# Extensive Auction Games

## 1 Introduction

Imagine an auction of paintings by four famous artists: Picasso, Van Gogh, Rembrandt and Da Vinci. In the auction room the auctioneer presents each piece to be sold, and all bidders then write their bids for the item on a secret sealed note that is handed to the auctioneer. The auctioneer then declares the highest bidder the winner, takes a payment (equal to their bid or to that of the second-highest bidder, depending on the auction), and starts the next round with a new item. If there is a target collection of paintings to buy, the first bidder to buy this bundle of goods terminates the auction and wins. Otherwise, the auction continues until there are no more items to sell. If there is no target bundle, the bidder with the paintings of the highest total value is the winner.

The objective is to implement strategies for a Python 3 bidding Bot that will participate in this game.

## 2 The Game

This is an extensive game with simultaneous moves encoded as an auction played sequentially. The game runs in the following way. An Auctioneer initialises a room full of bots, then sets up the auction. This involves giving each bot the same budget to spend, setting the sequence of items to be sold, and setting the rules of the auction such as how the overall winner of the game will be decided.

The Auctioneer will then announce an item type to be bid upon, and ask the bots for bids. Your Bot will use the information that the Auctioneer gives, including the state of the other players thus far, to determine an amount to bid. Once all bots have bid, the Auctioneer will declare the highest bidder the winner, who will then be charged a payment (not necessarily the amount they bid, see below) and receives the item. If the top bids draw, then the winner is chosen at random from those bidders. For each round, there is at most one winner.

The auction will continue until either there are no more items to sell or if there is a set winning condition, e.g., a bidder managed to acquire the target collection of artists' paintings needed, in which case they are declared the winner. If there is no target collection as a winning condition then the auction will end once all the paintings are sold, and the bidder who ends with the highest total value of items is the winner.

Note that, however, whilst the highest bidder will always win, the auction may be set up so the highest bidder does not pay their own bid. It can be set up so that the highest bidder is only charged the second-highest bid (see winner pays).

You will write your strategies in your Bot. Your Bot will be tested in a series of different auctions against Bots of varying difficulty and number. Finally, your Bots will be tested against each other in a tournament.

There are two types of games that will be played:

- **Value Game**
  - Highest total value at the end wins, the highest bidder pays the second-highest bid. Picasso is worth 15, Van Gogh worth 5, Rembrandt worth 3 and Da Vinci worth 1.
- **Collection Game**
  - First to collect a given bundle of painting types, the highest bidder pays their own bid. The collection bundle minimal condition will be 3 paintings of any artist, 3 of another artist, 1 of another artist and 1 of another artist. For example, 3 Van Gogh, 3 Picasso, 1 Rembrandt and 1 Da Vinci; or 3 Da Vinci, 3 Rembrandt, 1 Picasso and 1 Van Gogh.

Note that for all games in this tournament, the auction size (number of paintings up for auction) will be 200 and the starting budget for every bidder is 1001.