Agent Negotiation of the Utilitarian Welfare

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Assumptions

- The negotiation process is based on a contact network: complete, regular, random or small-world. An agent is able to negotiate with a restricted number of neighbors.
- The nature of the resources involved: discrete, not shareable, not divisible and static
- no compensatory payments
- decision-making of each agent based on local information: agents are able to report preferences to their neighbors only. No global information.
- preferences expressed by means of k-additive utility functions
- two criteria used: rationality and sociality.

Evaluation

The transaction that are allowed in the negotiation process:

- the social gift
- the social swap
- the social cluster-swap
- the rational swap
- the rational cluster-swap

The evaluation of the negotiation process is based on various criteria:

- number of performed transactions
- number of exchanged resources
- number of speech turns
- number of attempted transactions

We differenciate two types of optimum: the global optimum and the T-global optimum. Thus, the social value associated with the resource allocation on which the negotiation process ends is compared with the optimal one.

Results

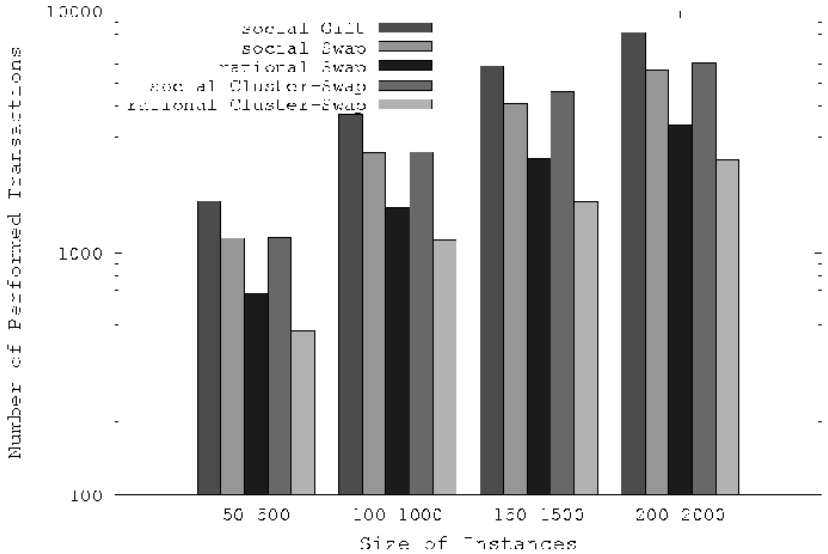
Table: Gap(%) due to the different transactions on a complete contact network

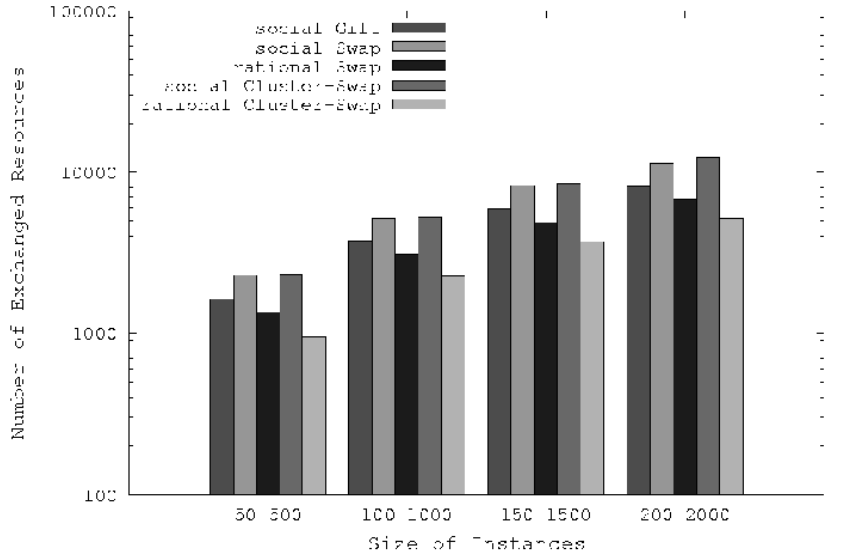
n-m	Social			Rational	
	Gift	Swap	CS	Swap	CS
50-500	0	0.94	0.96	2.15	6.71
100-1000	0	0.76	0.76	1.53	4.9
150-1500	0	0.65	0.71	1.31	3.9
200-2000	0	0.56	0.60	1.15	2.5

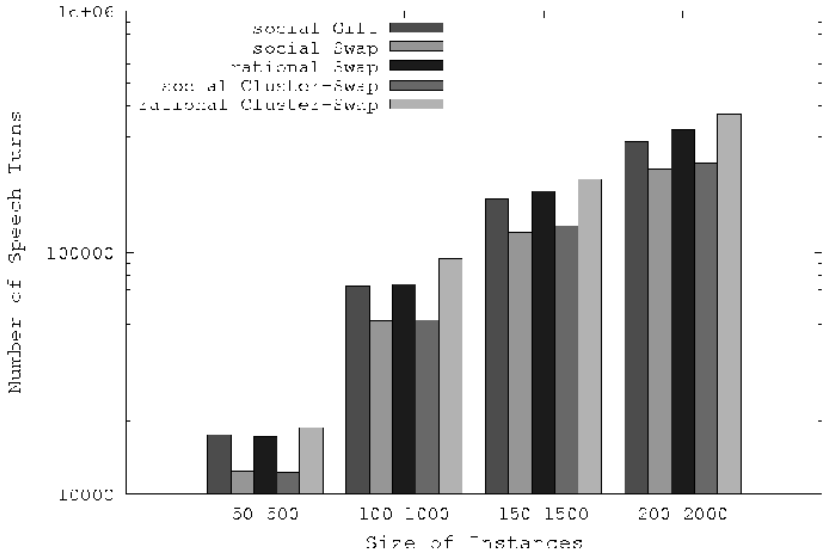
Table: Gap(%) due to the different transactions on a random contact network

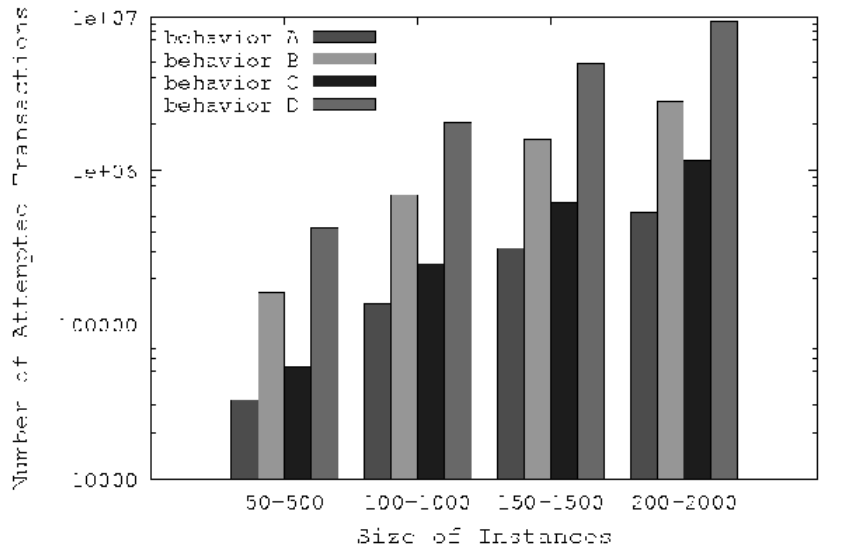
n-m	Social			Rational	
	Gift	Swap	CS	Swap	CS
50-500	1.3	3.41	3.4	6.05	5.88
100-1000	0.73	1.88	1.72	3.63	3.59
150-1500	0.43	1.3	1.35	2.69	2.42
200-2000	0.31	1.22	1.02	2.3	2.05

Comparison of Transaction Types









Behavior Variant

If the agent initiator and the selected neighbor find an acceptable transaction, it is then performed otherwise three different tasks can be done for the agent initiator:

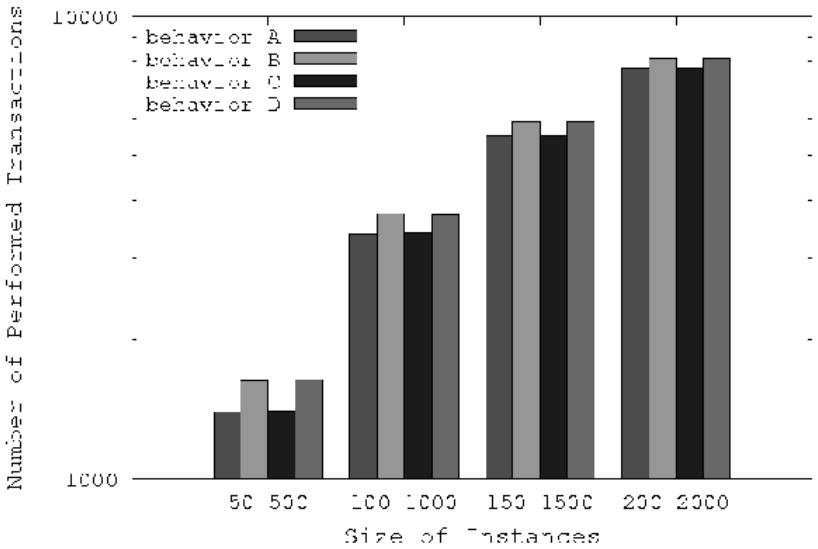
1. abort the negotiation
2. choose another resource with the same neighbor
3. choose another neighbor with the same resource

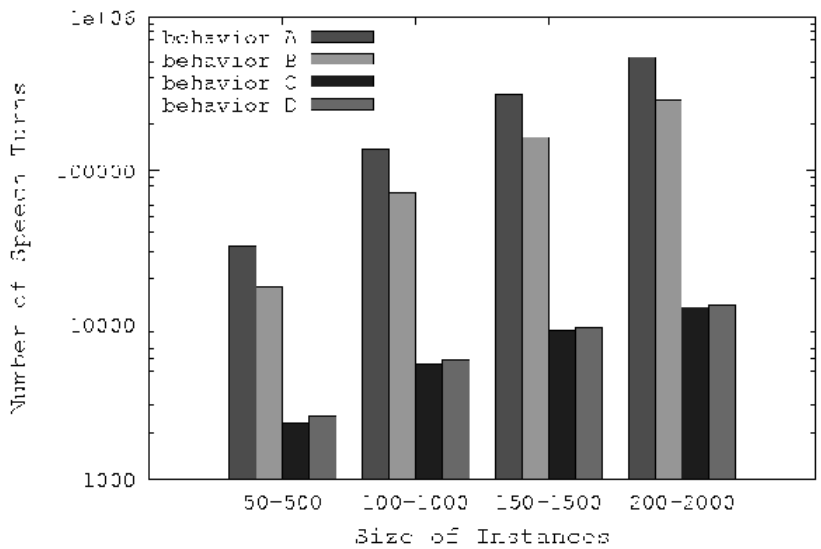
Based on this task set, four different behaviors can be defined. After the identification of an acceptable deal or the end of the negotiation, a new initiator is randomly chosen.

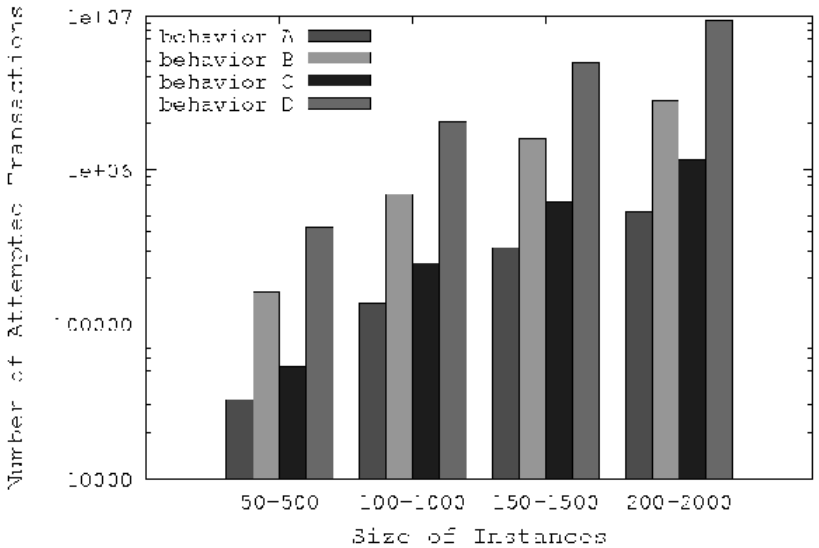
Table: Social gap comparison of the behaviors

n-m	A	B	C	D
50-500	1.2%	0%	1.1%	0%
100-1000	0.5%	0%	0.5%	0%
150-1500	0.3%	0%	0.3%	0%
200-2000	0.2%	0%	0.2%	0%

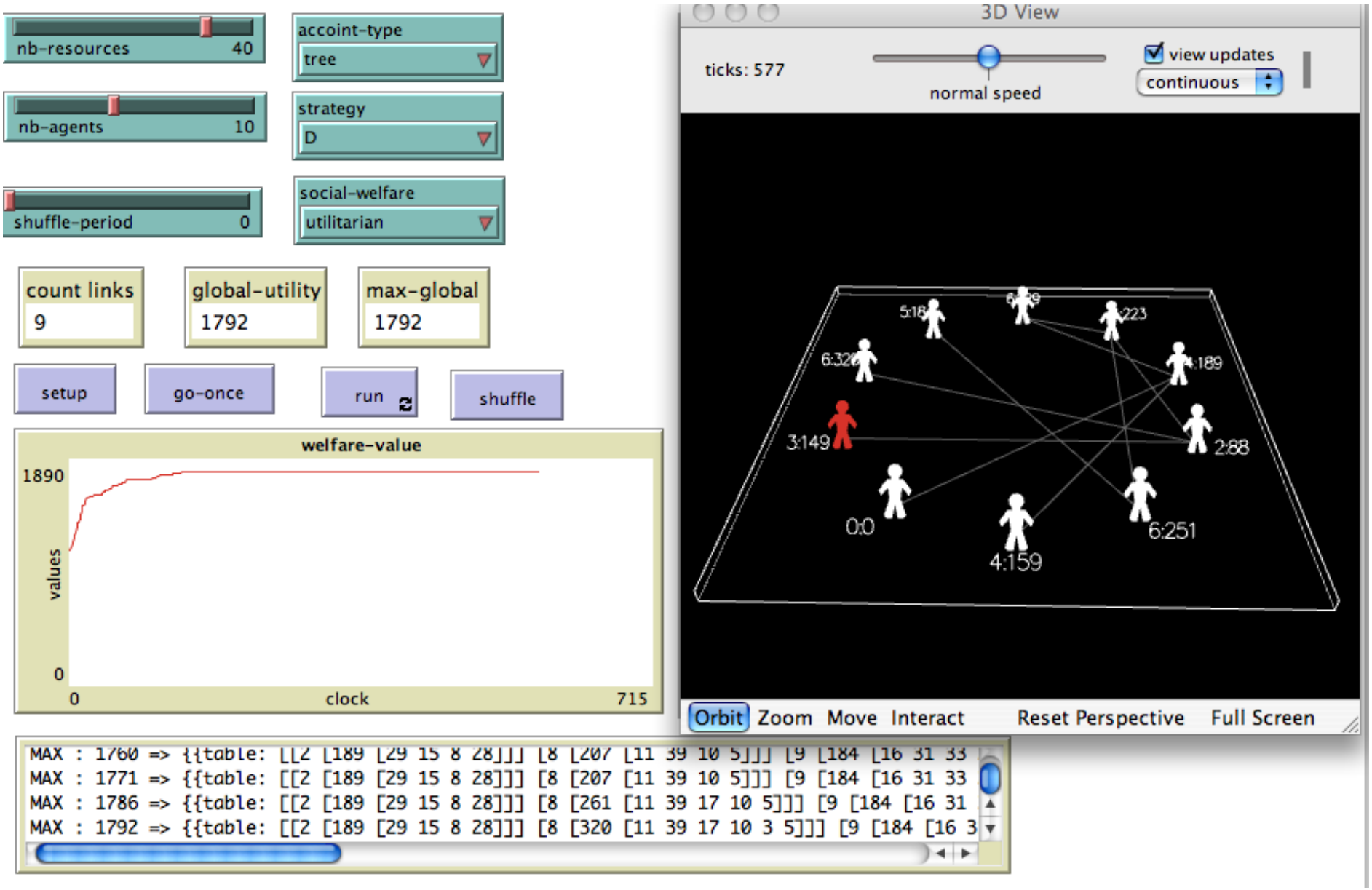
Behavior Variant Impact







Simulation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Optimal Social Value Determination

The linear programs is based on the variables x_{ra}:

$$x_{ra} = \begin{cases} 1 \text{ if the agent } a \text{ owns the resource } r \\ 0 \text{ otherwise} \end{cases}$$

$$sw_u^\star = \begin{cases} \max \sum_{a \in \mathcal{A}} \sum_{r \in \mathcal{R}} u_a(r) x_{ra} \\ \text{subject to: } \sum_{a \in \mathcal{A}} x_{ra} = 1 \end{cases}$$

It is also possible to determine the best rational resource allocation by adding a simple set of constraints:

$$\sum_{r \in \mathcal{R}} u_a(r) x_{ra} \geq u_a^{init} \quad a \in \mathcal{A}$$