

Assessment 4

Combining English and Dutch Auction

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Protocol Description

In the English-Dutch Auction Interaction Protocol (IP), the auctioneer seeks to find the market price of a ticket by initially proposing a price and then gradually raising the price. Each time the price is announced, the auctioneer waits to see if any bidders are willing to pay the proposed price. Each bidder checks if the price after an increment falls into budget. If bidder can accept the price, it proposes the new incremented price. As soon as one bidder indicates that it will accept the price, the auctioneer issues a new call for bids with an incremented price. The auction continues this English auction until no buyers are prepared to pay the proposed price, at which point the English auction ends.

Depending on the date of travel, the auctioneer sets a fixed date prior to date of travel. On this date, it starts with Dutch auction. If English auction ends before start-date of Dutch auction, then auctioneer keeps on waiting. It does not keep on propose incremented price as it knows that every participant is outbid at this point of time. However, with some changes, the system can be configured to start Dutch auction as soon as English auction ends.

Once the start-date of Dutch auction arrives, the auctioneer proposes the price which is much higher than the closing price of English auction. The idea behind this is that auctioneer catches the need of urgency for buyers as travel date approaches and seeks to find some buyer who can pay higher than English auction winner.

Each time the price is announced, the auctioneer waits to see if any bidders are willing to pay the proposed price. If no buyers are prepared to pay the proposed price, then auctioneer reduces the price and proposes new decremented price. The participants check the budget and if it can afford the price of the ticket then it informs the acceptance of the price. Each acceptance of a bid is simultaneously broadcast to all participants and not just the auctioneer. This may not be true in an agent market place, in which case it is possible for more than one agent to attempt to bid for the suggested price. [1]

As soon as one participant indicates that it will accept the price, the auctioneer checks if the accepted price by a buyer exceeds the auctioneer's (privately known) reservation price. If proposed price is higher than reserve price, the ticket is sold to that buyer for the agreed price. If the last accepted price is less than the reservation price, the ticket is not sold. [1]

At the end of the IP, the auctioneer will typically enter a request IP with the winning bidder to complete the auction transaction.

The representation of this interaction protocol is given in Figure 1

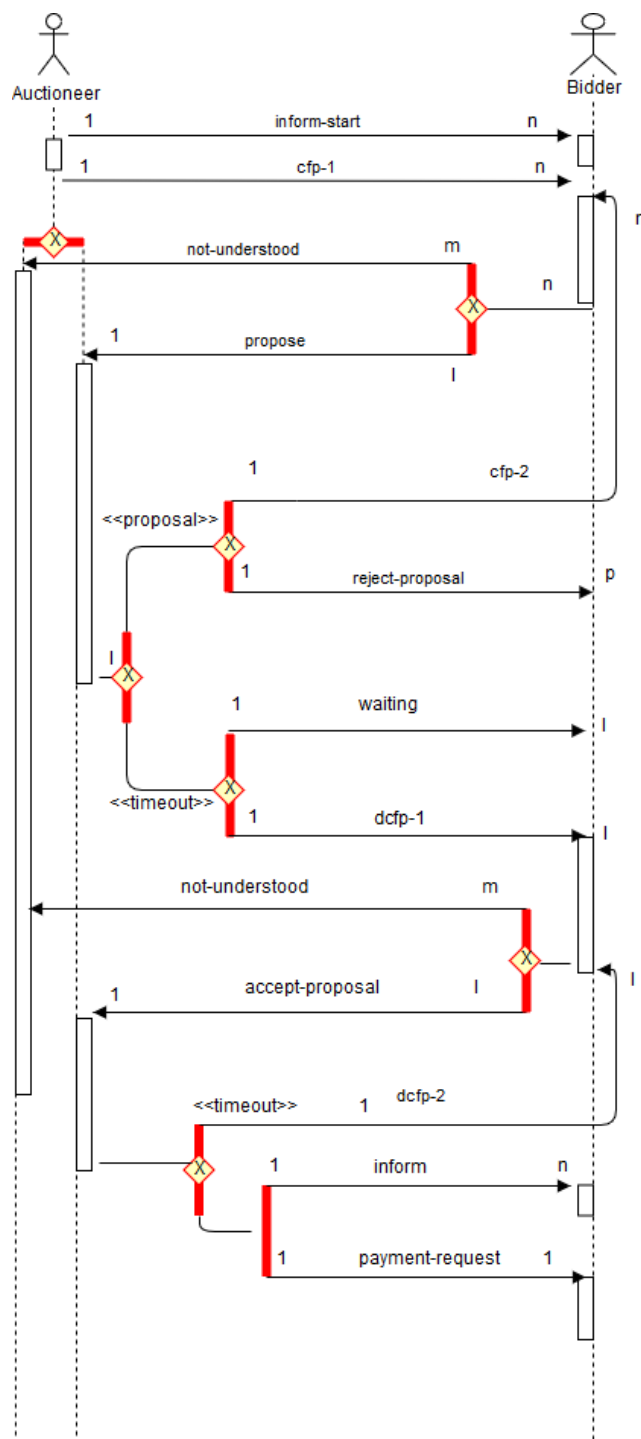


Figure 1. English-Dutch Auction Protocol

Format and content of messages

This section describes contents and format of different messages exchanged between auctioneer and bidder. In an online auction system, there could be multiple auctions going on simultaneously, so its important to keep track of messages to and from a particular auction. This can be done by assigning unique IDs to auctioneer (agent conducting auction), the auction and the bidder (buyer agent). Each message has at least these three parameters as content when messages are being exchanged. Other than this, some of the other parameters and their description is as follows:

ticketNo:	A unique identification number for ticket
Price:	Proposed price of the ticket for ticket with ticketNo sent by an auctioneer
Offer:	Proposed price sent by bidder
Winner:	BidderID indicating the winner of the auction
AuctioneerID:	Unique ID of auctioneer
BidderID:	Unique ID of bidder
auctionID:	Unique ID of auction

The format of the message, in general, is as follows:

[“message-purpose”, senderID, receiverID, auctionID, ticketNo(optional), Price(optional), offer(optional), winner(optional)]

Please note that the price and the offer are considered separately though they represent the same entity called “amount”, for the purpose ease of distinguishing between who has proposed the price. If bidder increases the amount of ticket, then it is denoted by offer.

The list of all possible message passed during the auction along with a short summary of purpose of the message is given below. All the messages have the characteristics of being correctly ordered, non-blocking and occurs in parallel execution.

List of messages:

1. (“Inform-start”, AuctioneerID, BidderID, AuctionID)
The first message in the list is sent by an auctioneer to bidders, informing about the start of the auction. It has first field auctioneerID as senderID, second field receiverID as BidderID and third field as auctionID.
2. (“call-for-proposal”, AuctioneerID, BidderID, AuctionID, ticketNo, Price)
The second message is also sent by auctioneer to bidders stating initial/increased price and it has “ticketNo”and Price as additional fields passed into the message.
3. (“not-understood”, BidderID, AuctioneerID, AuctionID)
Using this message bidder can inform auctioneer that it did not understood the message
4. (“propose”, BidderID ,AuctioneerID , AuctionID, offer)
The bidders send their prposed price to auctioneer.

5. ("reject-proposal", AuctioneerID, BidderID ,AuctionID, offer)
Auctioneer informs bidder about rejected proposal.
6. ("waiting", AuctioneerID, BidderID ,AuctionID)
The message sent to all bidder while waiting for Dutch auction to start
7. ("dutch-call-for-proposal", AuctioneerID, BidderID ,AuctionID, ticketNo, Price)
Informing participants about start of dutch auction and indicating that price sent along with the message is associated with Dutch auction.
8. ("accept-proposal", BidderID , AuctioneerID ,AuctionID, Price)
Bidder sends the message to auctioneer informing that it is ready to accept the proposed price
9. ("inform", AuctioneerID, BidderID ,AuctionID, winner)
This is a broadcast message to all bidders by the auctioneer stating the winner of the auction and ultimately end of the auction.
10. ("payment-request", AuctioneerID, BidderID ,AuctionID, Price)
Message sent to the winner by the auctioneer requesting the payments

Description of Auctioneer

The auctioneer of tickets starts the English auction with input as ticket_number of ticket for which participants are bidding, minimum reserve price, initial price, percentage change and tick threshold. Minimum reserve price is usually set by the seller of the ticket and received by the auctioneer from seller. The initial price at which auction starts depends on the auctioneer(user) and hence passed as user-configurable parameter. Percent change is parameter used by auctioneer to modify the proposed price and is discussed in further sections. Tick threshold is parameter indicative of the minimum number of days prior to travel date that Dutch auction should be conducted.

As an output, the auctioneer declares the winner of the auction after conducting auction in English - Dutch auction protocol. If no winner is found, auctioneer withdraws the ticket and may inform seller that ticket was not sold during the auction.

In this simulation, the auctioneer can also increase the price along with the bidders to get the best bid for the given ticket. During the auction, the auctioneer has to make several decisions regarding the increasing the price if it is English auction and decreasing the price during Dutch auction. The percent change for this increase or decrease is passed as an input to the auctioneer and auctioneer modifies the price by the given percentage. For simplicity, I am using the same percent change for both, English and Dutch auction. However, one can have different percent changes for reach auction. Moreover, different percent change can be used during each rounds of the auction. For example: as the travel date approaches, auctioneer may want to increment the price at higher rate to get the maximum benefit. System could be made intelligent by modifying proposed price after analysing number of interested bidders, their bids and days left.

One of the important decisions that auctioneer has to make is determining when to stop English auction and move on to conduct Dutch auction. This, again, is a user-configurable parameter used for determining the start of Dutch auction. The auctioneer starts with English auction, gets the rising bids for ticket from bidders and depending on the following cases, it decides to whether or not to switch to Dutch auction.

The auctioneer switches to Dutch auction for following cases:

Case 1: During English auction, every bidder is outbid but auction has a winner and number of ticks has reached tick threshold

Case2: During English auction, every bidder is outbid but auction has no winner and number of ticks has reached tick threshold

The auctioneer does not switch to Dutch auction and continue with English auction for following cases:

Case 1: During English auction, every bidder is outbid but auction has a winner and number of ticks has not reached tick threshold

Case2: During English auction, some bidder(s) is/are not outbid and number of ticks hasn't reached tick threshold

Another crucial decision that auctioneer has to make is to decide whether to accept or reject the offer/proposals. During English auction, if some bidder bids higher proposed price then auctioneer considers that bidder as temporary winner and rejects offers from other bidders. Whereas in Dutch auction, it keeps on reducing the price unless some bidder accepts it. If the accepted price is higher than minimum reserve price then auctioneer accepts it; else it rejects it.

Finally, the auctioneer has to determine whether or not this auction has yielded a winner. I have presented the cases wherein the auctioneer declares the winner. If none of the following criteria is met, then auctioneer withdraws the auction.

Case1: During English auction, some bidder(s) is/are not outbid, number of ticks has reached tick threshold. In this case, bidder with highest bid is declared as winner. If more than one bidder has bid for the same price, then winner is randomly chosen among them

Case2: During Dutch auction, some bidder(s) has/have accepted the price. In this case, bidder with who accepted the price is declared as winner if accepted price is higher than reserve minimum. If more than one bidder has accepted the same price, then winner is randomly chosen among them.

The auctioneer withdraws the auction if above two conditions are not met. Moreover, during Dutch auction, if current auction price goes below reserve minimum then the auctioneer withdraws the auction.

Pseudo code for auctioneer

```
Ticket <- {TicketNo, reservePrice, Price, perChange}
tick_threshold <- n           %parameter in config file
bidders <- {BidderID,.....}   %bidder IDs
AuctioneerID
begin
    AuctionID <- global_auction_no   %auction id initialised to global
    (Bidder, bid) <- (null, null)     %current best bid is null
    begin
```

```

        for all BidderID E bidders do
begin
    send("Inform-start", AuctioneerID, BidderID, AuctionID )
    send("call-for-proposal", AuctioneerID, BidderID, AuctionID, ticketNo, Price)
end
AuctionOn <- true
diff <- travel_date - today
while AuctionOn do
begin
    receive(msgs)          %either("not-understood",BidderID, AuctioneerID, AuctionID )
                           % or ("proposal", BidderID ,AuctioneerID , AuctionID, offer)

    if msgs is empty       %no bidder replied (timeout)
    if diff < tick_threshold
        if Price < reservePrice
            AuctionOn <- false
        else

            Price <-Price + (Price * perChange)    %start Dutch auction with higher price
            for all BidderID E bidders do
                send("dutch-call-for-proposal", AuctioneerID, BidderID ,AuctionID, ticketNo, Price)
            while Price > reservePrice do
                begin
                    receive(msgs)          %format like ("accept-proposal", BidderID, AuctioneerID,
AuctionID)
                    if msgs is empty       %nobody replies
                        Price <-Price - (Price * perChange)    %reduce the price
                        for all BidderID E bidders do
                            send("dutch-call-for-proposal", AuctioneerID, BidderID ,AuctionID, ticketNo,
Price)
                        else
                            remove "not-understood" messages from msgs
                            remove "accept-proposal" messages with different AuctionID
                            get ("accept-proposal", BidderID ,AuctioneerID , AuctionID, offer) %msg with
acceptance of offer
                            (Bidder, bid) <- (BidderID, offer)
                            remove ("accept-proposal", BidderID ,AuctioneerID , AuctionID, offer)    %select
randomly from msgs with "accepted offer"
                            if (Bidder,bid) not euqal to (null,null)
                                if bid >= reservePrice then
                                    bidders <- bidders - {Bidder}    %remove successful bidder
                                    send("payment-request", AuctioneerID, BidderID ,AuctionID, price)
                                end
                            end
                        for all BidderID E bidders do
                            send("inform", AuctioneerID, BidderID ,AuctionID,winner(Bidder, bid)) %inform
everyone about winner
                        AuctionOn <- false
                    end
                end
            end
        end
    end
end

```

```

else
    %do-nothing (wait)
    send("waiting", AuctioneerID, BidderID ,AuctionID)
else
    remove "not-understood" messages from msgs
    remove "proposal" messages with different AuctionID %filter msgs sent by mistake
    remove "proposal" messages with offer < Price %filter previous offers
    get ("proposal", BidderID ,AuctioneerID , AuctionID, offer) %msg with highest offer
    (Bidder, bid) <- (BidderID, offer)
    remove ("proposal", BidderID ,AuctioneerID , AuctionID, offer) %message with highest offer
    for all ("proposal", BidderID ,AuctioneerID , AuctionID, offer) E msgs do
        send("reject-proposal", AuctioneerID, BidderID ,AuctionID, offer) %reject low offers
    Price <- Price + (Price * perChange) %update price of ticket(increasing percentage)
    if bid > Price %if highest bid greater than next price, use it instead
        Price <- bid
    for all BidderID E bidders do
        send("call-for-proposal", AuctioneerID, BidderID ,AuctionID, ticketNo, Price)

end
end
end

```

Description of Bidder

The bidder starts bidding in an English auction with input as ticket number of the ticket that it wants to buy, highest price and percent change. The highest price indicates the maximum amount it can afford to pay for the given ticket. It can also be called as budget. Budget value depends entirely on individual user and hence it is user-configurable value. The next parameter, percent change, denotes the percent by which the bidder increases the proposed price during an English auction.

As an output, the bidder responds to auctioneer messages in the form of offer or acceptance of price. During an English auction, after receiving the proposed price, the bidder checks if incremented price is lesser than highest price. If that's the case then it responds to auctioneer, sending the new offer. During Dutch auction, bidder receives calls for proposals from the auctioneer, each call with reduced price than previous call. If the proposed price is lesser than highest price, then the bidder sends the message indicating acceptance of the price.

Other than call for proposals, it receives other types of the messages from the auctioneer. When it receives the message with label "inform start", it adds the auctionID into the set of current auctions. This is important especially when bidder has multiple auctions going on simultaneously. The bidder produces no output or does not reply with anything to the auctioneer when messages with labels "reject-proposal", "inform" or "waiting".

During the English auction, the bidder receives the message with label "call-for-proposal". It then checks if it is part of the auction the auctioneer is refereeing to by checking if auctionID belongs to the list of current auctions. If auctionID does not belong to its list, then it sends message with label

“not-understood”. Otherwise, if bidder is part of the auction then, it calculates new offer depending on the highest price and sends this offer to auctioneer as message with label “propose” along with the new offer.

During the Dutch auction, it receives the price from the auctioneer as a message with label “dutch-call-for-proposal”. This message is indicative of the fact that auctioneer has started with the Dutch auction. In response to this, the bidder sends the message with label “accept-proposal” if the proposed price is lesser than highest price bidder can afford to pay. If proposed price is not within the budget then bidder does not reply. If bidder is successful in winning the auction, the auctioneer sends the message for payment request. Upon receiving this message, bidder deducts the accepted price from the budget.

Pseudo code for bidder

```
Ticket <- {TicketNo, HighestPrice, perChange}
BidderID  %ID of bidder
begin
    receive(msg)
    case of msg
    ("Inform-start", AuctioneerID, BidderID, AuctionID )
        currentAuctions <- currentAuctions U {AuctioneerID, AuctionID}

    ("call-for-proposal", AuctioneerID, BidderID, AuctionID, ticketNo, Price)
        if(AuctioneerID, AuctionID) not belong currentAuctions then    %bidder hasnt heard of auction
            send("not-understood", BidderID, AuctioneerID, AuctionID )
        else
            if (TicketNo, HighestPrice, perChange) belong to Tickets and Price <= HighestPrice then
                %bidder interested in purchase & price in range
                if Price+ (Price *perChange) <= HighestPrice    %increase offer
                    offer <- Price + (Price *perChange)
                else
                    offer <- HighestPrice    %stop at highest
                send("propose", BidderID , AuctioneerID ,AuctionID, offer)    %send back proposal
            else
                null    %bidder is outbid or not interested

    ("dutch-call-for-proposal", AuctioneerID, BidderID, AuctionID, ticketNo, Price)
        if (TicketNo, HighestPrice, perChange) belong to Tickets and Price <= HighestPrice
            send("accept-proposal", BidderID , AuctioneerID ,AuctionID, Price)
        else
            null

    ("reject-proposal", AuctioneerID, BidderID ,AuctionID, offer)
        null %do nothing

    ("waiting", AuctioneerID, BidderID ,AuctionID)
        null %do nothing
```



```
("inform", AuctioneerID, BidderID ,AuctionID, winner(Bidder, bid))  
    null
```

```
("payment-request", AuctioneerID, BidderID ,AuctionID, price)  
    Budget <- Budget - offer
```

```
end
```

References

[1] "<http://www.fipa.org/specs/fipa00031/PC00031D.pdf>".

[2] "<https://www.eigpropertyauctions.co.uk/information/glossary/withdrawn-lots>".