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SOCIAL SEMANTICS FOR AGENT IN E-COMMERCE

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<Abstract>

Obtaining a suitable formal semantics for agent in e-Commerce is important and the greatest challenges for multiagent systems in e-Commerce. The social semantics discussed in this paper dealt with the social construction of interpersonal communication, i.e., interaction within social context. We present formal semantics based on the social commitments for ACL primitives. This semantics is essential to the multiagent protocols in e-Commerce.

1. Introduction

Because of its ubiquity and ease of use, the web is rapidly becoming the platform of choice for a number of important applications, such as trading, supply-chain management, and in general e-Commerce(electronic commerce). The web provides an excellent infrastructure through which agents can communicate with one another. In general, in an open system, the member agents are contributed by several sources and serve different interests. Thus, these agents are treated as

- *autonomous*-with few constraints on behaviour, reflecting the independence of their users, and
- *heterogeneous*-with few constraints on construction, reflecting the independence of their designers.

Coordination deals with how autonomous agents may align their activities in terms of what they do and when they do it. However, there is more to interaction in general, and compliance in particular. Specifically, interaction must include some consideration of commitments that the agents enter into with each other. The commitments of the agents are not only base-level commitments dealing with what actions they must or must not perform, but also metacommitments dealing with how they will adjust their

base-level commitments[1]. Commitments provide a layer of coherence to the agents interactions with each other. They are especially important in environments where we need to model any kind of contractual relationships among the agents especially in e-Commerce.

Such environments are crucial wherever open multiagent systems must be composed on the fly, e.g., in electronic commerce of various kinds on the Internet. The addition of commitments as an explicit first-class object results in considerable flexibility of how the protocols can be realized in changing situations. We term such augmented protocols as commitment protocols.

2. Backgrounds

Commitment protocols here are a multiagent concept. They are far more flexible and general than commitment protocols in distributed computing and databases, such as two-phase commit[2]. This is because our underlying notion of commitment is flexible, whereas traditional commitments are rigid and irrevocable. In databases, commitments correspond to a value being declared and are identified with successful termination of a transaction. When a transaction terminates successfully, it commits, but it is not around any more to modify its commitments. Thus the commitments are rigid and irrevocable.

We analyze conversations or place additional, but reasonable restrictions on the agents that would help focus their interactions on the true relationships between their respective computations. Given the autonomy and heterogeneity of agents, the most natural ways to treat interactions is as communications. A communication protocol involves the exchange of messages with a streamlined set of tokens. This approach assigns public, i.e., observable meanings in terms of social commitments. Thus, every communication protocol is a commitment protocol.

3. Commitments in Multiagent Systems

3.1 Spheres of Control

Spheres of control(SoC), which sought to characterize activities more generally than database transactions, were proposed[4]. SoC are defined in terms of three interacting concerns:

- Process atomicity: This determines what actions are included in the given unit of atomicity. All or none of these actions are performed.
- Process control: This determines which data items are owned by a process-these

cannot be modified by others.

- Process commitment: This identifies a specific function that determines the modified value of each data item.

3.2 Commitments

A commitment is a four-place relationship between a debt, a creditor, a context, and a proposition. The debtor owes it to the creditor to make the proposition true; the context serves as a witness and as an adjudicator of disputes. There is indeed a close relationship between commitments and regal reasoning.

A sphere of commitment(SoCom) is viewed conceptually as a scope within which a commitment applies; practically a SoCom is a multiagent system that the agents constitute, and which serves as the context for commitments among those agents.

A commitment C(x, y, p, G) relates a debtor x, a creditor y, a context G, and a discharge condition p.

Typically, the agents communicate with agents in order to create or adjust their commitments. The recipients autonomously process the communications. We use the following major actions or operations on commitments[5]:

- create: instantiate, performed by debtor or context
- discharge: satisfy, performed by the debtor
- cancel: give up, performed by the debtor
- delegate: make another agent the debtor, performed by debtor or context
- assign: make another agent the creditor, performed by debtor or context
- release: eliminate entirely, performed by creditor or context

The above set of operations is complete in the sense that it covers the possible manipulations to the different components of a commitment. By contrast, traditional commitments, once created, can only be discharged.

4. Communication and Agent Interaction

4.1 Interpersonal Communication

e-Commerce is complicated by the fact that all components can be sub-divided into further processes. For example, your social identity is not a single static entity-it can change and develop and is subject to various influences. All the components are of course interlinked as illustrated[8]:

- features of the social situation influence our social identities
- how we see ourselves influences how we see others-social perception

- these mental or cognitive processes influence how we act-how we encode and decode our communication

Although it is useful to identify the separate components of the social context to explain how they work, they never work in isolation in real situations. Any communication between entities will be influenced by the relationship which exists between them. This social relationship can be of different types which reflect different roles. It is important to consider the social context in detail and identify the components which are influencing particular communication[8, 9].

From this we can deduce some idea that the processes of autonomous business entities should be able to operate together logically. Such interoperation is the only reasonable approach to achieve the construction and management of virtual enterprises. This is also essential to support e-Commerce.

4.2 Agent Interaction

Interaction is one of the most important features of an agent[7]. In other words, agents recurrently interact to share information and to perform tasks to achieve their goals. Researchers investigating agent communication languages mention three key elements to achieve multiagent interaction:

- A common agent communication language and protocol
- A common format for the content of communication
- A shared ontology

Because our agents are autonomous, we must ensure that the interactions among them do not violate their independence. The most obvious such interactions are communications. Interaction-Oriented Programming(IOP) is important to develop and study primitives for the specification of systems of agents and constraints on their behavior. These primitives include societies, the roles agents may play in them, what capabilities and commitments they require, and what authorities they grant[3]. Agents can autonomously instantiate abstract societies by adopting roles in them. The creation, operation, and dissolution of societies are achieved by agents acting autonomously, but satisfying their commitments.

One of the benefits of a commitment-based approach is that it yields a natural account of how the participating agents may comply with the requirements of the roles they play. This idea can be used to give a public basis for the meanings of communications, and to verify the compliance of agents[6].

5. Social Semantics and Electronic Commerce

We now apply the above social commitment(SoC) for the social semantics to the ACL primitives for e-Commerce. In giving this semantics, we attempt to understand eah communication atomically, i.e., as an individual communication between agents. Clearly, communications usually occur in extended protocols.

We present an example of application for formal semantics based on the social commitments. This semantics is essential to the multiagent protocols in e-Commerce. We first define an abstract Spheres of Control(SoC) consisting of two roles:

Buyer and Seller, which require their capabilities and commitments about the basic requests and the validity of price quotes. To do these roles for commitments, the SoC manager has an abstract SoC for buy-sell deals with the roles of Buyer and Seller. And then Buyer asks for price quote and makes an order and Seller responds to the price quotes and accepts orders.

Table I and II give the formal semantics of the above SoC semantics.

Illocution	**Objective**	**Subjective**
inform(x,y,p)	C(x,y,p)	C(x,y,xBp)
request(x,y,p)	C(y,x,RFp)	C(y,x,y|Fp)
promise(x,y,p)	C(x,y,RFp)	C(x,y,x|Fp)
permit(x,y,p)	C(x,y,EFp)	C(x,y,~x|~Fp)
forbid(x,y,p)	C(y,x,~RFp)	C(y,x,~y|Fp)
declare(x,y,p)	C(x,y,p)	C(x,y,x|p)

Table I. Social semantics formalized: objective and subjective

Illocution	**Practical**
inform(x,y,p)	C(x,G,inform(x,y,p)→p)
request(x,y,p)	C(x,G,request(x,y,p)→AFC(y,x,p))
promise(x,y,p)	C(x,G,promise(x,y,p)→RFp)
permit(x,y,p)	C(x,G,permit(x,y,p)→~C(y,G,~RFp)
forbid(x,y,p)	C(x,G,forbid(x,y,p)→C(y,G,~RFp))
declare(x,y,p)	C(x,G,declare(x,y,p)→p)

Table II. Social semantics formalized: practical

6. Conclusion

Any communication between entities in social context will be influenced by the relationship which exists between them. It is important to consider the social context in detail and identify the components which are influencing particular communication.

Coordination deals with how autonomous agents may align their activities in terms of what they do and when they do it. However, there is more to interaction in general, and compliance in particular. Specifically, interaction must include some consideration of commitments that the agents enter into with each other. Commitments provide a layer of coherence to the agents interactions with each other. They are especially important in environments where we need to model any kind of contractual relationships among the agents.

Such environments are crucial wherever open multiagent systems must be composed on the fly, e.g., in e-Commerce of various kinds on the Internet. Interaction is one of the most important features of an agent.

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