Web interfaces between users and a centralized information multi-agent system

Emmanuel ADAM, René MANDIAU

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Plan

1. Context

3. Holonic multi-agent platform

5. CIMASTEWA: Centralized IMAS for TEnchnological WAthch.

7. IMAS Design & First Results

9. Perspectives for security and cooperation

11. Conclusion
Application/Social Context

- Integration of multi-agent organisation into human organisation
- Administrative systems as Holonic organisations [Koestler 69]
• Our MAS = Organisation + Roles + Agents

• Environment ? in the knowledge of the Agents - Roles
  – Role = {name, knowledge*, skill*}
  – Knowledge = {declarativeKnowledge*|proceduralKnowledge*}
  – Skill = {name, attribute*, function*} ≡ Class
  – Agent = {name, knowledge*, role*, supervisor}
Holonic multi-agent platform

```xml
<agent>
  <name>BOSS</name>
  <roles>
    <name>BigBossRole</name>
  </roles>
  <Knowledge />
  <localisation>127.0.0.1 4444</localisation>
  <boss />
  <subordinates>InformationResponsible</subordinates>
  <neighbours />
</agent>

<agent>
  <name>Coordinator</name>
  <roles>
    <name>Coordinator</name>
  </roles>
  <Knowledge />
  <localisation>127.0.0.1 4444</localisation>
  <boss>BOSS@127.0.0.1:4444</boss>
  <subordinates>InformationResponsible</subordinates>
  <neighbours />
</agent>

<agent>
  <name>InformationResponsible</name>
  <roles>
    <name>InformationResponsible</name>
  </roles>
  <Knowledge />
  <localisation>127.0.0.1 4444</localisation>
  <boss>Coordinator@127.0.0.1:4444</boss>
  <subordinates>InformationResponsible</subordinates>
  <neighbours />
</agent>

<agent>
  <name>RequestResponsible</name>
  <roles>
    <name>RequestResponsible</name>
  </roles>
  <Knowledge />
  <localisation>127.0.0.1 4444</localisation>
  <boss>Coordinator@127.0.0.1:4444</boss>
  <subordinates>InformationResponsible</subordinates>
  <neighbours />
</agent>

<agent>
  <name>SearchEngineResponsible</name>
  <roles>
    <name>SearchEngineResponsible</name>
  </roles>
  <Knowledge />
  <localisation>127.0.0.1 4444</localisation>
  <boss>Coordinator@127.0.0.1:4444</boss>
  <subordinates>InformationResponsible</subordinates>
  <neighbours />
</agent>

<method>
  <nameAgent>Coordinator</nameAgent>
  <nameMethod>initAgent</nameMethod>
  <parameter />
</method>

<method>
  <nameAgent>InformationResponsible</nameAgent>
  <nameMethod>go</nameMethod>
</method>
```

E. ADAM
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Automatic deployment

1. XML file parsing
2. Agents creating
3. Organization setup (agents linking)
4. Attribution of the roles (skills and knowledge (data files))
5. Attribution of the knowledge to agents
6. Methods launching

XML deployment descriptor of the MAS

JAVA Application (MAGIQUE platform) launched in local

127.0.0.1 : 4444

192.168.42.13 : 4444
192.168.42.14 : 4444
192.168.42.15 : 4444
Study case: a technological watch department

PB: Have a coherence in a group of distributed users → Use of Multi-Agent Systems
Solution: personal IMAS

It: Interface Agent
CA: Coordinator Agent
IA: Information Responsible Agent
RA: Request Agent
SA: Search Engine Agent

Database

Main user

Internet

communication links between agents

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New user needs

• A Centralized Information MultiAgent System for Technological Watch (CIMASTEWA)

• Why?
  – Security is essential in information retrieval (hackers, carnivore, ...)
  – Need of information control

• How?
  – Centralize the data into a database
  – Propose principles to scramble/blur the requests
    ➔ use computers dedicated to the information retrieval
New architecture
CIMASTEWA architecture

- MultiAgent System
  - Coordinator Agent
  - Information Responsible Agent
  - Request Agent 1
  - Request Agent 2
  - Request Agent n
  - Search Engine Agent 1
  - Search Engine Agent 2
  - Search Engine Agent 3
  - Search Engine Agent m

- Applications Server
  - Dynamic web components
  - Dynamic web pages
  - JSP - STRUTS
  - Tomcat

- Database Server
  - Queries
  - Results
  - Users

- Database
  - MySQL

- Internet

- Web browser

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• Reuse of a methodology, AMOMCASYS, that we have built to integrate agents organization into human organisation [AOIS’ 03]

  – First, general design of the roles

  – Secondly, design of cooperation between the CIMASTEWA agents and between these agents and the environment (users, database,...)
### Roles specification

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Social</th>
<th>Environmental</th>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Representational</strong></td>
<td>Knows the IA and RA</td>
<td>Knows the requests and results of the users</td>
<td>Knows its name, its IP address, its roles</td>
</tr>
<tr>
<td><strong>Organisational</strong></td>
<td>Controls the coordination of actions of CIMASTEWA agents</td>
<td>Manages the database</td>
<td>Ø</td>
</tr>
<tr>
<td><strong>Interaction</strong></td>
<td>Is the responsible of IA</td>
<td>Interacts with the database and the jsp pages</td>
<td>Ø</td>
</tr>
<tr>
<td><strong>Productive</strong></td>
<td>Sends requests to the IA</td>
<td>Fills the database with results provided by the IA and controls the requests provided by the jsp pages</td>
<td>Modifications of knowledge, of its roles</td>
</tr>
<tr>
<td><strong>Conservative</strong></td>
<td>Checks if its contacts IA are active...</td>
<td>Check the database</td>
<td>Deferred to its contacts</td>
</tr>
</tbody>
</table>

**CA: Coordinator Agent**

**RA: Request Agent**

**IA: Information Responsible Agent**

**SA: Search Engine Agent**
Cooperative specification

| User A | Web Components | Coordinator Agent A | Information Responsible Agent A | Request Agent A1 | Search Engine Agent A11 | Search Engine Agent A12 |

- **Describe the request**
- **Display a message**
- **Check the database**
  - **No similarity**
  - **Request has similarities with others**
    - **Send a message to the I.R. agent**
      - **analyse the request database**
        - **if**
          - **create an agent for each request to carry out**
            - **ask agent to load its role**
              - **load the skill**
                - **ask to the agents to perform the request**
                  - **[internal request]**
                    - **[internal request] : internal message between agents**
                      - **(information) : information exchanged between agents and between users and agents**
                        - **creation / destruction of an agent**
                          - **response of a synchronous request**

  - **[internal request]**
    - **there is at least one request to carry out**

- **Give the skill**
- **[internal request]**

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CIMASTEWA Web interfaces

Information sharing

Possibility to define the request as public
Inform user that other users have received the result

**encourage cooperation**
CIMASTEWA Web interfaces

Scrambling/blurring of requests, a simple solution: the merge
Enhanced scrambling of requests:
decomposition of a request into sub-requests
with the add of ‘lure’ worlds from a list of particular terms
by the request agents

Pb : Need resources

⇒ distribute search and choose the best organisation

Need quick results: invitation to tenders

Need pertinent results: Specialisation

Low resources: Delegation
• Objective: identify groups of actors having same interests centres to encourage them to cooperate

• Use of the Kohonen algorithm that regroups elements according to their distance from a null vector [Kohonen 91]

• Definition of an interest distance from the keywords used in the requests
Use of the Kohonen algorithm

A request is defined as a vector of pounds:

- if the word is a necessary word $\Rightarrow$ Coef = 10
- if the word is an allowed word $\Rightarrow$ Coef = 5
- if the word is forbidden $\Rightarrow$ Coef = -10
- if the word does not appear in the request $\Rightarrow$ Coef = 0
Kohonen: example of entries

15 users / 33 keywords

<table>
<thead>
<tr>
<th>Users</th>
<th>User1</th>
<th>User2</th>
<th>User3</th>
<th>User4</th>
<th>User5</th>
<th>User6</th>
<th>...</th>
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</thead>
<tbody>
<tr>
<td>Words</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Intelligent</td>
<td>5</td>
<td>10</td>
<td>0</td>
<td>-10</td>
<td>5</td>
<td>10</td>
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<td>-10</td>
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<td>5</td>
<td>...</td>
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<tr>
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<td>10</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>...</td>
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<tr>
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<td>...</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>...</td>
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<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
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</tr>
</tbody>
</table>
### Iterations

<table>
<thead>
<tr>
<th>Time</th>
<th>Value</th>
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<tbody>
<tr>
<td>T=0</td>
<td>0 / 3000</td>
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<tr>
<td>T=500</td>
<td>3000</td>
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<tr>
<td>T=1000</td>
<td>3000</td>
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<tr>
<td>T=1500</td>
<td>3000</td>
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<td>T=2000</td>
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<tr>
<td>T=2500</td>
<td>3000</td>
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<tr>
<td>T=3000</td>
<td>3000</td>
</tr>
</tbody>
</table>

**Objective:**

- Inform users that they have similar centre of interests (at their login or by mail)
- Encourage cooperation
Conclusion

- Holonic platform allow us to easily deploy multi-agent systems where number of agents playing the same roles is important
  - adaptation to FIPA compliant platforms

- AMOMCASYS method, limited to: analysis, modeling of complex administrative system and general specification of MAS
  - we turn to use of UML diagrams or A-UML in addition of AMOMCASYS

- Tests of the scrambling/blurring method

- Integration of the interest centers detector
Web interfaces between users and a centralized information multi-agent system

Thank you for your attention...

Emmanuel ADAM, René MANDIAU