Specification and execution of composite trading activities

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Published online: 24 October 2007
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Abstract With the growing number of trading opportunities available online, software tools designed to act on behalf of human traders are increasingly being used to automate trading activities. The next logical step in this evolution is the automation of composite trading activities designed to fulfill complex user goals and requirements. In this paper, we describe a model for specifying composite trading activities involving concurrent and interrelated negotiations with multiple parties and heterogeneous protocols. The model supports the specification of several types of constraints, such as the number of required successful negotiations, the limit price for the items to be traded, and the temporal constraints imposed by all trading parties. In order to guide the execution of the trading activities, we describe a novel planning and execution model for composite trading activities which is designed to maximize the expected utility of the user.

Keywords Trading activities · Negotiation protocols · Concurrent negotiations · Negotiation plans · Expected utility
1 Introduction

Electronic marketplaces, especially over the Internet, allow an increasing number of trading activities to be automated. Online auction houses (eBay, Yahoo, Amazon), online exchanges (World Chemical Exchange, e-STEEL), and electronic communication networks (Instinet, Island) provide the basic infrastructure for programmatic product discovery, quote polling, auctioning, bidding, order placement, trade settlement, etc. Already, several tools for trading partners discovery, price tracking, and automated bidding, among others, have emerged (e.g. BidXS, PhantomBidder).

Although simple automated programs [1–3] are available for bidding in concurrent auctions, these tools are not suitable for dealing with composite trading activities which are common in the business community. Composite trading activities can be employed in areas such as bidding in simultaneous online (English) auctions, supply chain management, the travel industry, share trading, foreign exchange markets, radio spectrum auctions, energy trading, and in emerging areas such as service composition. For instance, a paper production factory may concurrently negotiate with several suppliers for the purchase of recycled fibre. Composite trading activities involve securing deals by means of interrelated negotiation processes. Specifically, a composite trading activity may need to interact with multiple trading partners and marketplaces concurrently, to comply with temporal constraints, and to deal with specialized knowledge about market mechanisms and domain areas. Due to the large number of factors need to be considered in conducting composite trading activities, a rigorous planning and coordination scheme is needed.

Previous studies on the design of agents for participating in concurrent negotiations (e.g. [7, 9, 21]) assume an identical negotiation protocol across all trading activities (e.g. English auction). They are therefore not applicable to activities involving different negotiation protocols. Our work addresses this issue by proposing a common interface which is used to abstract the internal dynamics of trading activities. Based on this common interface, we propose a model which can be used to specify trading activities capable of concurrently participating in multiple negotiations. Using this model, composite trading activities are specified as assemblages of other (elementary and composite) trading activities. Our model supports (a) buying by means of English, Dutch, first-price sealed bid, or Vickrey auctions, (b) selling by means of a reverse auction and (c) buying/selling by means of an alternating offers bargaining protocol.

In addition to having to comply with the rules of the underlying negotiation protocols, trading activities are also required to comply with temporal constraints imposed by the participating negotiation parties. These constraints include the end times of the negotiations (or closing time of the auctions) and expiry times of proposals and counter proposals. The model described in this paper deals with negotiations which have known fixed end times, or which involve proposals with expiry dates.

When negotiations are performed, a trader may also wish to specify a maximum price at which a deal may be reached for a given trading activity, and the required number of successful trading activities. The model described in this paper allows these constraints to be captured, and an execution engine is proposed to enforce these constraints by monitoring and controlling the execution of composite trading activities.