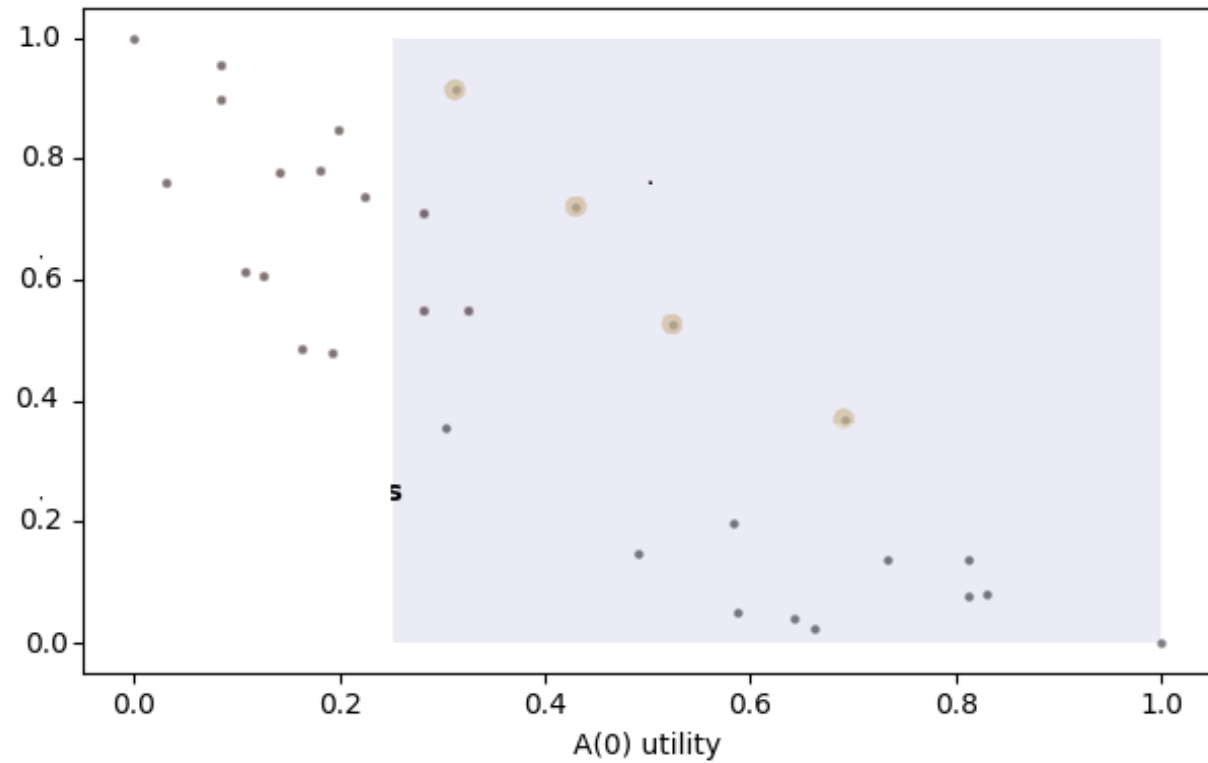
← Opponent's
reservation value

Our reservation
value



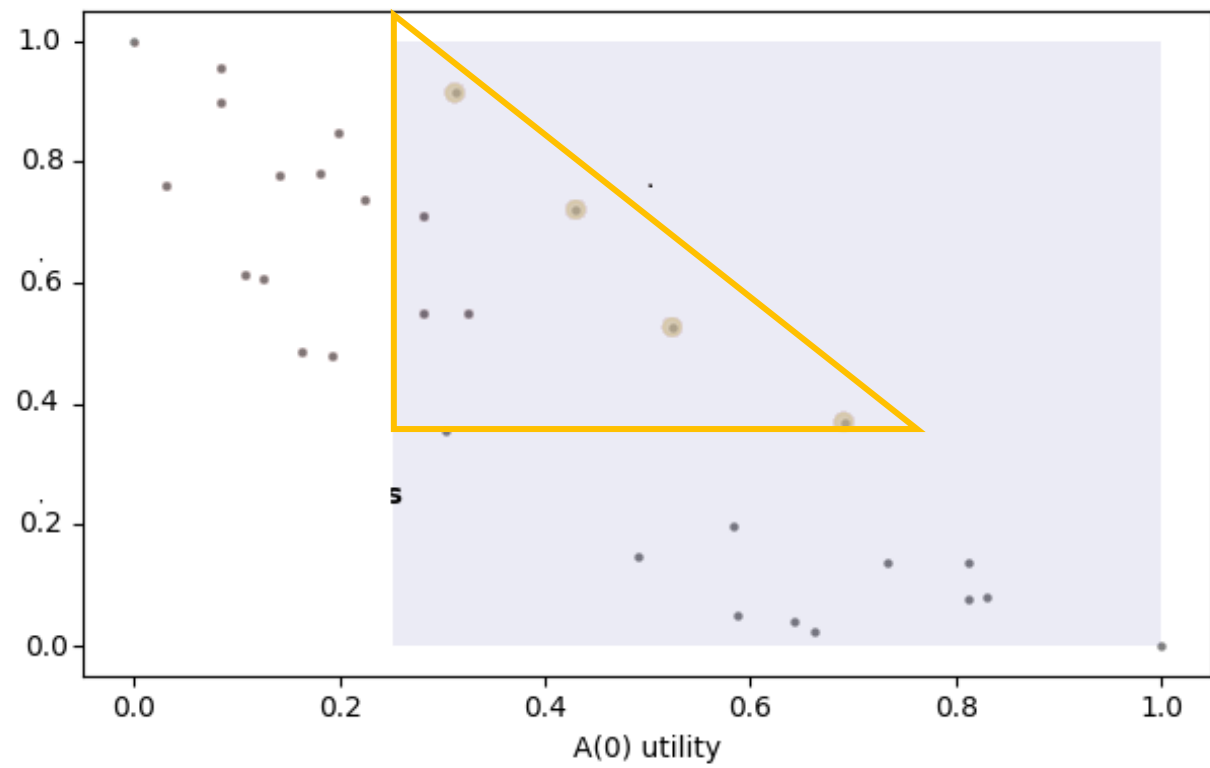
← Opponent's
reservation value

Our reservation
value



← Opponent's
reservation value?





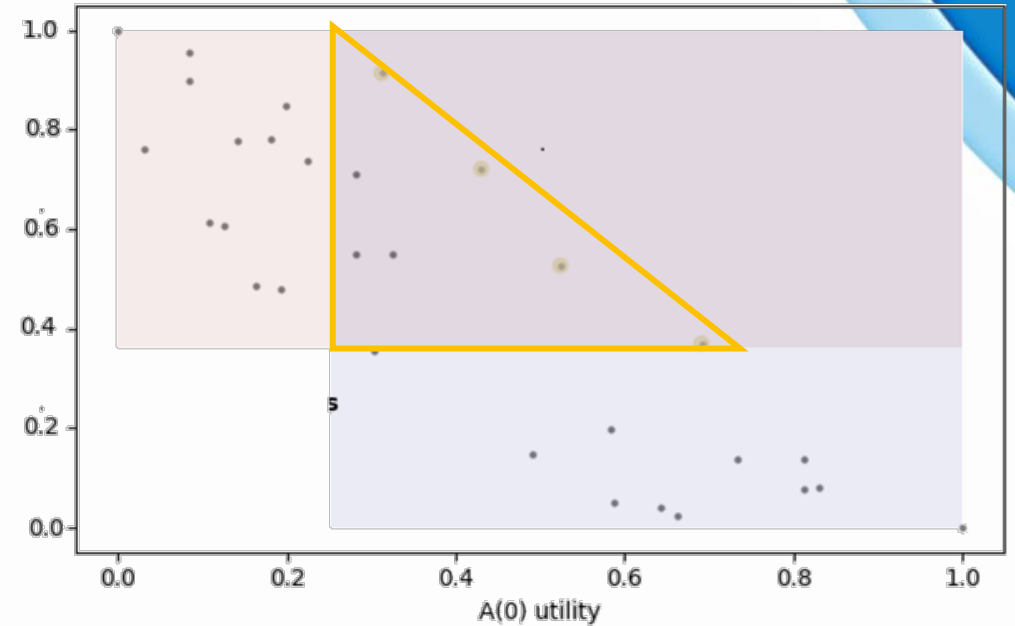
Evaluation

- Individual advantage

$$\frac{u_A - rv}{1 - rv}$$

- Nash point

$$(u_A - rv_A) \cdot (u_B - rv_B)$$



Evaluation

- Qualifications tournament
- Final tournament with top 10 of individual advantage.
- **Winners:**
 - Top 3 category individual advantage
 - Winner category Nash point

Special thanks to Yasser Mohammad for his time and effort.



Our participants

ChaosAgent

The Dealmaker

CARCAgent

BidBot

- 22 participants
- 6 countries

NayesianNice

UOAgent

Anti-Agent

AgentRenting

Goldie

Analysis

Bidding curve

- Many exploited the last turn
- Play “Hard to get”

Analysis

Reservation value modelling

- Using Bayesian Learning (e.g. NanyesNice)
- Using Neural Networks (e.g. AgentRenting2024)
- Using curve fitting/linear regression (e.g. CARCAgent)

“[...] We believe that the prediction of the adversary’s **reservation price** is impossible.

However, we believe that the adversary’s **final concession price** can be predicted by some adversary agents. ”

~Shochan



Reveal of the winners

1. ?	
2. ?	
3. ?	
4. AntiAgent	0.3849
5. HardChaosNegotiator	0.3483
6. KosAgent	0.3371
7. NayesianNice	0.3328
8. CARCAgent	0.3130
9. BidBot	0.2691
10. AgentNyan	0.2541

KosAgent for ANAC2024 Auto Negotiation League (ANL)

Kosuke Nakata
Tokyo University of Agriculture and Technology

ANL ANAC2024 Nayesian

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AAMAS2024 competition
15th Automated Negotiating Agent
Automated Negotiation League



CARCAgent: Advancing Automated Negotiation Through Reservation Value Fitting and Strategic Adaptation

Tianzi Ma, Hongji Xiong, Xuan Wang, and Yulin Wu
Harbin Institute of Technology, Shenzhen

April 30, 2024

THIRD PLACE OF THE AUTOMATED NEGOTIATING AGENTS COMPETITION 2023

~AUTOMATED NEGOTIATION LEAGUE~

(INDIVIDUAL ADVANTAGE)



TAMARA FLORIJN

YASSER MOHAMMAD

REYHAN AYDOGAN

KATSUhide FUJITA

TIM BAARSLAG

CATHOLIJN JONKER

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€100

THIRD PLACE OF THE AUTOMATED NEGOTIATING AGENTS COMPETITION 2023

~AUTOMATED NEGOTIATION LEAGUE~

(INDIVIDUAL ADVANTAGE)

THIS CERTIFICATE IS AWARDED TO

MICK ELSHOUT

UTRECHT UNIVERSITY, NETHERLANDS

TO HONOR THEIR EXCELLENT NEGOTIATION STRATEGY

AGENT RENTING 2024

TAMARA FLORIJN

YASSER MOHAMMAD

REYHAN AYDOGAN

KATSUhide FUJITA

TIM BAARSLAG

CATHOLIJN JONKER

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SECOND PLACE OF THE AUTOMATED NEGOTIATING AGENTS COMPETITION 2024

~AUTOMATED NEGOTIATION LEAGUE~

(INDIVIDUAL ADVANTAGE)



?

TAMARA FLORIJN

YASSER MOHAMMAD

REYHAN AYDOGAN

KATSUHIDE FUJITA

TIM BAARSLAG

CATHOLIJN JONKER

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SECOND PLACE OF THE AUTOMATED NEGOTIATING AGENTS COMPETITION 2024

~AUTOMATED NEGOTIATION LEAGUE~

(INDIVIDUAL ADVANTAGE)

THIS CERTIFICATE IS AWARDED TO

HIROTADA MATSUMOTO

TOKYO UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, JAPAN

TO HONOR THEIR EXCELLENT NEGOTIATION STRATEGY

UO AGENT

TAMARA FLORIJN

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CATHOLIJN JONKER

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WINNER OF THE AUTOMATED NEGOTIATING AGENTS COMPETITION 2024

~AUTOMATED NEGOTIATION LEAGUE~

(INDIVIDUAL ADVANTAGE)

(NASH OPTIMALITY)

?

TAMARA FLORIJN

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TIM BAARSLAG

CATHOLIJN JONKER

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€250

WINNER OF THE AUTOMATED NEGOTIATING AGENTS COMPETITION 2024

~AUTOMATED NEGOTIATION LEAGUE~
(INDIVIDUAL ADVANTAGE) (NASH OPTIMALITY)

THIS CERTIFICATE IS AWARDED TO
SHOTA TAKAYAMA
TOKYO UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, JAPAN

TO HONOR THEIR EXCELLENT NEGOTIATION STRATEGY
SHOCHAN

TAMARA FLORIJN

YASSER MOHMMAD

REYHAN AYDOGAN

KATSUhide FUJITA

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NEC-AIST
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€250



Winners come forward for a photo!

Shochan-Strategy@ANAC2024



Shota Takayama
Fujita Lab,
Tokyo University of Agriculture and
Technology

Introduction

- Origin of the name “Shochan”
 - Part of my name, “Sho”
 - “Chan” is used in Japan to call people by their names in a friendly manner.
- My goal is to make “Shochan” a beloved agent in ANL in the future.

Contents

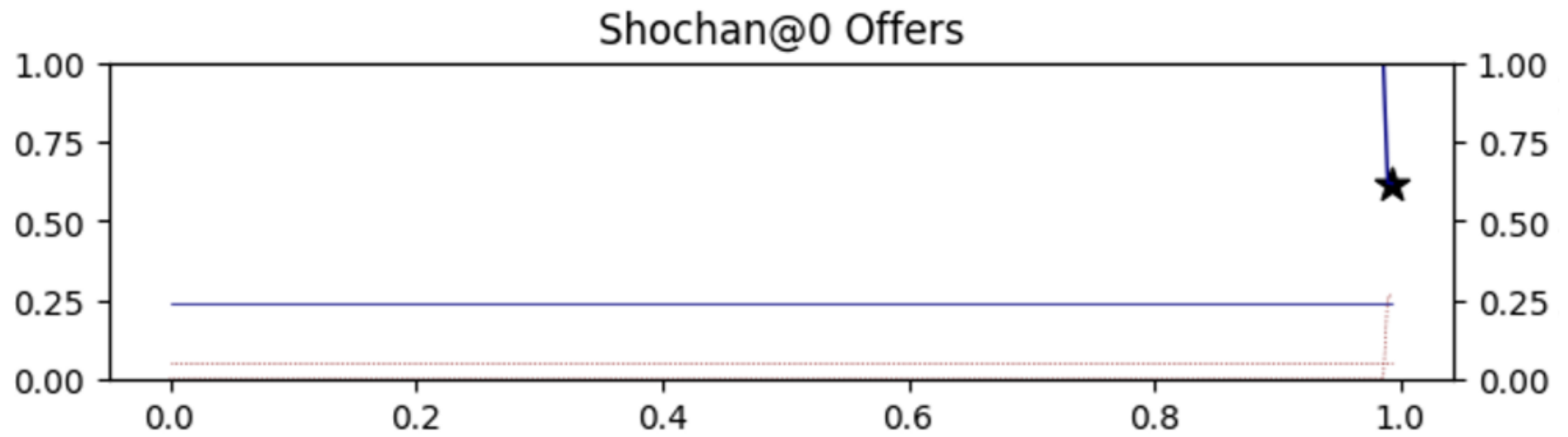
- 1. Concepts
- 2. Bidding Strategy
 - For opponents
 - For Scenarios
- 3. Acceptance Strategy
- 4. Evaluation

Concepts

- 1. Choose the best strategy depending on the scenarios and the opponents.
 - There is no optimal strategy for every situation.
 - It is very important to switch strategies.
 - Opponent agent
 - Nash seeker or Time-dependent agent
 - scenarios
 - Cooperative or No cooperative
 - Number of Negotiation steps (deadline) are large or small
- 2. Aim for the last few chances.
 - Expect any agent to be basically a time-dependent strategy.
 - Mutual concessions are more likely to be made at the end of negotiations.

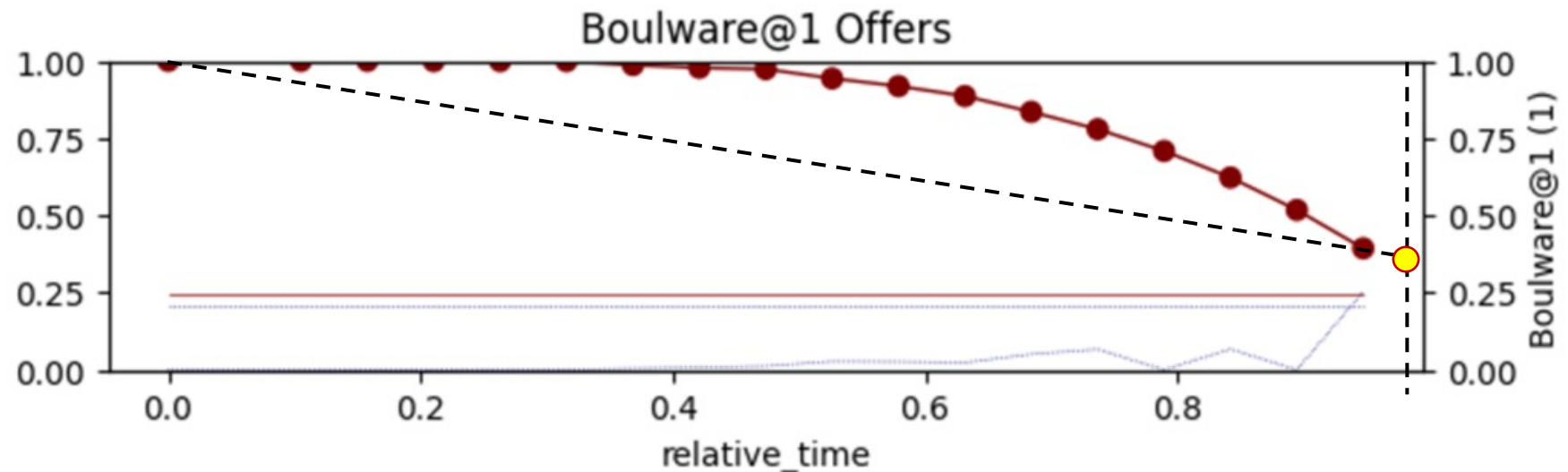
Bidding Strategy

- Aim for **the last one or two** chances.
 - Calculate **average time per step** from current time
 - one step = relative time / number of steps
 - Determine when is the last one or two step **with certainty**
 - Proposal that the **opponent is likely to accept**.



Bidding Strategy for opponents

- For **Time-dependent opponents**
 - Predictions are effective
 - Opponent will be more concessionary at the next proposed step.
- Shochan **Linearly predicts** and proposes **maximum concession price**
 - Linearly connect the opponent's maximum and minimum (yellow circle)



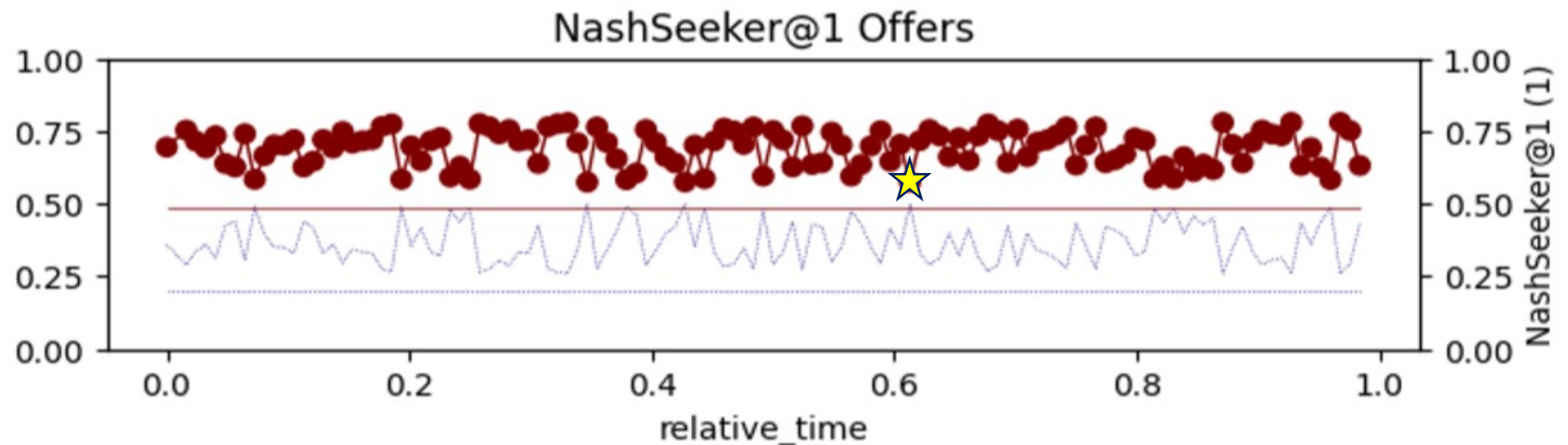
Bidding Strategy for Time-dependent opponents

- Why not do a more accurate regression?
 - Stability of the bid that the enemy accepts
 - If forecasts are too accurate, the slightest deviation from the forecast makes it harder
 - I also used scipy curve fitting, but it didn't always work
 - For example, when the opponent was too strong.



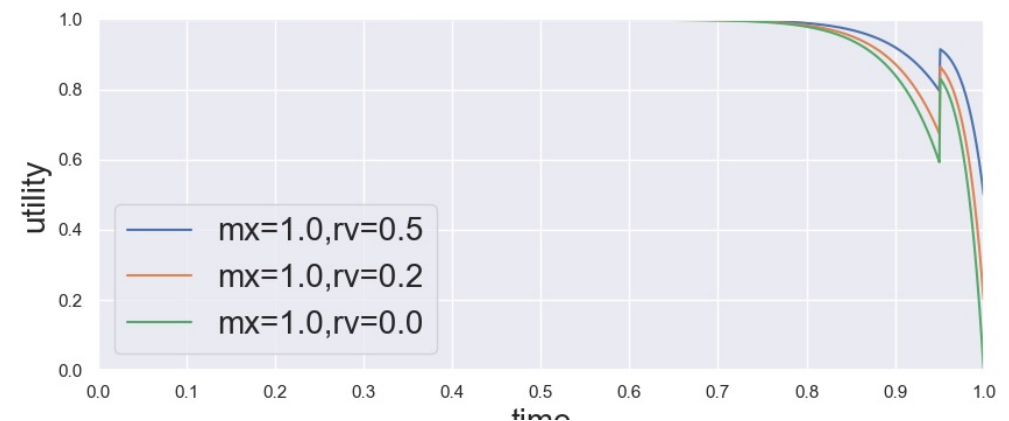
Bidding Strategy for opponents

- For **Nash-seeker opponents**
 - Nash-seeker makes some concession early on.
 - Possibility of already proposing the maximum concession price
- Suggest **the best of opponent's proposal** (yellow star).
 - No prediction of the opponent's maximum concessionary price



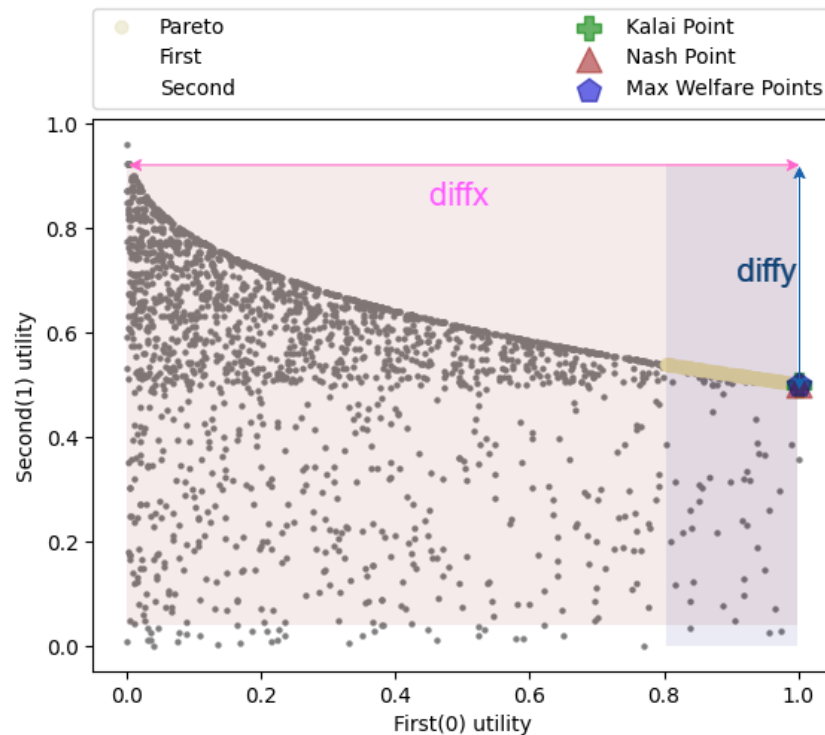
Bidding Strategy For Scenarios

- For Scenarios **with fewer negotiation steps**
 - Compromise is not well continuous due to too wide a time range
- Use **time-dependent strategies** to make concessions except for the last few times
- Suggest **The Nash solution**
 - because the opponent's utility value is hard to predict.

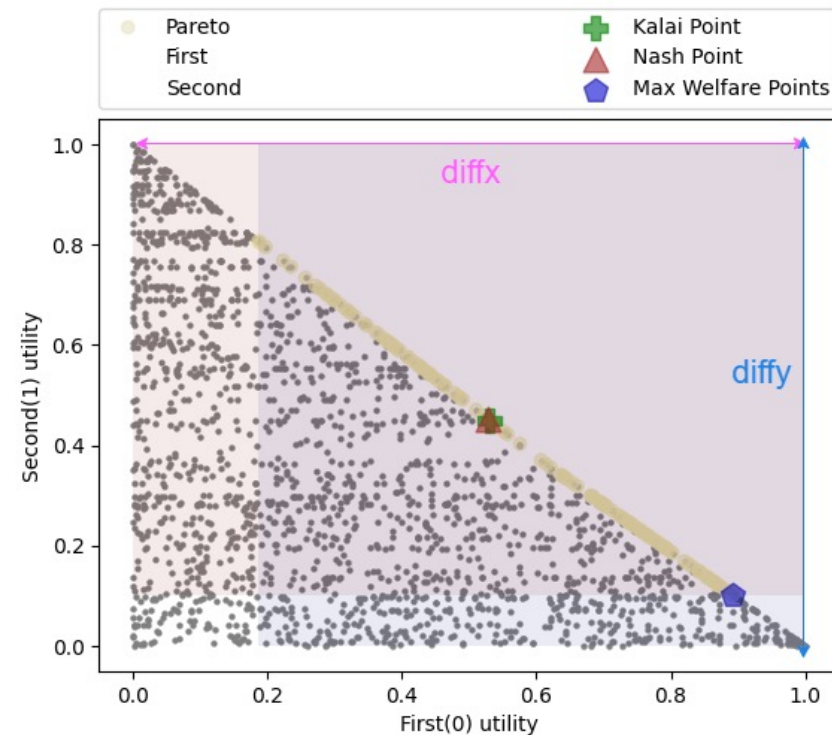


Bidding Strategy For Scenarios

- For Scenario **where concessions are desired**
 - Judged by the difference between the opponent's maximum bid and my maximum bid.
 - Opponent can gain an advantage **without reducing my utility value too much**.



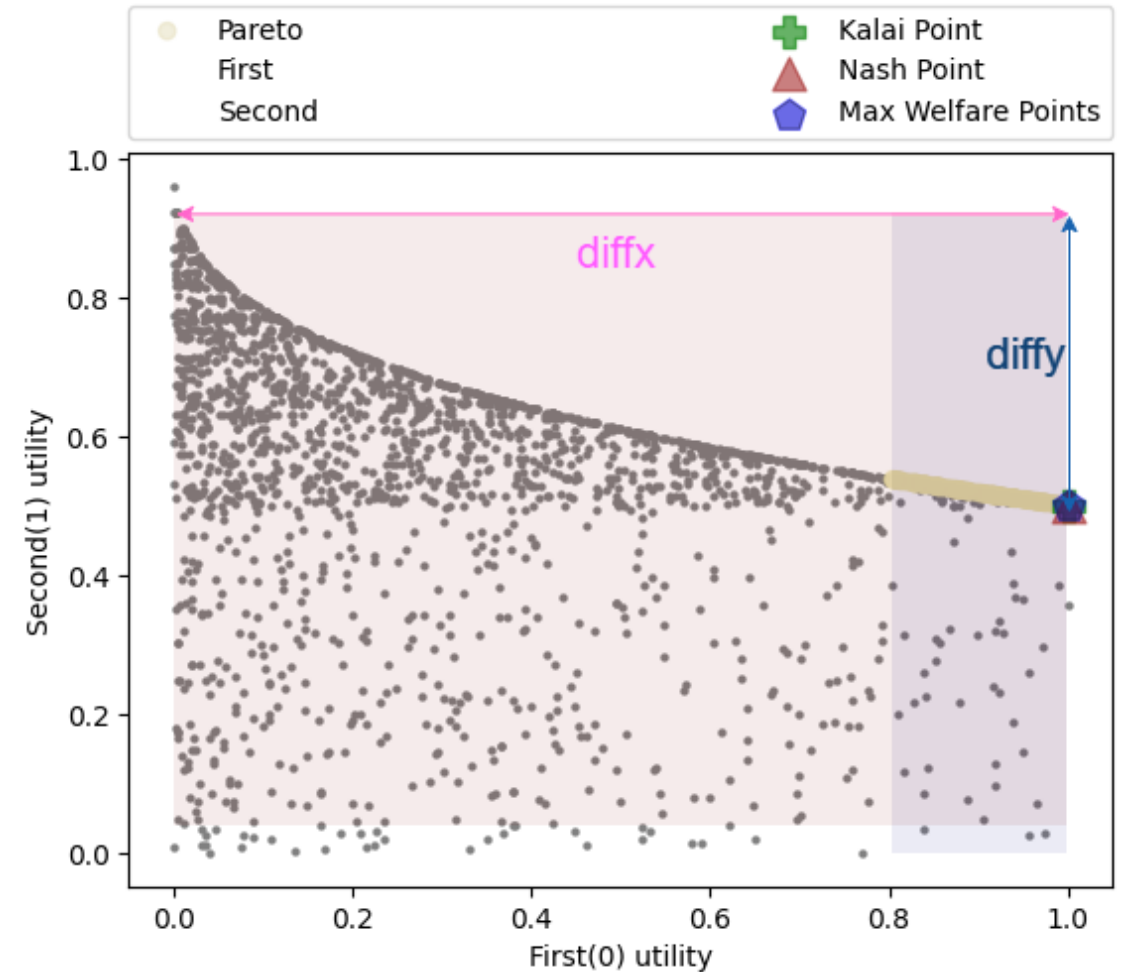
concession-friendly scenario



Equality scenario

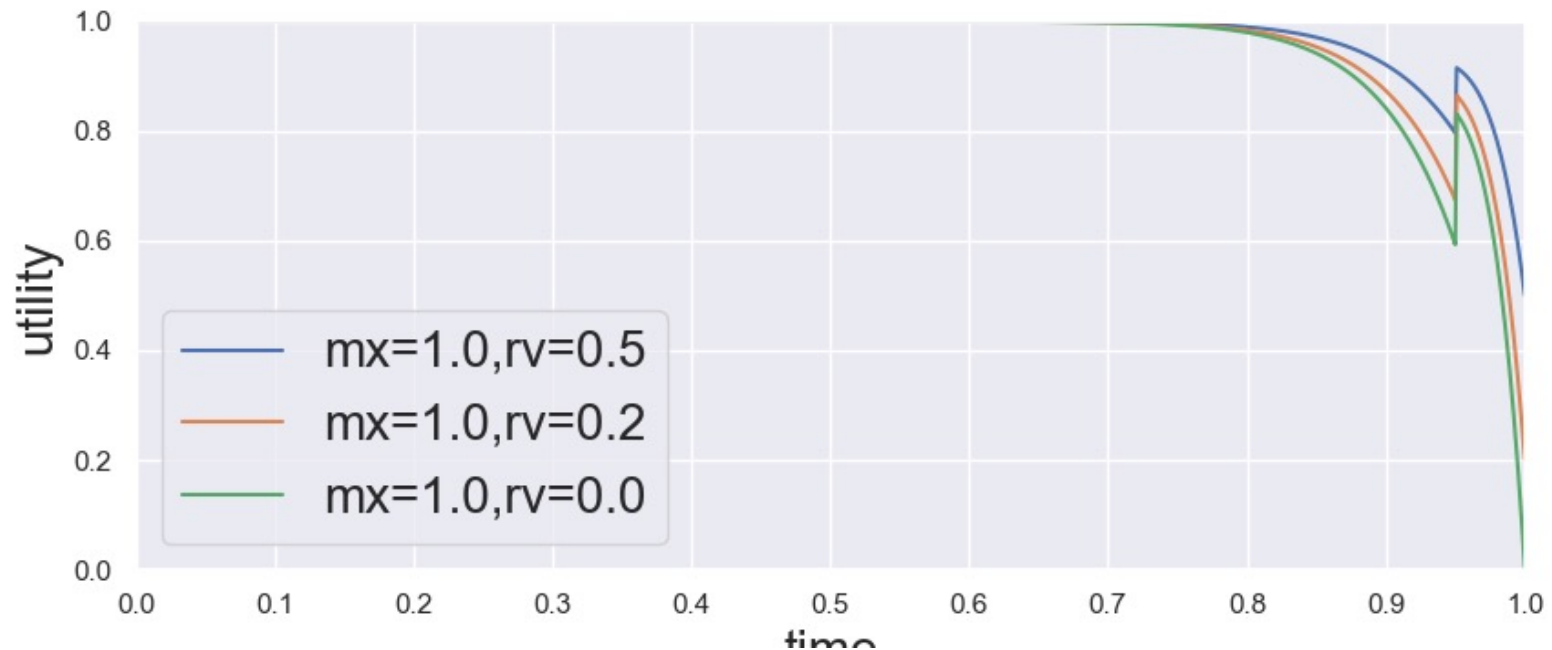
Bidding Strategy For Scenarios

- For **concession-friendly scenario**
 - Use a **time-dependent strategy**
 - If $\text{diffx} - \text{diffy}$ is greater than 0.2
 - diffx : difference in enemy utility values
 - diffy : difference in my utility value



Acceptance Strategy

- 1. Accept by **time-dependent concessionary price**
 - After 0.95, Be strong for my last few proposals to be successful.
 - Whenever I use a time-dependent strategy, I use it for this curve
 - mx = my maximum utility, rv = reservation value



Acceptance Strategy

- 2. Accept Last chance with no time to make my proposal next time.
 - Reject If not 0.1 greater than my reservation value.
 - The last opponent's proposal is likely to be a concession.

Evaluation

- Shochan's evaluation with basic and agents
 - 100 scenarios
 - utility space of size 2000

Table 1: Evaluation of Shochan

strategy	advantage		nash_optimality	
	mean	std	mean	std
Shochan	0.443542	0.33072	0.830802	0.140649
StochasticBoulware	0.394607	0.283079	0.857884	0.124012
Boulware	0.390621	0.280535	0.857427	0.122168
StochasticLinear	0.328998	0.239777	0.875009	0.113681
Linear	0.315592	0.240342	0.87121	0.115393
NashSeeker	0.309114	0.24016	0.899923	0.110483
StochasticConceder	0.245843	0.203001	0.86554	0.120462
NaiveTitForTat	0.235999	0.27621	0.819927	0.141721
Conceder	0.224678	0.202051	0.856586	0.123002
MiCRO	0.194509	0.311425	0.762553	0.153555

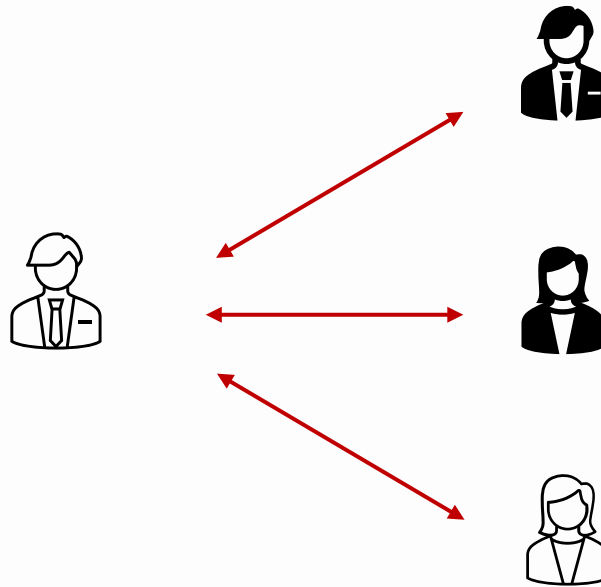
Conclusion

- Strategies for agents and scenarios are important.
 - Many other measures [exist for each of these situations](#).
 - ANL2024 rules allow us to understand each other's utility space
- Future work
 - the scenarios could be [parameterized to change the strategy](#)
 - Winwin_level
 - Conflict_level
 - Oppsistion_level
 - How to detect opponents strategy

Thank you for listening



Next year's challenge



Proposal:

- Each agent plays both sides
- Multi-deal: utility function for A is the maximum of all its deals
- Utility for group B is A's chosen deal, else reservation value

Still open:

- Asynchronous or synchronous bidding?
- Same or different outcome space?
- Bidding cost or time discount?

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