Chapter 2
A Unified Classification Ecosystem for Auctions

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ABSTRACT
Auctions have known considerable and continuous growth during the last decades due to their interesting properties in price formation when the value of goods traded is not known or varies. The systematic research in the area of auctions has advanced considerably since William Vickrey’s seminal paper on 1961. Although earlier research has been based mainly on Microeconomics and Games Theory, recent advances extended relevant research in Operational Research and Information Technology. Today, auctions and their applications form a challenging topic not only for economists but for operational researchers, marketers, logisticians and management engineers as well. This paper provides an overview of recent literature in auction theory, focusing on contemporary auction techniques and proposes an Auctions Classification Ecosystem (ACE) that encompasses previous works and new developments in the area. The proposed unified classification approach encompasses auction features and mechanism design parameters in a single scheme. This scheme facilitates the understanding of auction characteristics and supports auction practitioners in designing the appropriate format depending on the application requirements.

INTRODUCTION
Auctions have proven to be an excellent trading mechanism to allocate goods, services, resources, etc., (hereinafter, “items”) to individuals and firms. A great variety of items are commonly traded via auctions including art, antiques, tickets, public goods, air seats, stamps, flowers, freight capacity, stocks, radio spectrum licenses, livestock, industrial supplies, construction contracts, oil drilling rights, manufacturing capacity, etc. Although the items described above are heterogeneous, they have a common characteristic: the valuation of each item is not standard...
so they cannot be traded using a direct pricing mechanism.

A widely-accepted definition of an auction has been proposed by Wolfstetter (1996). It is "a bidding mechanism, described by a set of auction rules that specify how the winner is determined and how much he has to pay. In addition, auction rules may restrict participation and feasible bids and impose certain rules of behaviour". This definition may extend to the purchasing case too, also known as reverse auction, where a buyer uses an auction for procurement. In reverse auctions –in contrary to forward auctions– the price of the item decreases and the winner is the one who submits the lowest bid (offer). Figure 1 depicts a typical auction process which constitutes of bid submission, bid evaluation, price computation, closing, and the (optional) feedback to bidders.

Market participants are buyers, sellers and auctioneers. In most cases, sellers do not organize or conduct the auction; typically, this is a responsibility for an intermediary auctioneer. Auctioneers are independent agents, experienced in conducting and securing the auction process, possibly receiving commission from the other participants. Buyers and sellers, depending on the environment an auction is conducted, may either have the role of an initiator (the one who initiates the auction in order to buy or sell a good) or that of a bidder (the one who makes an offer). In the so-called forward auctions, the seller acts as the initiator while a buyer is the bidder; in reverse auctions in the contrary, a buyer acts as the initiator while a seller is the bidder (Figure 2).

The aim of all trading mechanisms (e.g., auctions, negotiations, bargaining, posted pricing, etc.) is to reach a final price which is acceptable to the involved parties (that is, sellers and buyers) and which serves, at the same time as the dominant evaluation criterion for a bid. A final price in this context is assumed to be "acceptable" when these parties have the feeling or impression that it is fair, attractive and profitable for them. The common denominator in all trading mechanisms is therefore, the formation of this final price. The value of the final price is highly likely to differ depending on the trading mechanism when all other factors (e.g., number of participants, type of market, information dispersion, etc.) remain unchanged. Overall, any price formation system needs to be efficient in communicating and dispersing information among interested market participants under specific limitations concerning information and society asymmetries and trading item qualities, so that the only decision-making variable for buyers and sellers is the final valuation vector reflecting monetary value (price) and qualitative attributes of the trading item.

In order to systematically study auctions results and participants behaviour, economists developed Auction Theory, which provides the framework for explicit modelling (yet with certain restrictions) of price formation. Auction Theory has many research implications: it is applicable – much more than economic mathematics; it can constitute a testing platform for economic theory (games with partial information); it is an excellent price formation mechanism especially in oligopoly; and, it is a base for theoretical research in price formation systems.