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Chapter 19

Designing Agent-Based Negotiation for E-Marketing

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ABSTRACT

This chapter describes how to design agent-based negotiation systems in e-marketing. Such a negotiation scheme requires the construction of a suitable set of rules, called a protocol, among the participating agents. The construction of the protocol is carried out in two stages: first expressing a program into an object-based rule system and then converting the rule applications into a set of agent-based transactions on a database of active objects represented using high-level data structures. We also describe how to detect the termination of the negotiation process based on Commission-Savings-Tally Algorithm.

A simple example illustrates how a set of agents can participate in a negotiation protocol to find the shortest travel route on a map of cities represented as a directed weighted graph.

INTRODUCTION

In Chapter 13, "E-business Transaction Management in Web Integrated Network Environment," we described the applications of agents in e-business transaction. As described there, agents consist of information objects and an associated script that knows what to do with the information and how to deal with the environment. They behave like actors and have intentions and actions. Agents are autonomous and they have a built in control to act only if they want to. In addition, agents are flexible, proactive, and have multithreaded control. In this chapter, we describe in detail how a set of agents can be used for negotiation in e-marketing. For this purpose we need to have a model of the multi-agent-based paradigm for executing the negotiation process in a manner very similar to what human beings do.

An important model of multi-agent paradigm that is suitable for our purpose is from Fisher (1995). This model is applicable to design a concurrent multi-agent negotiation paradigm based on the transactional logic model (Bonner & Kifer, 1994). Although other models of the multi-agent system have also been proposed (Figure1) (Chen & Dayal, 2000; Dignum & Sierra, 2001; Genesereth & Nilsson, 1987; Ishida, 1994), Fisher's model has the simplicity and adaptability for realization as a distributed transaction-based paradigm for negotiation .

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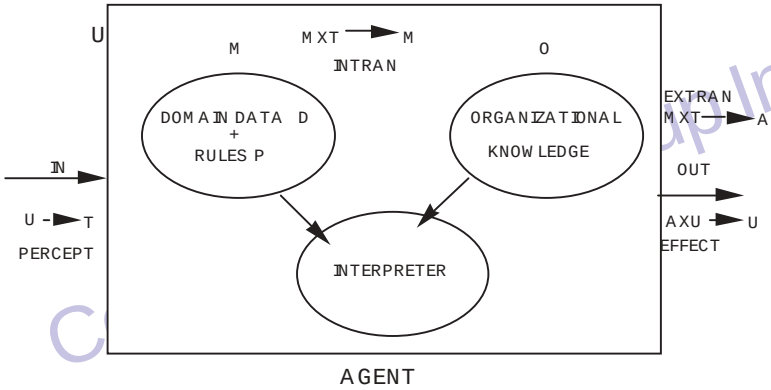
Figure 1. Model of the Multi-Agent System



A multi-agent system consists of the following subsystems:

(1) Worldly states or environment U: Those states that completely describe the universe containing all the agents.

(2) Percept: Depending upon the sensory capabilities (input interface to the universe or environment), an agent can partition U into a standard set of messages T, using a sensory function Perception (PERCEPT): PERCEPT :U→ T.

PERCEPT can involve various types of perception: see, read, hear, smell. The messages are assumed to be of standard types based on an interaction language that is interpreted identically by all agents.

(3) Epistemic states or Mind M: We assume that the agent has a mind M (that is essentially a problem domain knowledge consisting of an internal database for the problem domain data and a set of problem domain rules) that can be clearly understood by the agent without involving any sensory function. The database D sentences are in first order predicate calculus (also known as extensional database) and agents' mental actions are viewed as inferences arising from the associated rules that result in an intentional database that changes (revises or updates) D.

The agent's state of belief, or a representation of an agent's state of belief at a certain time, is represented by an ordered pair of elements (D, P). D is a set of beliefs about objects, their attributes, and relationships stored as an internal database, and P is a set of rules expressed as preconditions and consequences (conditions and actions). When T is input, if the conditions given on the left-hand side of P match T, the elements from D that correspond to the right-hand side are taken from D, and suitable actions are carried out locally (in M) as well as on the environment.

(4) Organizational Knowledge (O): Since each agent needs to communicate with the external world or other agents, we assume that O contains all the information about the relationships among the different agents. For example, the connectivity relationship for communication, the data dependencies between agents, interference among agents with respect to rules, and information about the location of different domain rules are in O.

(5) INTRAN: M is suitably revised or updated by the function called Internal Transaction (INTRAN). Revision means acquisition of new information about the world state, while update means change of the agent's view of the world. Revision of M corresponds

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