Intelligent Software Agents in E–Commerce

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INTRODUCTION

Agent technology is one of the most widely discussed topics in information systems and computer science literature. New software products are being introduced each day. A growing number of computer information professionals recognize that there are definite issues surrounding intelligent agent terminology. These must be resolved if agent technology is to continue to develop and establish.

Current research on intelligent agent software technology can be categorized as two main areas: technological and social. In the excitement of emergent technology, people often forget to scrutinize how new technology may impact their lives. The social dimension of technological progress is the driving force and most central concern of technology. Technology is not created for its own sake as a technological imperative. This article critiques the current state of software intelligent agents by examining technological issues and the social implications of intelligent agent software technology.

TECHNOLOGICAL ISSUES

An attempt to arrive at a generally accepted definition is the first hurdle. In order for this term to have any effectiveness, there must first be a universal definition that can be agreed upon and used consistently. Unfortunately, there is none. Many proposals for defining an "intelligent agent" have been put forth, but none has received wide acceptance. Some of these proposals are the following:

- "An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors." Russell and Norvig (1995)
- "Let us define an agent as a persistent software entity dedicated to a specific purpose. 'Persistent' distinguishes agents from subroutines; agents have their own ideas about how to accomplish tasks, their own agendas. 'Special purpose' distinguishes them from other entire multifunction applications; agents are typically much smaller."
- "An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future." Franklin and Graesser (1996)

While these terms attempt to describe characteristics of intelligent agents, no comprehensive and generic description for these agents has gained wide recognition as the definitive description of a software agent. A consensus definition has not yet been achieved. As Franklin and Graesser (1996) indicate, most of the definitions proposed are derived from conceptualizations peculiar to the subjective views of the individuals. It is important to note that it is this intuitive aspect of an "intelligent agent" which makes it difficult to establish a broadly accepted formal definition. Ironically, it facilitates marketing of intelligent agent software technology.

A second reason for a lack of a consensus definition is that much of the agent research is proprietary. Companies that make investments to sponsor such research do not wish to reveal their competitive edge nor give away the value of their work. Standardization of new technology is difficult. Uncertainty will continue until the companies and individuals with the proprietary information recognize that sharing knowledge benefits everyone.

A third reason for the difficulty for the lack of a generally approved definition of an intelligent software agent, and probably the most important reason of the three outlined in this article, is that intelligent agent software does not seem to be qualitatively different from other software. "Is it an agent, or just a program?" Franklin and Graesser (1996) ask and observe, correctly, that all software agents are programs. The authors also state that not all programs are agents. The implication is that some programs are, in fact, agents. If an "intelligent agent" were

just an added complex program, the term "intelligent agent" would simply mean that a software program was simply extended, made more composite and possibly more useful than other typical programs. An intelligent agent differs from a procedural program in two ways. First, it is an agent and broadly speaking, it is defined as someone or something that acts. To be able to act, the entity must have a purpose or a goal. A computer program can only perform a prescribed set of instructions. An intelligent software agent has the same capability and is similar to a computer program in this respect.

Computer programs act utilizing a relatively low level of logic. These programs cannot act autonomously. For any entity to act with autonomy there must be concomitant independence and freedom. Procedural computer programs do not have volition, because whatever is written into the program is executed. The key factor is logic bound and a closed program. The term "react" is an inherent limitation of closed computer programs. An agent, in the true sense of the word, initiates action. The several reasons illustrate why some time is required for an acceptable definition of software agent. This process is likely to be somewhat similar to the emergence of the distinction between artificial intelligence, expert systems and decision support systems, which became clear gradually with more widespread usage of this distinctive software.

We do not demean the effort that has been invested into these products. Systems that are based on the detection of patterns in conjunction with explicit user commands and preferences are based on straightforward computational mathematics and logic. Technical challenges exist in the areas of security, connectivity, storage, peer group collaboration, network-based services, user interface, stability and standards (Bantz et al., 2003). Park and Park (2003) propose an agent-based system for merchandise management and verify its application in a duty-free shop, which performs evaluating and selecting merchandise and predicting seasons and building purchase schedules autonomously in place of human merchandise managers under a business-to-business (B2B) electronic commerce (EC) environment. In order to facilitate the agent's intelligent behavior, several analysis tools such as data envelopment analysis (DEA), genetic algorithm (GA), linear regression and rule induction algorithm are incorporated into the system.

E-mail and filters reject messages that do not comply to the user's defined preferences. Help engines and data warehousing tools search for built-in patterns. Patterns are pre-built into the engines, which are limited by the closed logic bounds specified by the designs. News and searching tools have a great potential, albeit they pose a concern. The dilemma is if many users have news searching intelligent agent tools constantly searching for information on the Internet, the Internet may possibly be clogged up by too many of these searching tools. Imagine if one of these intelligent agents had a built-in error (bug) that caused the program to continuously spawn even more agents to search the Internet. Moreover, some intelligent agents searching the Internet for information could get lost and not return with the requested information. Thus, one can see the latent technical threat in employing such ill-designed intelligent agents. These "lost" agents may create severe bottlenecks on the Internet.

Although intelligence means people thinking, it may be possible to replicate the same set of behaviors using computation. This idea was discussed by Turing in the 1940s. In 1950 he proposed a test, now called the Turing Test (TT), for computational intelligence. In the test, a human judgment must be made concerning whether a set of observed behaviors is sufficiently similar to human behaviors that the same word - intelligent - can justifiably be used. Feigenbaum (2003) discuss the challenges for computational intelligence, including: 1. an alternative to TT that tests the facet of quality (the complexity, the depth) of reasoning, 2. building a large knowledge base by reading text, thus reducing knowledge engineering effort, and 3. distilling from the WWW a huge knowledge base, thus reducing the cost of knowledge engineering.

Olin et al. (2001) suggest that although tools in the shape of distributed artificial intelligence will be available and be particularly applicable to the complexities of decision-making in the typical global enterprise, a number of issues will arise in the next few years as intelligent agents become the mainstream enablers of "real-time" enterprise process, such as the need to ensure continuity in the transition phase by careful integration of intelligent agent systems in to a legacy systems.

Van Den Heuvel and Maamar (2003) propose a framework for contract-based support to establish virtual collaboration using loosely coupled and heterogeneous intelligent Web services (IWS) in which contracts encapsulate the control information for IWSs engaged in e-business transactions. Since IWS technology is still in its infancy, several important issues must be addressed before agentified Web services can be successfully deployed at e-marketplaces, such as the integration of IWSs with wrapped legacy systems, the semantic integration of Web services, and the integration of Web services into e-commerce transactions (Van Den Heuvel & Maamar, 2003).

While search engines have become the major decision support tools for the Internet, there is a growing disparity between the image of the World Wide Web stored in search engine repositories and the actual dynamic, distributed nature of Web data. The traditional static methods in which search and retrieval are disjoint seem limited. Menczer (2003) proposes using an adaptive population of intelligent agents mining the Web online at query time and

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