Agent-Based Electronic Commerce: Opportunities and Challenges

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1. Negotiation and Trading

A trading agent that closely models the strategies and preferences of the person or business it represents should consider many possibilities for a single "transaction." How these parallel negotiations occur will be a matter of strategy, processing power, governing policies and an agent's ability to manage complexity. An agent may even consider the things already owned by the buyer, other needs outside the transaction, or the status of related negotiations. However, even a versatile agent will be constrained by laws and policies outside its control.

My current research concerns self-interested agents working in opposition to, or at least *not in cooperation with,* the other parties to a transaction. We presume that buyer's and seller's agents have private valuations for the items under discussion. However, we do not presume that agents are confined to, or primarily interested in, the price of goods. Price-only negotiations may find each side attempting to merely exit a transaction with minimal personal loss. Further, although many kinds of transactions may be accurately modeled as auctions, we are looking beyond auctions to integrative activities, invoking more complete disclosures of qualities such as delivery terms and finely detailed descriptions of needs.

Trading protocols

The lack of broadly accepted protocols for trading impedes progress with agent trading. How do agents know what to say to each other? How can agents and their owners be confident that the transaction *as understood* is identically understood by the other party?

Agent-to-agent negotiations have also been held back by the rush to the Web. Web sites obscure database-borne information by casting it into machine-unfriendly pages behind proprietary queries. Other companies then run screen-scraping programs to generate inferior machine-readable data from the web pages.

XML addresses this unending cycle, but so many XML "standards for e-commerce" now exist that trader-specific transcoding may be required to bridge XML dialects.

Rather than employing XML as the base language of trade, we are exploring the use of lower-level descriptions of individual *needs* and *offers* held by all the parties to a transaction. We do not decree the rules of exchange in advance by name, but create agents that describe their true needs, offers and dealmaking preferences. These models may follow established trading protocols, or may differ subtly or substantially from established practice.

2. Trust and Privacy

Issues in trust and privacy include *delegation of authority* from a human to a software construct; *confidence* in the execution of strategies by the software; and *protection of private information* from accidental disclosure or theft.

Delegation of authority

In everyday transactions, a *principal* that delegates authority to an *agent* must make its intentions clear. The agent should then follow the principal's instructions faithfully. As with delegation from person to person, misunderstandings may occur at the interface between a human principal and a software agent – when a principal does not clearly define its intentions, when an agent does not fully comprehend the instructions, or when the two parties interpret identical instructions differently.

Well-meaning legislative attempts to clarify roles and obligations in electronic transactions may complicate them instead. The Uniform Computer Information Transactions Act [UCITA, UCITA2], for example, eliminates a consumer's right to "read the contract" before payment for goods and allows sellers to define consent so that future transactions could occur without advance notice to buyers. See [BRAUCHER] for more details.

Confidence

Market-wide issues of confidence include the possibility that all parties do not share the same understanding of an agreement. Also, should the market serve traders, or may it bias its actions to further its own self-interest?

Our research discusses altruistic markets that facilitate but do not interfere in negotiations. It is essential to build agent market systems that are impartial, equally binding on and informative to all parties. Complete and fully-distributed information should be free of external influence such as a market's own preference regarding the outcome, rules or pace of negotiations.

Can markets – meeting places and support mechanisms for traders – maintain relevance *without* interposing themselves in trades? They can, but only by deliberately stepping aside. The role and overhead of third-party markets will be significantly diminished when they carry on as meeting places but are no longer needed to clear transactions or to pair offers with requests.

Protection of private information

Assertions of privacy control take two forms: (1) an *arms race* in which privacy seekers attempt to outrun and outwit those who seek information (2) *legislated and market-driven privacy policies* that obviate the arms race by rendering private data either uninteresting or illegal. Of course a privacy arms race is ultimately futile. Every privacy strategy attracts new countermeasures (e.g. cookie-blocking software catalyzed the invention of single-pixel "web bugs"). Only legislation or, in its absence, market pressure brought by many individual actors, can command respect for individual privacy rights.

Agent technologies are well suited to privacy enhancement through both policy and technology. For example, an agent may prefer suppliers with strong privacy practices. If enough trading agents express this preference, the persistent, composite demand can force market actors to conform to their wishes. Also, agents that transparently manage pseudonyms and one-time transaction data can make basic privacy protection universally available. Unfortunately, in the past, schedule pressures and the state of uncaring or unknowing among software designers conspired against simple, practical privacy in everyday applications.

Direct agent interfaces to systems like the American Express Private Payments system [AMEX] would make excellent examples of the potential for agent technologies that both *drive* and *utilize* progressive rulemaking in civil law and business practice. When client software finally moves from web pages and browsers into consumer-driven applications, superior protocols and practices will appear. Though serviceable privacy tools have been available for some time, interface and design failures have left them unusable by most people [WHITTEN]. In e-commerce, the SET protocol [SET] is well regarded but not widely adopted. Protocols and procedures for private comparisons of individual preferences [HUBERMAN] must be embedded in consumer agents to benefit all traders.

We are building a client interface to the agent trading environment mentioned previously, to explore these premises. We have also conducted preliminary investigations into interfaces and protocols for transparent e-mail encryption, research that we hope will generalize to other forms of messaging, including agent negotiations.

3. Agent Economics

We ask whether agent explorations must necessarily lead consumers to a lowest price. What signifies the lowest price? Are price reductions and price-driven negotiations the only persuasive options available to a seller? Certainly not, even for "commodity" transactions.

Furthermore, a fair profit can be healthy not only for sellers, but for a marketplace and its consumers too. Profits needn't merely enrich sellers. They fund improvements to products and services, new features, better post-sale support, and other buyer benefits. For a medical procedure, we should prefer a well-paid surgeon whose fees support education, modern equipment, a skilled staff, and time for rest. Myopic focus on "best price" also increases the risk that price-setting agents may stumble into ruinous price wars. Simulations [KEPHART] have demonstrated outcomes in electronic marketplaces inhabited by both learning-capable and naïve agents.

Search costs and uneven dispersion of information fuel the transfer of value in traditional markets through the work of arbitrageurs and bargain hunters. But traditional sources of *friction* are muted in electronic markets. *Differentiation* replaces friction in new markets – distinguishing buyers, sellers, goods, policies and terms of transactions – through a rich expression of needs and offers. How will negotiations over "more than price" progress? Traders are freed to consider all that a buyer or seller may offer to conclude a negotiation, such as additional goods, better terms, flexibility in a "non-refundable" ticket, or more (or fewer) frequent flyer miles.

What then happens to *brand identit*y? Agents do not care about the name of the vendor or the maker of goods. But their owners may retain an interest in that information. Erik Brynjolfsson [BRYNJOLFSSON] has shown that consumers do prefer familiar brands, and will deliberately select a familiar vendor even when that vendor's prices are relatively high. Prominent brands maintain their *identities* through billboards, broadcasts and print ads that appeal to decision-makers. In an agent-inhabited market, traditional branding activities are invisible to the decision-makers. Agents don't (yet) watch television.

How does a "brand" assert itself in this arena? A productive approach is to build "brand" around those things that matter to agent decision makers, such as peer recommendations, customer-driven policies, and rapid well-formed responses to queries.

5. References

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