

ALMAS Group

Conceptual Models in Multi-Agent Systems

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Aims

- Find a model for a society of self-interested agents to represent cooperation and negotiation options.
- Model the different possible roles of the society's facilitator.
- How would the agent choose among facilitator's roles?

Negotiation objects

- The range of issues over which agreements must be reached

NO03: NO
Name: Paint_House
Cost: Value:100, Type: integer, Modif=Yes;
Deadline: Value: May_12, Type: date, Modif=No;
Quality: Value: high,
 Type: one of (low, average, high), Modif=Yes

Negotiation object utility

- An estimation of how useful an NO is for the negotiator
- An NO may be modified during negotiation

$$U_o(NO) = \sum_{i=1}^n w_i \text{mod}(V_i^o, V_i) + \sum_{j=1}^m w_j \text{extra}(V_j)$$

Facilitator model

Request profile

- **Negotiation object description** – NO description + what means “best offer”
- **Facilitator role profile**
 - Inform
 - Select
 - Negotiate

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Agent negotiation model

Utility of a negotiation

$$U_{Neg}(NO) = \frac{U_o(NO)}{c * N_s}$$

N_s – number of negotiation steps

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Individual cooperation profile

A, X

- Facilitator's role - r_1, r_2, r_3 (maybe more roles)
- s_i – no. of successful negotiations under role r_i
- f_i – no. of unsuccessful negotiations under role r_i

Global utility for successful negotiations

$$GU_s(r_i) = \frac{\sum_{k=1}^{s_i} U_{Neg}^{r_i}(NO_k^s)}{s_i} \quad i = 1,3$$

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Individual cooperation profile

A, X

- Facilitator's role - r_1, r_2, r_3 (maybe more roles)
- s_i – no. of successful negotiations under role r_i
- f_i – no. of unsuccessful negotiations under role r_i

Global utility for unsuccessful negotiations

$$GU_f(r_i) = \frac{\sum_{k=1}^{f_i} U_{Neg}^{r_i}(NO_k^f)}{f_i} \quad i = 1,3$$

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Choose facilitator's role

- Compute gain for each role
- Choose role according to maximum gain

$$Gain(r_i) = GU_s(r_i) - GU_f(r_i), i = 1, 3$$

$$\max_i (Gain(r_i))$$

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Group cooperation profile

A, (X1, X2, ...)

- same formulas but for a group of agents

Favor sometimes **exploration versus exploitation**

$$\max_k (\varepsilon * Gain(r_k), Gain(r_{k+1}), Gain(r_{k+2}))$$

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Conclusions

- Agent model to guide negotiation
- Facilitator model
- Utility of negotiation objects and negotiations
- Choose facilitator's role based on computed utilities

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Future developments

- Combine current proposed models with the model of cooperation profiles (proposed in previous work)
- Combine models with "RL" learning to negotiate based on NO utilities (proposed in previous work)

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