

Inf2C: Software Engineering Coursework 1

Capturing requirements for an auction house system

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1 Introduction

This document captures the requirements of an app for the Auld Reekie Auction House, codenamed *Auctionista*.

2 Stakeholders

We can consider the following stakeholders:

- *Auction House*: the Auction House wants to replace its existing bidding system with a software that will:
 - Perform existing in-house functions that the auction house currently manages manually. such taking in new bids;
 - Open up new features to their clients (buyers, sellers, and the public) so that lots can be viewed, edited, and bid on through an online interface and without being physically present.

Their value from the system is to facilitate lot auctions in order to collect commissions from sales.

- *Auctioneer*: Manages auctions and oversees the bidding process by taking in new bids. They want to be aware of bids as they come in through the platform, and want to notify those involved in the bidding process as things change. Their value from the system is for it to allow them to perform their work duties through a simple digital interface, and to provide a way to manage their associated auctions.
- *Buyer*: Watches and bids on lots under auction. They want to see lots and their associated images, descriptions, and valuations, and want to mark interest for and bid on the lots that they want. Their primary value from the system is being able to purchase lots that they desire.
- *Seller*: Brings lots to the auction and provides information about a lot (description, reserve price). They want to be able to manage their lots and their images, descriptions, and valuations. They want to be notified about bids on their lots and told of the final prices (hammer and hammer minus seller's commission) of any lots they have put up for auction. Their primary value from the system is being able to sell their lots.
- *Member of the Public*: Wants to peruse the existing lots. A member of the public without an existing account wants to be able to see some details about a lot — lot description — while not being able to see all of it or bid on it. Their value from the system is to be able to see the lots available at the auction house.
- *Expert*: Wants to assist the seller in putting a lot up for auction, providing valuations for high / low estimates. They need access similar to that of a Member of the Public, but with additional abilities to contact the seller and negotiate aspects of a lot. Their value from the system is to provide a digital interface to perform their work duties.

- *Lot Display Professional*: These are the professionals involved in taking photos and writing descriptions of a lot. They are interested in the multimedia capabilities of a lot's listing, as that will affect their process for marketing it and making attractive to potential buyers. Their value from the system is to provide a digital interface to perform their work duties.

3 System State

The system consists of five major state components:

1. *Auctions*: The auction house keeps a list of auctions. Each auction will have:
 - (a) A list of associated lots.
 - (b) A list of associated auctioneers.
 - (c) A minimum bid increment (whether this increment is set on a by-lot or by-auction basis is discussed in section 7).
 - (d) A start date and time
 - (e) If the auction is in process, which lot is on auction
2. *Auctioneers*: Auctioneers administrate the process of an auction. Associated with an auctioneer is:
 - (a) A list of all auctions they will administrate.
3. *Lots*: Lots have:
 - (a) An associated seller.
 - (b) An associated auction, and possibly their location within that auction (ie. when they will be auctioned).
 - (c) A high/low estimate.
 - (d) A description, consisting of text and images. Note that if a lot has multiple items, each of these items may have their own description.
 - (e) A reserve price, only visible to the seller and auctioneer
 - (f) A list of interested buyers, not visible to other users, who have marked their interest on the lot before the lot has gone on auction.
 - (g) If the lot is actively on auction, a list of bids placed on the item and a current selling price.
 - (h) If the lot has been sold, information about the final winning bid.

A lot may have an associated auction status:

- (a) Pre-auction
- (b) Currently being auctioned

- (c) Post-auction, sold
 - (d) Post-auction, not met reserve price
4. *Buyers*: Buyers have:
- (a) Associated personal information (eg. name, address)
 - (b) Contact details (eg. telephone number or email)
 - (c) Payment information, ie. bank account details
 - (d) A list of lots they have marked their interest in
 - (e) A list of bids they have made on lots
5. *Sellers*: Sellers, much like Buyers, have:
- (a) Associated personal information (eg. name, address)
 - (b) Contact details (eg. telephone number or email)
 - (c) Payment information, ie. bank account details
 - (d) A list of lots they have currently registered with the auction house, including their status

4 Use Cases

4.1 Bid on lot

Primary actor: Buyer

Supporting actors: None

Summary: Buyer places a bid on a lot and the lot's price is updated as needed.

Precondition: The lot is listed on the system. The lot is currently being auctioned (ie. it is not pre-auction and the auction has not already ended).

Trigger: Buyer presses button in interface to bid on lot.

Guarantee: Buyer's bid on lot is recorded, and if appropriate, current bid price of lot is updated.

Main Success Scenario:

1. System records bid information in log; this will include the identity of the buyer, whether the bid was an increment or a jump bid, the time the bid was placed, the associated lot, and the new price of the lot.
2. System updates current bid price on lot and propagates this to all buyers also looking at the lot.
3. Buyers who are interested in the lot are informed that a new bid has been placed on the lot.

Extensions:

- 2a. Bid is increment bid of value i . System updates the lot's current bid price c to be $c = c + i$.
- 2b. Bid is jump bid of value j . If $j < f$, with f being the fixed bid increment, we go to 2c. Otherwise we update the lot's current bid price $c = c + f$.
- 2c. Bid is insufficient. We display an error message to the buyer informing them that placing a bid has failed and wait for the buyer to bid again.

Stakeholders and interests:

Buyer looks to bid on lots they are interested in.

Seller looks to sell their lot.

Auction house want to assist in selling the lot in order to collect commission.

Notes:

- A non-functional requirement associated with this use-case is that the system must be able to handle bids in an ACID-adherent way: more specifically, if two bids are placed at the same time (or within a very small time interval) there must be a way of deciding which is to be treated as having come first. There must therefore be a very small (µs) latency on bid placement and update of a lot's current bid price.

4.2 Close lot auction

Primary actor: Auctioneer

Supporting actors: Buyer, seller, auction house staff, bank

Summary: Auctioneer declares auction closed and lot is removed from auction; relevant parties are notified, and appropriate financial transactions are executed

Precondition: Lot has gone on auction, auctioneer has allowed time for bids to be made

Trigger: Auctioneer assesses that there are no more bids to be made

Guarantee: Lot is removed from auction; appropriate parties are notified about change of status; financial transactions are successfully executed if appropriate

Main Success Scenario:

1. Auctioneer closes bidding; no further bids can be made and the lot is removed from auction.
2. Hammer price and winning buyer are recorded in system.
3. Buyers who are interested in the lot are informed that the lot has been sold.
4. Hammer price plus buyer's premium is deducted from winning buyer's account.
5. Hammer price minus seller's commission is debited to seller's account.

Extensions:

- 1a. It may be desirable for the auctioneer to decide the winning buyer, rather than the system, in order to avoid sniping (a bid being placed after the auctioneer has decided the auction is to be closed, but before the auction is actually closed).
- 2a. Hammer price is below reserve price. The lot auction is unsuccessful and we finish the scenario here. The lot is removed from auction and the seller is notified that the lot did not sell.
- 3a. It may be desirable for the unsuccessful buyers to be informed also of the winning buyer and price the lot was sold for.
- 4a. Buyer's account cannot be charged. The system informs auction house staff (eg. through email or an in-app message) that the payment did not go through, and auction house staff attempt to contact the buyer in order to fix payment details. Once this is fixed, the system re-attempts step 5.
- 4b. The payment may be taken either by the system directly communicating with the buyer's bank, or through a third-party intermediary
- 5a. Seller's account cannot receive payment. The system informs auction house staff (eg. through email or an in-app message) that the payment did not go through, and auction house staff attempt to contact the seller in order to fix payment details. Once this is fixed, the system re-attempts step 6.
- 5b. The payment may be taken either by the system directly communicating with the seller's bank, or through a third-party intermediary

Stakeholders and interests:

Winning buyer wishes to own the lot by paying for it.

Non-winning buyers wish to be informed about sale of lot.

Seller wishes to sell their lot and gain payment from sale.

Auction house wishes to facilitate the sale of the lot in order to collect commission.

4.3 Register buyer

Primary actor: Member of staff at auction house

Supporting actors: Buyer

Description: Buyers require an account to register interest in lots and bid on lots. To do this, staff will register a buyer with an account using their personal details. Then, the staff will prompt the buyer to input their banking details. Finally, the staff will prompt the system to confirm that the banking details are legitimate and billable.

4.4 Note interest in lot

Primary actor: Buyer

Supporting actors: None

Description: When a buyer wishes to bid on a lot upon its auction, they must mark their interest in a lot. To do this, they press a button in the interface, on the listing for the lot they are interested in. It will then register them as interested and subscribe their account to future notifications about the lot.

(A): It is ambiguous when low and high estimates, as well as bidding figures and seller details, should be shown. When a buyer marks themselves as interested, we may want to reveal this information if it hasn't been revealed already.

4.5 Add lot listing

Primary actor: Member of staff at auction house

Supporting actors: Seller

Description: A seller wishing to list their lot on the auction house app will contact the auction house staff in order to facilitate this. The auction house staff will then assist the seller with uploading to the system the lot, including the following information:

- Reserve price, to be decided by the seller
- Lot description, including text and pictures
- High and low estimate, likely decided by the auction house in conjunction with the seller
- Bid increment if this is set on a by-lot basis

Once this lot addition is approved, the system will place the lot in a state where it can be browsed by buyers and members of the public through the app.

4.6 Browse lots in auction catalogue

Primary actor: Buyer, member of public

Supporting actors: None

Description: A buyer or member of the public wishes to view available lots. The system will show the available lots (those which have not been sold yet) with their associated attributes, and perhaps also lots which have already been sold. The system may allow the user to filter by such attributes as auction date, high/low estimate, or seller id.

The system may show parts of lot information to some but not all users, for example:

- Hiding reserve price from all users other than auction house staff and the seller who owns the lot
- Hiding high/low estimates from buyers until they indicate interest in the lot
- Hiding all information about the lot other than its name and description from members of the public

4.7 Start lot auction

Primary actor: Auctioneer

Supporting actors: Buyers

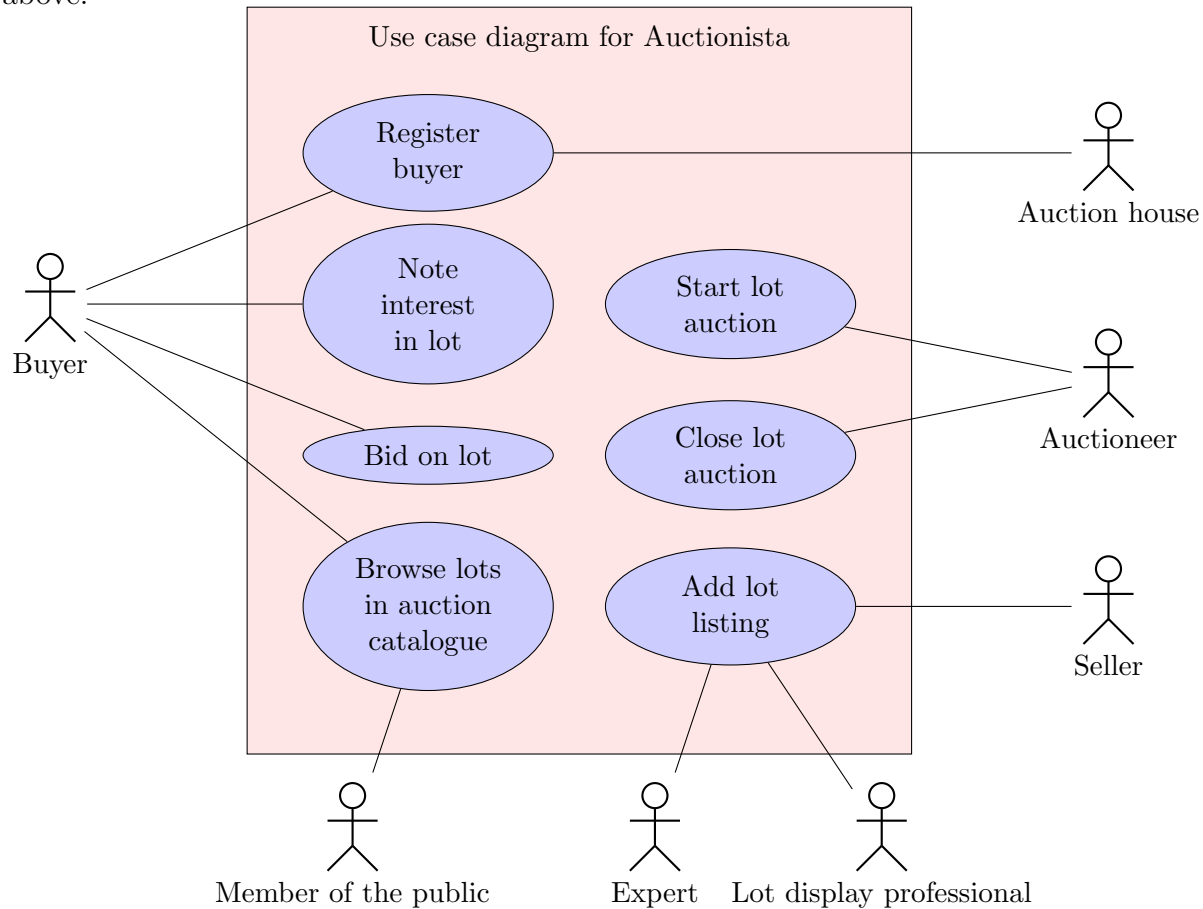
Description: Once the set start time and date of a lot's auction is reached, the lot's auction must begin. This could be triggered:

1. By the system itself upon the set start time and date being reached. This is desirable if full automation of the lot auction is desired, but this approach may cause problems if the auctioneer is not present to close the auction.
2. By the auctioneer in the app. This is desirable if delays can be expected in the start-time of the auction (eg. an auction may start late because of previous delays earlier in the day) or if the start time of the auction is specified vaguely.

The system sets the lot to be in the state of being auctioned, setting the initial price as decided by the auctioneer or the low estimate, and allows buyers to begin to place bids on the item. Buyers who have indicated their interest in a lot should be informed that the item is now available to bid on.

5 Use case diagram

We note that this use case diagram only includes *primary actors* in order to maintain visual clarity. Supporting actors for each use case are enumerated in their respective descriptions above.



6 Non-Functional Requirements

Non-Functional Requirements are categorised into five sections:

6.1 Security

- *Bidding Authentication*: The auction process for a lot, and placing bids for a lot, must be restricted to users that have proper authentication as buyers and possibly also restricted to those that have shown interest in the lot before auction. Therefore, the authentication system must be well secured to prevent people who do not meet these requirements from having access. There must be no possibility of a user elevating their access without explicit permission from the auction house.

Two techniques may prove useful to this end:

- *Authentication Tokens*: Once a user is logged in, provide their client with a token. This token will be provided to authenticate all future dealings, instead of a password. This means that even if the user is snooped on, only their current session is compromised, not their login details for the foreseeable future.
 - *Permission System*: Each token or set of credentials has a certain level of access. This level determines whether and how they can view and manipulate data in other tables. Any transaction must be authenticated against the user's access level.
- *Bank Transactions*: Bank transactions, being financial in nature, are especially sensitive to tampering. Such transactions, as well as the personal data required to make them, must be encrypted and verified beforehand to make sure both eavesdropping and untoward manipulation of the transaction are impossible.

At a minimum, all connections should be made over HTTPS with Extended Validation Certificates. This will mean that:

1. Traffic cannot be tampered with or eavesdropped on by someone else in the network, as HTTPS is a secure protocol. This will provide reassurance to both the auction house and its customers that financial data is kept safe.
 2. Through using Extended Validation (EV) certificates, buyers and sellers are assured of the identity of the auction house. Using EV certificates is considered by many to be industry-standard when the organisation must perform financial transactions.
- *Anonymity*: A buyer may want to keep their identity secret in high-profile contexts. In this case, the personal data of a user must be secured so that authentication must be duly provided to access this personal data. At a minimum we would expect that buyers and sellers cannot see each others' information: seeing this is restricted only to certain auction staff if necessary. Furthermore, a log must exist so that administrative changes can be correctly audited and reverted in the unlikely event of a breach. Providing different levels of administrator access would be a good step towards this goal. This way, critical maintenance can be performed by some of the staff using one

level of administrative access, without exposing to them important and more privileged data.

6.2 Usability

- *Internationalisation Support:* Buyers may hail from a variety of countries and backgrounds, and to capture the largest number of potential buyer an auction house should target them through support for their language and currency. Currency support will be especially important: when dealing with large bids, different currencies may be used to pay a single sum. Conversion with these currencies must be exact. At a minimum the system must support transactions in GBP (£), but USD (\$) and EUR (€) may also be desired.

Regarding language, we expect support for the English language at a minimum. Depending on the auction house's clientele, support for other languages (eg. Scots) may also be desired. Many standards bodies have initiatives regarding internationalisation and accessibility, so that different interfaces may be read and translated in a commonly understood way. One of the most well-known of these initiatives is the World Wide Web Consortium's (W3C) i18n initiative. It would be useful to read over these documents when designing and writing internationalisation into the software; additionally, the W3C provides a tool for assessing the internationalization of a page ¹, which would be an effective way to quantitatively assess the level of international support of the app.

- *Simple Interface:* Since the bidding process is fast-moving and high-value, customers cannot be encumbered by the interface in making their decisions. The interface must be streamlined towards the fundamental functions of auctioning, such as bidding, setting a hammer price, listing a lot, or closing the auction.
- *Multi-Platform Support:* Clients will use a variety of platforms to access the auction house, as will members of the public. Clients that are accessing the platform from afar especially may be on the go and need mobile platform support. The web as a platform is known for compatibility with many devices, and has very strong mobile interface support.
- *Notification Customizability:* Information overload is a serious concern in a fast-moving context such as an active bidding session. Customers must be given only the notifications they need in order to carry out their bids, and auctioneers must only receive the notifications necessary to administrate an auction.

6.3 Performance

- *Scalability:* As auctions may happen simultaneously, as the auction house may expand to multiple venues, and as the auction house attracts more clients, the system must not become slow or sluggish. The ability to scale up and down as needed by the business

¹<https://validator.w3.org/i18n-checker/>

is critical.

Cloud services, such as Google Cloud Compute and Amazon Web Services, have a huge number of customizations in this area so that assets such as servers can be spun up and down dynamically as demand and system load changes.

- *Low-Latency / Low-Bandwidth:* Customers in transit or from afar will be placing bids. Since the placing of a bid can represent major investment, and the acceptance of a bid affects the outcome of an auction seriously, all bids must be delivered quickly and even over patchy connections. This requires many of the transactions to have little network overhead.

Websockets allow small data packages to be sent over a constantly enabled connection. This would allow rapid transactions between the system and a client, ideal for bids and notifications.

Such products as Google firebase build upon this to provide support for patchy networks, by caching data locally on the client and syncing it as necessary.

- *Low-Cost Computer Support:* Similar to Multi-Platform Support under the usability subsection, clients may be connecting through limited PCs or under-powered mobile devices. The interface to bid must not slow down on such devices. This may involve choosing investing development time into platform-specific optimisations and fixes. The auction house may choose to perform a survey of possible users in order to assess which platforms they will most likely need to support.

6.4 Reliability

- *Concurrency Management (ACID):* Transactions, especially bids, will come in asynchronously but must be processed synchronously and durably. Using a database that follows the ACID principles would ensure that bids processed in the correct order and not made to overlap or interfere with one another.
- *Integration Testing:* Failure in the middle of an auction is not an option. All user scenarios and actions that a user can take would best be adequately tested using some automated testing framework.

6.5 Maintainability

- *Conceptual Modularization:* In order to speed up training, understanding, and diagnosing the system, the program must be properly split into easily-digested modules that relate to a specific concept or process that is needed. This way, whenever an error occurs, it is self-evident what it causes by where it comes from. Whenever a new feature is needed, it is self-evident where the new feature should go and feature creep can be avoided.
- *Unit Testing:* Often, valuable hours are wasted on chasing errors due to regressions or diagnosing an in-production problem. The hot-fixing of production problems may also gradually introduce more and more cruft into a code-base, making it hard to predict

and maintain further down the road. Unit testing is ideal for catching bugs early and keeping regressions out of the code-base on every change.

Testing harnesses abound for most languages - QuickCheck for Haskell, JUnit for Java, and assert, Jasmine, and MochaJS for JavaScript are a few of the examples that can be provided.

It is desirable to aim for 95% code coverage over the system.

7 Ambiguities, Subtleties, Incompleteness

1. What information about a lot is visible to various users? We can consider lot characteristics like:

- High / low estimates — this can be useful for both members of the public and buyers to be able to filter lot search by price. However, it may be that a seller may desire this to be hidden from public view like the reserve price.
- Which auction it is being sold in, and the time and date — it is more desirable for this to be available to buyers, and less so for members of the public. Hiding this information from members of the public would encourage them to sign up as buyers, while it is essential that buyers be able to know when an lot they are interested in is being sold. It might also be possible to hide this at a more granular level, eg. the time/date of an auction associated with a lot is only shown to buyers if they show interest in that item
- Seller's commission / buyer's premium by lot if appropriate — it would make sense to show seller's commission to the seller of a lot only, while buyer's premium may be shown to buyers and optionally members of the public

2. Is the seller's commission, buyer's premium, bid increment:

- Different according to the lot they are associated with?
- Set on an auction-level?
- Decided by the auction house for all items?

Either of the three could be reasonable approaches, but would require differing implementations in software, with the third option being the simplest.

3. How do buyers and sellers register with the system? There could be two possible approaches:

- Self-registration through the app
- Registration through the auction house - in this case, who in the auction house would perform this operation, and what role would they require in the system to do so?

4. What information is contained in the notification sent to a buyer when a bid is placed on an lot they are interested in? Obvious candidates include the new price of the lot and the time left on the auction; undesirable information may include the identity of the competing buyer
5. Is the bank account information of a user verified through some verification method?
If yes:
 - What verification method is used? A common method is attempting to withdraw / deposit £0.01 into the account and confirming the user has received it; other methods may include communicating with the user's bank
 - At which stage are payment details verified? Options could include:
 - At registration — the natural choice, although this may cause friction in the registration process
 - When placing a bid — this is undesirable if the user is blocked from bidding due to a failed verification, because of the time-sensitive nature of auctions
 - On having won an auction — in this case, what is done if the account fails verification with the auction over?
6. Are on-site and off-site buyers treated any differently by the system? As a corollary, do off-site sellers exist (eg. those who ship the items to the auction house to be sold), and if yes are they also treated differently to on-site sellers?
7. Do buyers provide contact details as part of their contact information, and if yes:
 - Is this information validated? A common method would be to send a confirmation PIN to a provided email or phone
 - Is it necessary for the auction house staff to be able to contact the buyer after the auction, and if contact information is found to be invalid, how can staff contact the buyer?
8. Is collecting payment and providing the buyer the lot after the auction has been won a fully automatic process, or does it involve participation from a member of staff at the auction house? If yes, does the app need any provisions to be able to support this?
9. Does information about a lot remain in the system after it is sold, either in public view (eg. with a 'sold' tag) or on the database? For GDPR purposes it may be preferable to remove information about a lot either immediately or after a predetermined period of time. If lot information is to be removed, is this process automatically done by the system or is it manually done?
10. Can a person have both a buyer and a seller role — in order to minimise the amount of information they need to enter when registering, as the two will likely overlap significantly — or would they need to register separate accounts? If separate accounts are needed, should the app have support for switching between accounts if eg. a person is present at an auction as both a buyer and a seller?

11. Can lot information be amended after it has been added to the system? If yes, should the system have support for this or will it need to be done manually through a member of staff?
12. How does the system handle bank transactions? There are two possible scenarios:
 - The system handles transactions itself. This would require a high level of oversight and testing to adhere to regulatory regulations
 - The system handles transactions through some broker, eg. PayPal. This simplifies the process of creating transactions but will add additional cost and external dependencies on an API.
13. Are other auction house staff than auctioneers required to have roles within the app? If yes, what roles do they fulfil?
14. Can a lot contain items from multiple sellers?
15. Does a lot have an overall description, or do the items it is composed of have separate descriptions?
16. Is payment transferred to seller after payment has been received from buyer, or immediately after sale? The latter may introduce problems if the buyer is unable to pay, while the former may produce delays in payment which are undesirable to the seller.
17. Can a buyer mark their interest in a lot while the lot is on auction, or only before it is auctioned?