Formation de coalitions pour une composition de services Web fondée sur la confiance dans les réseaux sociaux

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Journées Francophones sur les Systèmes Multi-Agents (JFSMA)

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Outline

1. Motivation
2. Background
3. Trust model
4. Coalition formation process description
5. Experimental Results
6. Conclusion and Perspectives
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Motivation

Service Composition

- Satisfies a **complex user needs** which cannot be achieved by an **atomic service**
- Allows the definition of **value added** applications, which have the potential to reduce effort and time of development [Ponn 02]
Motivation

The model : a multi-agent model

- Able to perform complex and distributed tasks
- Support different forms of interaction including negotiation and coordination
- Capable to extract and interpret information

Existing multi-agent approaches

- Planning (graph, state, actions) [Paik 06, Ponn 02, Siri 04, Tong 11, Xu 11]
- Coordination (reasoning, roles, negotiation) [Charif 13, Siala 11, Wang 06, Maam 05]
- Cooperation (organization, preferences, sociability) [Grif 03, Ermo 03, Mull 06, Hong 09, Bour 09]
Proposition : a coalition formation process

Challenges

1. How to integrate social dimension in the coalition process
   ⇒ Social trust model

2. How to ensure providers autonomy to decide with whom to cooperate
   ⇒ Endow agents with the ability to participate in the coalition process according to their preferences

3. How to enable agents to leave coalition when they are not satisfied
   ⇒ Definition of an incremental, dynamic and overlapping protocol for member selection
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**Concepts Definitions**

- **Social network**: Given a set $A = \{a_1, a_2, \ldots, a_l\}$ of agents and a set $E \subseteq A \times A$ of edges, a social network is a connected graph $G = \langle A, E \rangle$ where an edge $(a_k, a_j) \in E$ represents an asymmetric trust relationship between $a_k$ and $a_j$.

- **Agent**: An agent $a_k \in A$ is an autonomous entity such that $a_k = \langle S_k, \text{Trust}, ET, CT, \lambda_{\text{Inf}} k, \lambda_{\text{Sup}} k, \beta_k, B\text{list}_k \rangle$.

- **Service**: A service $s$ is a tuple such as $s = (in, out, f, q^1, q^2, q^3)$.

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Louati, A., El Haddad, J., Pinson, S.
A Multilevel Agent-based Approach for Trustworthy Service Selection in Social Networks in IAT 2014
**User query**: Let $F$ be the definition domain of available functionalities. A user query $Q = \{f_1, f_2, \ldots, f_n \mid \forall 1 \leq i \leq n, f_i \in F\}$ is a finite set of functionalities.

**Coalition**: Let $Q$ be a user query. A coalition $c = \{(f_1, x_1), \ldots, (f_i, x_i), \ldots, (f_n, x_n) \mid \forall i \in [1, n], \exists k \in [1, s] \text{ such as } x_i = a_k \text{ et } a_k \in A_i\}$ is a set of agents that satisfy $Q$. 
Multi-agent model

**Figure** – A broker-based multi-agent model for dynamic service composition

Agents cooperate to satisfy complex user’s needs based on decentralized decision making guided by trust in cooperation.
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Trust

Trust in cooperation

\[ CT(a_k, a_j) = \begin{cases} 1 & \text{if } NbSoll_k[j] = 0 \\ \frac{NbMem_k[j]}{NbSoll_k[j]} & \text{otherwise} \end{cases} \]

Level of reliability of a candidate \( a_j \) according to a member \( a_k \) based on their history of cooperation

Trust in coalition

\[ evalC(a_k, c_z) = \sum_{a_t \in c_z} \frac{CT(a_k, a_t)}{|c_z|} \]

Degree of satisfaction of a candidate \( a_k \) to join a coalition \( c_z \)
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Service discovery and selection process

Multi-Relationnel Social Network

Step 1: Service Discovery

Social Trust

Functional Matching

Trust-Relation Social Network
Service discovery and selection process

Step 1: Service Discovery
- Social Trust
- Functional Matching

Step 2: Trust inference

Multi-Relationnel Social Network

Provider
Recommender
Service discovery and selection process

Step 1: Service Discovery

Step 2: Trust inference

Multi-Relationnel Social Network

Trust-Relation Social Network

Agent | services | Trust
--- | --- | ---
a_2 | s_{21}, f= f_1 | 0.9
a_1 | s_{15}, f= f_1 | 0.585
a_6 | s_{65}, f= f_2 | 0.75
a_2 | s_{24}, f= f_2 | 0.9
a_3 | s_{32}, f= f_2 | 0.51
a_6 | s_{62}, f= f_3 | 0.75
a_9 | s_{94}, f= f_3 | 0.31
a_{10} | s_{102}, f= f_3 | 0.65
Coalition formation process description

Service discovery and selection process

Multi-Relationnel Social Network

Louati, A., El Haddad, J., Pinson, S.
Trust-Based Service Discovery in Multi-relation Social Networks in ICSOC 2012

Louati, A., El Haddad, J., Pinson, S.
A Multilevel Agent-based Approach for Trustworthy Service Selection in Social Networks in IAT 2014

Louati, A., El Haddad, J., Pinson, S.
A Multilevel Agent-based Approach for Trustworthy Service Selection in Social Networks in AAMAS on workshop TRUST 2014

Step 1: Service Discovery

Step 2: Trust inference

Step 3: Service Selection

<table>
<thead>
<tr>
<th>Agent</th>
<th>services</th>
<th>ET</th>
<th>Trust</th>
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<td>a_2</td>
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<td>0.72</td>
<td>0.9</td>
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<td>a_1</td>
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<tr>
<td>a_6</td>
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<td>0.75</td>
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<tr>
<td>a_3</td>
<td>s_{31}, f = f_2</td>
<td>0.45</td>
<td>0.51</td>
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<tr>
<td>a_6</td>
<td>s_{62}, f = f_3</td>
<td>0.81</td>
<td>0.75</td>
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<tr>
<td>a_9</td>
<td>s_{98}, f = f_3</td>
<td>0.73</td>
<td>0.31</td>
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<tr>
<td>a_{10}</td>
<td>s_{102}, f = f_3</td>
<td>0.70</td>
<td>0.65</td>
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</table>

<table>
<thead>
<tr>
<th>Agent</th>
<th>services</th>
<th>Trust</th>
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<tr>
<td>a_2</td>
<td>s_{21}, f = f_1</td>
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<td>s_{24}, f = f_2</td>
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<tr>
<td>a_{10}</td>
<td>s_{102}, f = f_3</td>
<td>0.65</td>
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</tbody>
</table>
Coalition formation process description

Sequential process composed of three phases:

1. Initial Coalitions Generation (e.g. \( C = \{ c_1 = \{ a_2 \}, c_2 = \{ a_6 \} \} \))
Coalition formation process description

Sequential process composed of three phases:

1. Initial Coalitions Generation (e.g. $C = \{c_1 = \{a_2\}, c_2 = \{a_6\}\}$)
2. Member Selection

$$c \leftarrow \text{argmax}_{1 \leq z \leq |C|} \sum_{a_t \in c_z} ET(a_t)$$
Sequential process composed of three phases:

1. **Initial Coalitions Generation** (e.g. $C = \{c_1 = \{a_2\}, c_2 = \{a_6\}\}$)

2. **Member Selection**

3. **Best coalition choice** $c \leftarrow \text{Argmax}_{1 \leq z \leq |C|} \frac{\sum_{a_t \in c_z} ET(a_t)}{|c_z|}$
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## Experimental methodology

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Scenario</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tbody>
<tr>
<td>User query</td>
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<td>2</td>
<td>3</td>
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<td>6</td>
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<td>services</td>
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<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>timeout (ms)</td>
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<td>3000</td>
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<td>3000</td>
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</tbody>
</table>

**Table** – Definition of test scenarios
Performance of the coalition process

**Figure** – Percentage of generated coalitions per test scenario

**Figure** – The average frequency of abandon per test scenario
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Conclusion

Trust-based dynamic coalition formation process for service composition in social networks

- Incremental, dynamic and overlapping selection protocol
- Agent cooperate based on a decentralized decision-making process guided by trust in cooperation
- Members are able to leave any coalition if they are no longer satisfied
Perspectives

- More experimentation
- Investigate the correlation between the quality of the chosen composite service and the trustworthiness of its members
- Analyze the impact of the variation of the maximum layer value on the coalition formation process
- Integrate negotiation in the coalition formation process: persuasions strategies
- Examine the coalition stability: parallel coalition generation and define the utility of a service composition
Thank you!
Questions … ?