Agent Based Bidding System in Multiple Online Auctions

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Abstract

Auctions are widely used to conduct commercial transactions. Increasing number of online auctions is challenging to those who are looking for good deals. These problems can be solved by participating across multiple online auctions. Agent technology can be applied to E-commerce today in order to help users in buying things. This system presents an approach to develop bidding agents, participating in multiple online auctions, for obtaining an item at the acceptable price. It consists of prediction method and a planning algorithm. Buying laptop computers and mobile phones will be implemented as the case study of the system.

Keywords: Online Auctions, Autonomous Agent, Bidding Strategy, Multiple Auctions, Alternative auctions, Bidding Agent

1. Introduction

With the rapid development of online marketplaces, trading practices such as dynamic pricing, and exchanges gained a great attention during these days. Agent acts autonomous by interacting with its environment and with other agents. An auction is a process wherein items are bought and sold by offering goods for sale by accepting bids from buyers and then selling the goods to the highest bidder. The bidding history of a product is valuable information for future auctions, including dates and times when bids were placed for the specific product and the values of those bids. This system presents the issue of seller comparison in online auction.

2. Related Work

Although there has been much recent interest in the design of bidding agents for online auctions, most of this work has concentrated on an agent operating in a single auction (be it Dutch [8], continuous double [5] or any other protocol without a clearly computable dominant strategy). Anthony et al [1] developed a heuristic method that covered all the protocols discussed in this paper, but which purchases only a single item and which does not have a clear analytical framework underpinning its operation. There has been some recent work on agents for multiple auctions. Boutilier et. al. [3, 2] discuss sequences of sealed bid auctions, using dynamic programming to determine optimal bid-choices. While this work is clearly important, we believe the multiple auction contexts is likely to become more important in the longer term since it can create more efficient and stable marketplaces [4].

3. Agent Technology

An agent is a software entity that is autonomous, communicating, and adaptive. Autonomy means that an agent is driven by its own objectives, possesses resource of its own, is capable of recording information about its environment, and can choose how to react to the environment. An agent is also a communicating software entity. Multiagent system is one that consists of a numbers of agents, which interact with one another. Agents communicate directly with other agents by passing messages. Agent has the following properties:

- Autonomy
- Social Ability
- Reactivity
- Pro-activeness

3.1. Bidding Agent

The bidder agent is given a hard deadline by when it needs to obtain the item. The bidder agent utilises the available information to make its bidding decision; this includes the consumer's private valuation, the time it has left to acquire the item, the current offer of each individual auction, and its sets of tactics and strategies. The private valuation is derived from the item's closing price distribution, observed from past auctions. The output of the bidding decision is the auction the agent should bid in and the recommended bid value that it should bid in that auction. If the agent does not purchase the item by its deadline, it returns to the consumer for further instructions.

Bidding systems are implemented to help the buyers in bidding multiple auctions. Buyers found difficulty in finding the best auction for the tremendous auctions. Bidding system finds the best auctions for the buyers and also computes the bidding price. With bidding price computed by bidding system, buyer can get the item in an

appropriate price based on his / her preferences. This system will implement English Auction for auction houses.

4. Online Auctions

Online auctions mimic auctions in the physical world and differ according to many parameters like the role of the sellers or buyers and the sort of pricing or bargaining. They are the largest class of electronic marketplaces. Figure 1 shows the general auction framework. Online auction sites give buyers a virtual market with new and used merchandise from around the world. They give sellers a global storefront from which to market their goods. Because many online auctions can be regarded as multi-agent E-marketplaces.

Internet auctions are online bazaars. Some are the scenes of business-to-person activity, where a Web site operator physically controls the merchandise for sale and accepts payment for the goods.

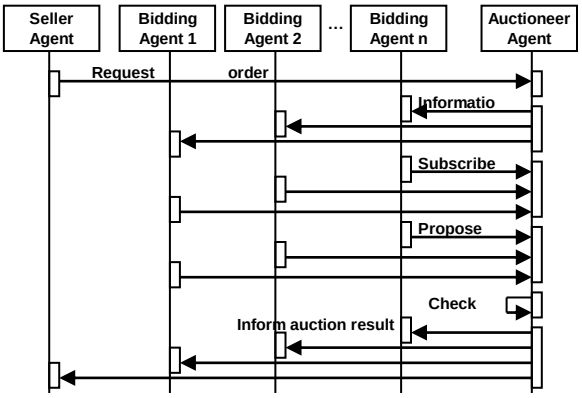

Figure 1: General auction framework

4.1. Types of Auctions

There are various types of online auctions, namely English, Dutch and Sealed-bid auction.

- English auction or open ascending price auction, where bidders submit increasing bids until no bidders wish to submit a higher bid.
- Dutch auction or open descending price auction, where the price moves down from a high starting point until a bidder bids, at which point the auction terminates.
- In first-price sealed-bid auction (FPSB), where each bidder submits a single bid, the highest bidder gets the object and pays the amount the bid.
- A second-price sealed-bid auction (SPSB) or Vickrey auction, where each bidder submits a single bid, the highest bidder gets the object and pays the second highest bid.

4.2. Auction House

Auction house contains list of current running auctions and history of past auctions. Auction type may be any type. In this system English auction type is implemented. An auction includes – Item Type, Starting Price, Deadline and Item Attributes.

For example,

Item = Phone
Brand = Nokia
Model = N 81
Opening price= $800.0
Current price = $850.0
Bids = 8
Deadline = 20/12/2009

(a)

Item = Phone
Brand= Sony Ericsson
Model = W 580
Final price = $900.0
Bids = 10

(b)

Figure 2:(a)Current running Auction, (b)Past Auction

5. Assumption of the System

This system presents an approach to develop agents capable of participating in multiple potentially overlapping auctions, with the goal of winning exactly one of these auctions at the lowest possible price, given the following user parameters:

M: The maximum (or limit) price that the agent can bid.

D: The deadline by which the item should be obtained.

G: The eagerness, i.e. the minimum expected probability of obtaining the item by the deadline.

The auctions in which a bidding agent participates may run in several auction houses. Each auction is assumed to be for a single unit of an item, and to have a fixed deadline. Auction satisfying this condition is English Auction. The approach is based on a prediction method and a planning algorithm. Following figure shows the system architecture.

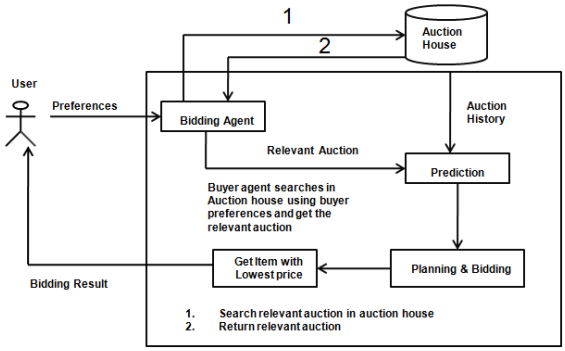

Figure 3: System Architecture

5.1. Prediction Method

The prediction method exploits the history of past auctions in order to build probability functions capturing the belief that a bid of a given price may win a given auction. These probability functions are then used by the planning algorithm to compute the lowest price, such that by sequentially bidding in a subset of the relevant auctions, the agent can obtain the item at that price with a probability above the specified eagerness.

5.2. Planning Algorithm

In particular, the planning algorithm detects and resolves incompatibilities between auctions. Two auctions with equal or similar deadlines are considered to be incompatible, since it is impossible to bid in one auction, wait until the outcome of this bid is known (which could be at the end of that auction), and then bid in the other auction. Given a set of mutually incompatible auctions, the planning algorithm must choose one of them to the exclusion of the others. This choice is done in a way to maximize the winning probability of the resulting plan.

6. System Implementation

This system is an implementation of bidding agent system for the buyers to get the lowest price. Buyer provides preferences along with deadline D, maximum price M and eagerness G to the bidding agent. With user preferences, agent searches in the auction houses to get the relevant auctions. Bidding agent returns with relevant auctions. Bidding agent computes probability of auctions (prediction phase) using auction history. Then it calculates the bidding price (r) in the planning phase. Bidding agent sequentially bids in alternative auction with price r. Then bidding agent returns the results to the buyer.

6.1. Bidding Agent Implementation

It is based on a prediction method and a planning algorithm. It exploits the history of past auctions in order to build the probability functions capturing the belief that a bid of a given price may win a given auction. These probability values are then used by the planning algorithm, to compute the lowest price, such that by sequentially bidding in a subset of the relevant auctions. Agent can obtain the item at that price with a probability above the specified eagerness.

6.2. Processes of Prediction

We choose three points in the past auctions from the auction house.

1. max : the highest price in the past auctions
2. min : the lowest price in the past auctions
3. med := (min + max) / 2

bid shaving vector , z = { min , med , max }
Probability of winning with a bid of z ,
z >= max = 1;

$$med <= z < max = \frac{\text{number of times win with prize} < max}{\text{total number of past auctions}}$$

$$min <= z < med = \frac{\text{number of times win with prize} < med}{\text{total number of past auctions}}$$

z < min = 0 ;

Example of past auctions are,

Item = Phone Brand = Nokia Model = N 81 Final price = $290.00	Item = Phone Brand = Nokia Model = N 82 Final price = $270.00
Item = Phone Brand = Sony Ericsson Model = K 550i Final price = $250.00	Item = Phone Brand = Nokia Model = 6300 Final price = $290.00
Item = Phone Brand = Sony Ericsson Model = W 580 Final price = $279.00	Item = Phone Brand = Sony Ericsson Model = W 595 Final price = $269.00

Figure 4 : Sample Past Auctions

Sample prediction process is as follows:

- Bid shaving vector, z = [250 270 290]
- Probability of winning of z >= 290 = 1.0
- Probability of wining of 270 <= z < 290 = 4 / 6 = 0.66
- Probability of winning of 250 <= z < 270 = 2 / 6 = 0.33
- Probability of winning of z < 250 = 0.0

6.3. Process of Planning

In the planning phase, the bidding agent selects a set of auctions and a bidding price r (below the user's maximum), such that the probability of getting the desired item by consistently bidding r in each of the selected auctions is above the eagerness factor. The resulting bidding plan, is such that any two

selected auctions a1 and a2 have different end times. In this way, it is always possible to bid in an auction, wait until the end of that auction to know the outcome of the bid, and then place a bid in the next auction. Planning algorithm works as follows:

```
Begin
    Found := 0;
    r := current price + constant value;
    repeat
    z := r;
    p := calculate prediction method by using z;
        if  p > eagerness(G)  then
            Found:=1;
        else
            r := r + constant value;
        end if;
until r <= maximum price(M) &&  Found==0;
r := r - constant value;
        if  r > current price  then
          current price := r;
          else
          current price := current price;
        end if;
End.
```

- r = bidding price
- p = probability of winning with price r
- G = eagerness of user for auction
- M = maximum price of user for the auction

Following figures show the sample buyer in online auction and current running online auction.

Name = Mg Mg	Item = Phone
Item = Phone	Brand = Sony Ericsson
Brand = Sony Ericsson	Model = T 700
Model = T 700	Deadline = 30/12/2009
Maximum price = $300.00	Opening price = $250.00
Eagerness = 0.9	Current price = $270.00

(a) (b)

Figure 5: (a)Sample Buyer **,**
(b)Current Running Auctions

Sample Running Process
Bidding price , r = 280
r <= M && P(r) <= G , Set r=290
r <= M && P(r) > G, is wrong, so r=290
r > current price , Set current price = r
current price = 290

6.4. Process Flow of the System

The process flow of the system is as follows:

- User provides preferences to the system through the user interface.
- Agent finds relevant auctions from the auction house, using user's preferences.
- In the prediction phase, past auction history is used to calculate winning probability for the auctions.
- Planning algorithm computes the lowest price r to bid in the sequential auctions.
- Agent bids sequentially in the compactable auctions.
- Then bidding results are back to the user.

The above process shows in figure 6.

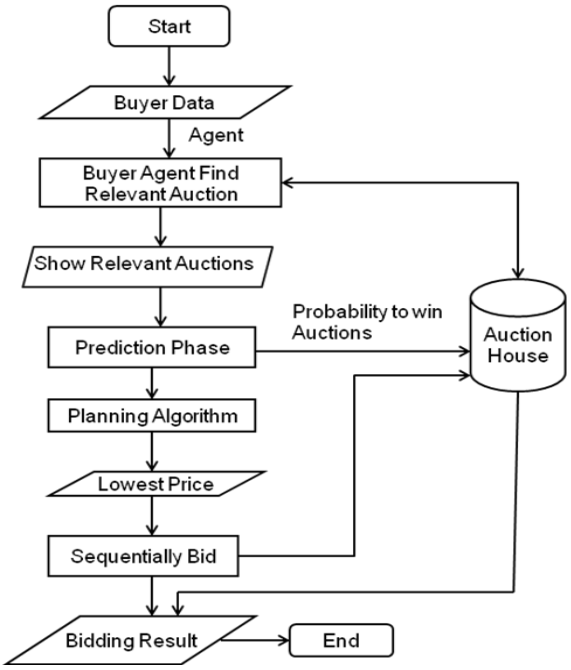

Figure 6: Process flow of the system

7. Conclusion

This system presents an approach to develop bidding agents that participate in a number of auctions, with the goal of winning exactly one of them at the lowest price, with a given level of probability, and before a deadline. A bidding agent's implementation process is based on a prediction method and a planning algorithm. The prediction method estimates the probability of winning an auction with a given bid. The planning algorithm determines where and how much to bid, in such a way as to ensure that the probability of winning an auction is above the eagerness. By using this system, buyer can get the item with the lowest price.

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