Knowledge Management in Multi-Agent Systems
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Agenda
• Introduction
  ▪ Agents and Multi-Agent Systems
  ▪ Role of ontologies in Knowledge Management
• Organizing ontologies among agents
• Management of OWL ontologies using the Java language
• Case study
  ▪ Introduction
  ▪ Ontology organization
  ▪ Managing ontologies
Agents and Multi-Agent Systems

- Multi-Agent Systems (MAS) are gradually becoming a new paradigm for developing distributed computing systems.
- An appropriate platform for integrative decision support within business information systems and knowledge management.
- “An agent is a computer system that is situated in some environment, and that is capable of autonomous actions in this environment in order to meet its design objectives” [Wooldridge, 2000].
- AgentLink

Role of ontologies in Knowledge Management

- An ontology is an explicit specification of a conceptualisation of the real-world entities of an application domain. [Gruber, 1995]
- OWL, World Wide Web Consortium
Organizing ontologies among agents  (1)

• Every agent has knowledge about its problem domain and directly communicates with another agent.
• **Advantages:** every agent can decide for itself whether it should trust another agent and request information from the agent it finds the most credible.
• **Drawbacks:** reduced performance.
• $N \cdot K$

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Organizing ontologies among agents  (2)

• An agent sends an inform message to all the interested agents about new information. Other agents can request the new information when they need to update their knowledge.
• **Advantages:** more appropriate when most of the possible agents will not need the information each time it changes.
• $N \cdot I + N' \cdot I + N' \cdot K, 0 \leq N' \leq N$
• $N \cdot I < N \cdot K < 2 \cdot N \cdot I + N \cdot K$
Organizing ontologies among agents (3)

• An agent sends an inform message to all the interested agents about new information which is in a common ontology. A common ontology is an intersection of all of the agents’ ontologies.
• **Advantages:** avoiding unnecessary message passing.
• **Drawbacks:** complex mechanisms of coordination needed in case of MAS where more agents reason about the same issue.
• N - I

Organizing ontologies among agents (4)

• An agent sends an inform message to all the interested agents about new information which is in a common ontology. A common ontology is an union of all of the agents’ ontologies.
• **Advantages:** possibility of restoring knowledge in case of failures.
• **Drawbacks:** complex mechanisms of coordination needed in case of MAS where more agents reason about the same issue.
• N - I
Management of OWL ontologies using the Java language

- **JADE** - Java Agent DEvelopment Framework
- Two main approaches:
  - Generating Java code from an ontology,
  - Direct access to OWL ontology.
- Mapping OWL to Java is not straightforward.

**COMPROMISE**

Agent’s reasoning
Communication between agents
Reasoning on the common ontology

Case study (1)

Introduction
Case study (2)
Ontology organization

Notifying ontology
- notification policy
- context of business users

Information retrieval ontology
- information extraction rules
- case based reasoning

Data mining and warehousing ontology
- Critical Success Factors monitoring
- prediction models

Case study (3)
Managing ontologies
Conclusion

• In achieving higher degree of autonomy and automation of Information Systems sharing and reusing knowledge is vitally important.
  ▪ Ontologies offer efficient mechanism for knowledge manipulation.
• Presented a solution to an efficient use of OWL ontologies in Multi-Agent Systems.
  ▪ Case study from the domain of mobile communications

Questions