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Intelligent Agents in Accounting and Finance

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Abstract

This paper presents some problems concerning the intelligent agents and their use in accounting. There are a lot of viewpoints for using this new technology in various fields of the economy, in finance and accounting.

Key Words: Intelligent agent, multi-agent system, agent-oriented programming, object-oriented programming, accounting, finance.

Introduction

Like many other modern technologies, the intelligent agents and multi-agent systems can be and are used in many domains of the economy and the economic activities, especially in e-commerce, in marketing and management. The IA and MAS can be used, also, in the domain of the accounting.

First of all, the programmers can use the AOP (agent oriented programming) in designing and developing a general accounting program. We will present a comparison between the OOP (object oriented programming) and the AOP (agent oriented programming), emphasizing the distinction between them.

Another example is the effective using of the intelligent agents in financial applications, where they can take rational decisions, accordingly to the current situation of the enterprise, and we will present an example of an agent which will work like a counselor in costs calculation.

1. Agent-Oriented Programming

1.1. Agent-oriented programming according to Shoham's definition of agent

Agent-oriented programming is a fairly new programming paradigm that supports a societal view of computation. In AOP, objects known as agents

interact to achieve individual goals. Agents can exist in a structure as complex as a global Internet or one as simple as a module of a common program. [5]

Agents can be autonomous entities, deciding their next step without the interference of a user, or they can be controllable, serving as a mediator between the user and another agent.

An agent, according to (Shoham, 1993) is *"an entity whose state is viewed as consisting of mental components such as beliefs, capabilities, choices, and commitments"*. This definition is cryptic at best and useless at worst. In his paper, Shoham narrows this definition by applying the criterion of Dennet and McCarthy. Dennet recognized that many simple, inanimate objects could be viewed as falling into this framework (which he calls the *intentional stance*). McCarthy suggests that mental attributes should be ascribed to objects when they are "useful".

Shoham suggests that an AOP system needs each of three elements to be complete:

- A formal language with clear syntax for describing the mental state. This would likely include structure for stating beliefs (e.g. the predicate calculus), passing messages, etc. Most of the research in the field has been on this portion and stresses the semantic issues related to artificial intelligence.
- A programming language in which to define agents. The semantics of this language should be closely related to those of the formal language. In many situations, functionality will be difficult or impossible to implement and further limitations will be introduced. We will see this in more than one case.
- A method for converting neutral applications into agents. This sort of tool would allow an agent to communicate with a non-agent by attributing intentions much the same way as we did with the inter-planetary rover above. This portion of the specification is not related to the language issues and will not be discussed here.

1.2. The agent and Agent Oriented Programming

What is an *Agent*? According to Jennings, an agent is an object capable of displaying:

- **Reactivity:** Changes in internal structure in response to changes in environment.

- **Social Ability:** Interaction with other agents through some form of language.
- **Pro-Activity:** Goal-directed actions.
- **Autonomy:** Some degree of control over its own actions ("self-activation").

The key distinction is **a*utonomy.*** Distributed control, ***not*** just distributed actions. According to Jennings, conventional objects encapsulate attributes and methods but not *self*-activation and *localized* action choice.

Autonomy means that each agent effectively has its own persistent thread of control. Each agent decides for itself which actions to perform at what time, based in part on external environmental conditions *and in part on private internal aspects* (current beliefs, desires,…).

Thus, in multi-agent systems, a potential source of uncertainty for each agent is not knowing for sure what other agents will do (called *"behavioral"* or *"strategic"* uncertainty).

Example [6]**: Class WorkerBot**

Public Access:

// **Socially enforced methods**
Protocols governing job search
Protocols governing negotiations with potential employers
Protocols governing unemployment benefits program

Private Access Only:

// My behavioral methods
// My Data

1.4. AOP and the computational laboratories

A computational laboratory is a computational framework for the study of complex system behaviors by means of controlled and replicable experiments.

Graphical User Interface (GUI) permits experimentation by users with no programming
background. Modular/extensible form permits framework capabilities to be changed/extended by users who have programming background.

AOP via Computational Laboratories Evolution of trade networks among strategically interacting traders (buyers, sellers, and dealers). Traders are instantiated as "tradebots" (autonomous software entities with internal attributes and methods). The tradebots engage in event-driven communication

. The tradebots evolve their trade methods over time, starting from *initially random* trade methods

An example is The Trade Network Game Lab (TNG) Laboratory. This was developed by Leigh Tesfatsion, professor of Economics and Mathematics Professor in Department of Economics at Iowa State University. [6]

2. Intelligent agents and multi-agent systems in business applications

2.1. The XBRL language and standards

eXtensible Business Reporting Language (XBRL) brings the publication, exchange, and analysis of the complex financial information in corporate business reports into the dynamic and interactive realm of the internet. [7]

XBRL provides a common platform for critical business reporting processes and improves the reliability and ease of communicating financial data among users internal and external to the reporting enterprise. XBRL is an XML-based, royalty-free, and open standard being developed by *XBRL International Inc.,* which is a not-for-profit consortium of around 200 companies and agencies, delivering benefits to investors, accountants, regulators, executives, business and financial analysts, and information providers. XBRL International has released a Candidate Recommendation of a document on the design of taxonomies for financial reporting.

The Financial Reporting Taxonomies Architecture (FRTA) 1.0 guides the creation and use of effective taxonomies. It sets out a recommended design architecture and establishes rules and conventions both for taxonomies and their corresponding instance documents. It will be a key reference for those who are producing or extending financial reporting taxonomies. It will also help in the comparison of taxonomies and the efficient consumption of XBRL-tagged data.

The FRTA document assumes use of the new XBRL 2.1 Specification. Financial reporting, as defined for the FRTA, includes disclosures based on authoritative financial reporting standards and other reports whose subject matter is related primarily to financial position and performance.

2.2. Financial Reporting and Auditing Agent with Net Knowledge

At the E&Y CARAT *(Center for International Business Education and Research)* center are developing this website as a resource center for accounting and auditing professionals. Our efforts include an intelligent agent named FRAANK (Financial Reporting and Auditing Agent with Net Knowledge) [8] that retrieves financial and non-financial information from 10Q reports of publicly traded companies (that file their reports with the SEC's EDGAR system). In order to keep abreast with the latest technological advancements, they started extending the original FRAANK technology to incorporate XBRL

The FRAANK-XBRL software currently converts 10Q and 10K reports in text formats to a tagged version based on the US XBRL taxonomy. Please check the links to these websites (under the "Research" section) to get a live demo of the various systems currently being developed.

For more information about professional organizations, CPA Exam requirements for various states in US check the "Resource" section. For more information or to download the Digital Analysis software that determines data abnormality go to the "Research" section.

2.3. XBRL and FRAANK: A Digital Reporting Language with Intelligent Agent

XBRL (Extensible Business Reporting Language) [7] is an XML-(Extensible Markup Language) based language for business reporting where business information is tagged and thus processed, analysed, and reported without human intervention.

We all know that HTML (HyperText Markup Language) revolutionized web browsing. XBRL will similarly revolutionize e-business. HTML provides tags to display the text (content) on the web without any context knowledge.

XBRL, on the other hand, tags information with both content and context. It basically tags all relevant business information for both external and internal decisions.

The XBRL International (a consortium of over 170 firms in the world) is developing XBRL taxonomies for various countries. The US jurisdiction has just published version 2 taxonomy for public comments. There are test cases (e.g., FDIC) where XBRL is already showing its benefits by making the process of creating and analysing information more efficient and cost effective. [7],[8]

2.4. An intelligent agent for suggest the method of cost calculation

Having as starting point a model of expert system developed by prof. dr. Ioan Andone and dr. Alexandru Țugui [1] we designed an intelligent agent to suggest the method of cost calculation.

The agent is adequate to a specific situation from a firm. The selection of method will make function of the size of the society, function of the production process, function of the classification of the costs and other elements.

The system is in work, and his bases are described in [1].

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