BOFA - A Framework for Fairness in Automated Negotiations

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Research question

Can we create a fairer negotiation strategy for the agent within automated negotiation?

Introduction

- Fairness has many interpretations - equity, equality, Rawlsian, according to need, Eye for an Eye, etc.
- A distributed network where there may not be a global observer to verify fairness
- Parties can have different fairness views
- A bargaining game of incomplete information

The F is in BOFA

BOFA adds Fairness to the standard the bidding strategy, the opponent model, and the acceptance strategy. Under BOFA bids are evaluated through the value function:

$$V = c_1*utility + c_2*F_s + c_3*F_d$$

utility - the material utility of the bid given a profile
F_s - is the static view of fairness (outcome fairness) given a bid, a fairness view, and two profiles [-1, 0]
F_d - is the dynamic view of fairness (process fairness) [-1, 0]. Uses a Kindness Function [-1,1]
c_1, c_2, c_3 - just constants

THEMIS

- **Strictly Exploring**: Offers best bids with a random chance to proceed to next. Accept offer above target_min if $c_1 > c_2 + c_3$
- **T4T Setup**: Proportional concession strategy while also lowering target_min to 0.9*proportional_outcome.
- **Fairness Maximiser**: Proposes bids between target_min and target_min + window_size in descending order based on value function. Accept if incoming bid better than next 3 bids agent is about to offer.
- **Eager**: After time passes T_max, propose best bids received if $c_1 > c_2 + c_3$, otherwise repeat last bid sent.

Evaluation

Experiment in the form of a tournament between Boulware THEMIS that finds NASH point, THEMIS that finds KALAI point, Boulware Agent [1], IAmHaggler2012[3], and Social Agent[2] on the Zimbabwe Scenario[3]. Each agent was ran against each other for 20 times with both profiles.

ParAcc – Percentage of times on Pareto frontier
DistToKalai – Average distance to Kalai Point
Nash – Average Nash product
Util – Average agent's utility

No disagreements were reached. The proposed agents performed the best in their respective category

Agent	ParAcc	DistToKalai	Nash	Util
Boulware	0.6125	0.0434	0.645	0.808
IAmHaggler2012	0.7125	0.062	0.649	0.767
Social Agent	0.725	0.068	0.635	0.796
Themis Nash	0.725	0.037	**0.652**	**0.823**
Themis Kalai	**0.750**	**0.034**	0.647	0.818
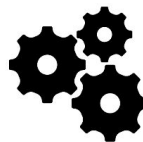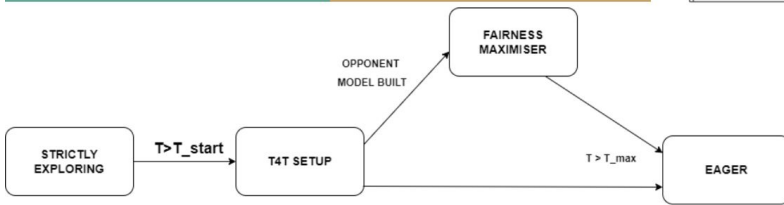
References

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[2] V. Sanchez-Anguix, O. Tunali, R. Aydogan and V. Julian. Can social agents efficiently perform in automated negotiation? Applied Sciences, vol. 11, no. 13, p. 6022, 2021.
[3] Williams, C.R., Robu, V., Gerding, E.H. and Jennings, N.R. An overview of the results and insights from the third automated negotiating agents competition (ANAC2012). In Novel Insights in Agent-Based Complex Automated Negotiation; Springer: Berlin/Heidelberg, Germany, 2014; pp. 151-162

STRICTLY EXPLORING → T>T_start → T4T SETUP → OPPONENT MODEL BUILT → FAIRNESS MAXIMISER → T > T_max → EAGER