

Design Specifications (G3)

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Overview

Software

Our software aims to provide an end-to-end solution for customers participating in online auctions. We provide personalized interfaces for all users taking into account their preferences and auction history. We allow prospective auctioneers to declare items and schedule auctions at their convenience. Our software provides for multiple bidders to join auction rooms, leave auction rooms and bid for items of interest.

Design

This document encapsulates our data-flow-diagrams, their abstract inputs and outputs along with the appropriate structured charts and their comprising modules. We also specify each module type and its predicted complexity in the system in terms of cohesiveness and coupling. This document highlight possible bottlenecks and error-prone modules with intuitive reasoning and mathematical analysis. We also consider the tentative lines-of-code (LoC) for every input, transform and output subsystems./ We summarize our software through an interface sketch comprising of relevant classes, attributes, methods and inheritances.

Data Flow Diagrams

We elucidate the data-flow of our software through the following diagrams. To simplify our data-flow and modularize our application we effectively split our software into three very loosely coupled systems - authentication, general utilities and auction-room management. We have also highlighted the most abstract inputs and outputs for each of these subsystems in their respective diagrams.

Structured Charts

We now list sequentially modules formed from the aforementioned data-flow diagrams via factoring at different levels and the final structured chart with all modules combined.

First Level Factored Modules

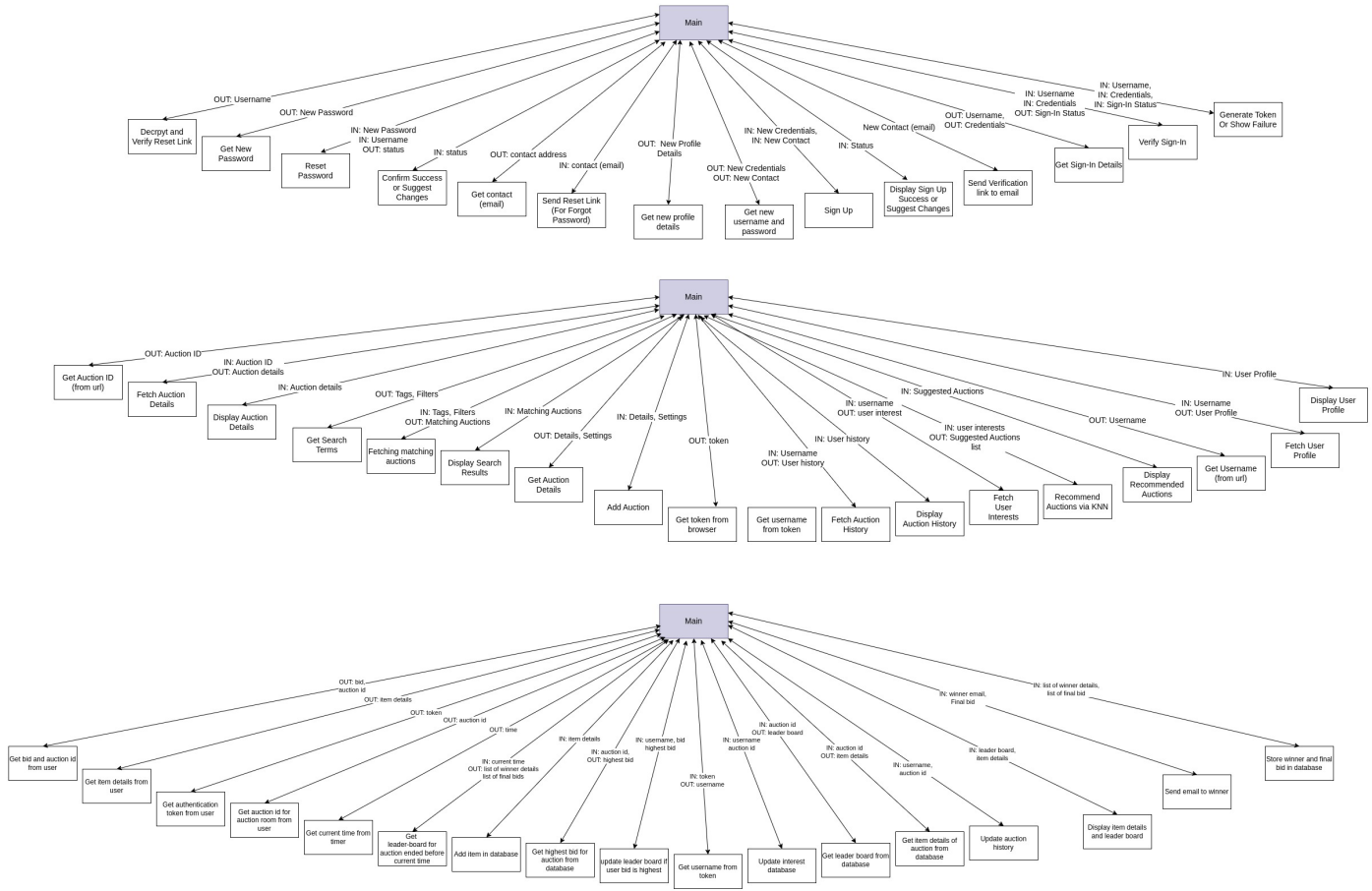


Figure 2: First Level Factoring

Factored Input Modules

Factored Output Modules

Factored Transform Modules

Final Structured Chart

Design Analysis

List of Modules

We list our final factored modules in the table below with corresponding type of module and cohesion, and its estimated size.

Module Name	Module Type	Cohesion Type	Estimated Size
Decrypt+Verify Reset Link	Input	Functional	50
Get New Password	Input	Functional	50
Reset Password	Coordination	Functional	50
Verify Password Strength	Input	Functional	20

Module Name	Module Type	Cohesion Type	Estimated Size
Update Password	Output	Functional	50
Confirm Reset Status	Output	Functional	25
Get contact (email)	Input	Functional	50
Send Reset Link	Output	Functional	75
Get new profile details	Input	Functional	100
Get Location	Input	Functional	25
Get Age	Input	Functional	25
Get Topics of Interest	Input	Functional	50
Get Sign Up Details	Input	Functional	100
Get Username	Input	Functional	25
Get New Password	Input	Functional	25
Get Contact	Input	Functional	25
Sign Up	Transform	Functional	50
Check If Username Exists	Transform	Functional	50
Check Length	Transform	Functional	15
Check Symbols	Transform	Functional	15
Hash Password	Transform	Functional	15
Insert User Details	Output	Functional	50
Display Sign Up Status	Output	Functional	150
Get Sign-In Details	Input	Functional	150
Verify Sign-In	Transform	Functional	50
Retrieve Credentials	Input	Functional	50
Generate Token or Failure	Output	Functional	150
Store Token in Browser	Output	Functional	50
Display Sign-In Failure	Output	Functional	50

Module Name	Module Type	Cohesion Type	Estimated Size
Get Auction ID (from url)	Input	Functional	50
Fetch Auction Details	Transform	Functional	100
Display Auction Details	Output	Functional	250
Display item name	Output	Functional	250
Display item type	Output	Functional	250
Display item image	Output	Functional	250
Display auction host name	Output	Functional	250
Display auction start time	Output	Functional	250
Get Search Terms	Input	Functional	50
Get tag	Input	Functional	50
Get filter username	Input	Functional	100
Get filter item name	Input	Functional	100
Fetching matching auctions	Composite	Functional	150
Form query - matching auction	Transform	Functional	250
Execute query-matching auction	Transform	Functional	250
Display Search Results	Output	Functional	250
Get Auction Details	Input	Functional	150
Add Auction	Output	Functional	150
Get token from browser	Input	Functional	50
Get username from token	Transform	Functional	100
Decrypt token	Transform	Functional	50
Fetch Auction History	Transform	Functional	150
Display Auction History	Output	Functional	150
Fetch User Interests	Transform	Functional	50
Recommend Auctions via KNN	Transform	Functional	500
Display Recommended Auctions	Output	Functional	500
Get Username (from url)	Input	Functional	50
Fetch User Profile	Transform	Functional	100

Module Name	Module Type	Cohesion Type	Estimated Size
Display User Profile	Output	Functional	250

Module Name	Module Type	Cohesion Type	Estimated Size
Bid Main	Composite	Functional	
Get Bid Price	Input	Functional	25
Get Auction ID (URL)	Input	Functional	25
Positive Bid	Transform	Logical	25
Item Main	Composite	Functional	
Get Item Name	Input	Functional	25
Get Item Tag	Input	Functional	25
Get Item Image	Input	Functional	25
Get Item St Price	Input	Functional	25
Get Auth Token	Input	Functional	25
Get Auction ID (Room)	Input	Functional	25
Get Current Time	Input	Functional	25
Get Leaderboard (abrupt)	Composite	Temporal/Sequential	50
Query for End Auction	Transform	Logical/Temporal	100
Exec Query End A uction	Transform	Logical/Temporal/Fnl	100
Add Item (DB)	Output	Functional	100
Get Highest Bid	Composite	Communicational/Fnl	50
Query for Highest Bid	Transform	Functional	50
Exec Query Highest Bid	Transform	Functional	100
Update Leaderboard	Composite	Logical/Functional	50
Check Greater User	Transform	Logical/Functional	50
Update Leaderboard Bids	Output	Functional	100
Get Username	Composite	Functional	50
Get Encryption Key	Input	Functional	50
Decrypt Token	Transform	Functional	50
Update Interest	Output	Functional	50
Query for Leaderboard	Transform	Functional	50
Exec Leaderboard Query	Transform	Functional	50
Get Auction Item List	Composite	Functional	100
Query for Item List	Transform	Functional	100
Exec Query for Item List	Transform	Functional	50
Display for Auction Room	Coordination	Functional	250
Display Item List	Coordination	Functional/Temporal	250
Display Item	Output	Functional	250
Display Leader Board	Output	Functional	250
Update Auction History	Output	Functional	150
Store Auction End	Output	Functional	150

Module Justifications

In general we can observe a few trends that can be characterized as follows:

1. **Query - Get Information - Execute Query Triads:** These subsystems consist of three modules - one transform module that consists of forming the query, one composite module that handles getting information for the main module and one transform module that is responsible for executing the query. In most of these cases, all three modules are significantly coupled as all three modules are interconnected and dependent on each other but we can argue that these modules are not tightly coupled as their connections are weak and are only limited to a fan-in and fan-out of 1. Again it can be noted that all three modules primarily exhibit functional cohesiveness with the central composite module also serving secondarily as a communication module.

2. **Central Continuous Forms:** These subsystems consist of a central module that continuously expects actions and information and passes on information from its subordinate modules. The central module is a composite module with

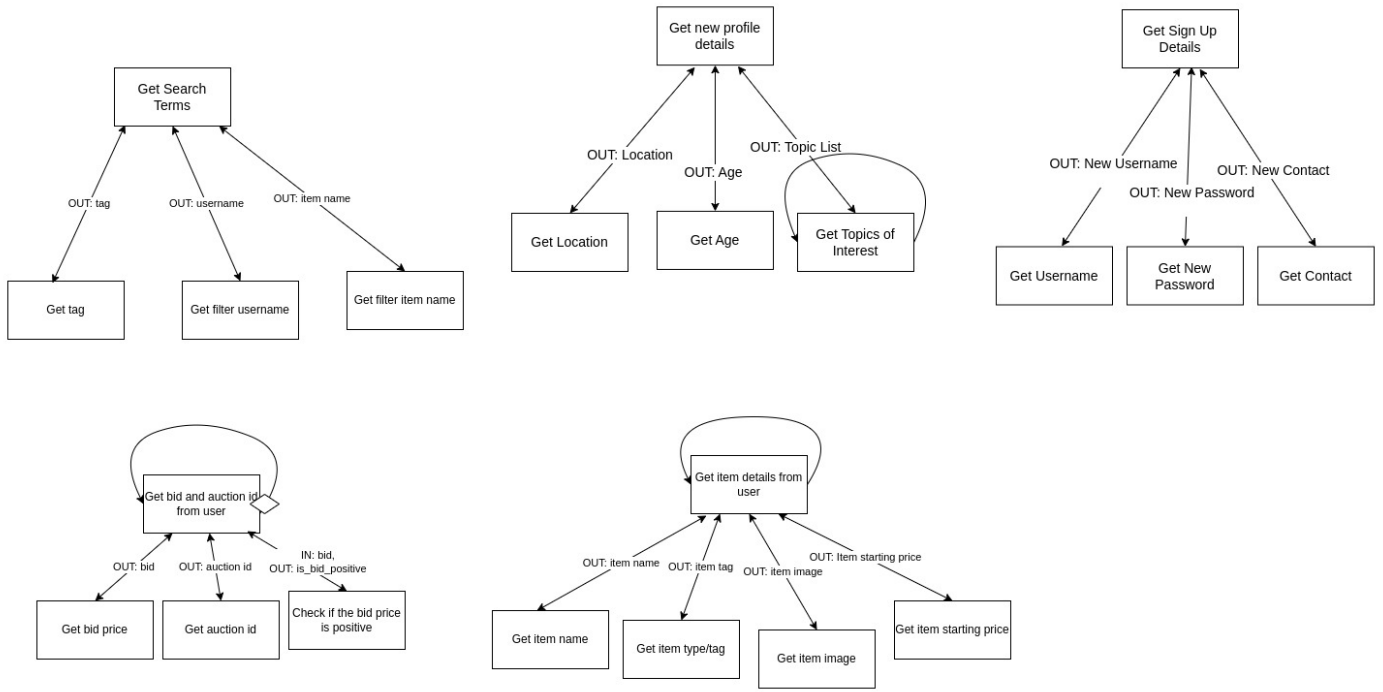


Figure 3: Factoring Input Modules

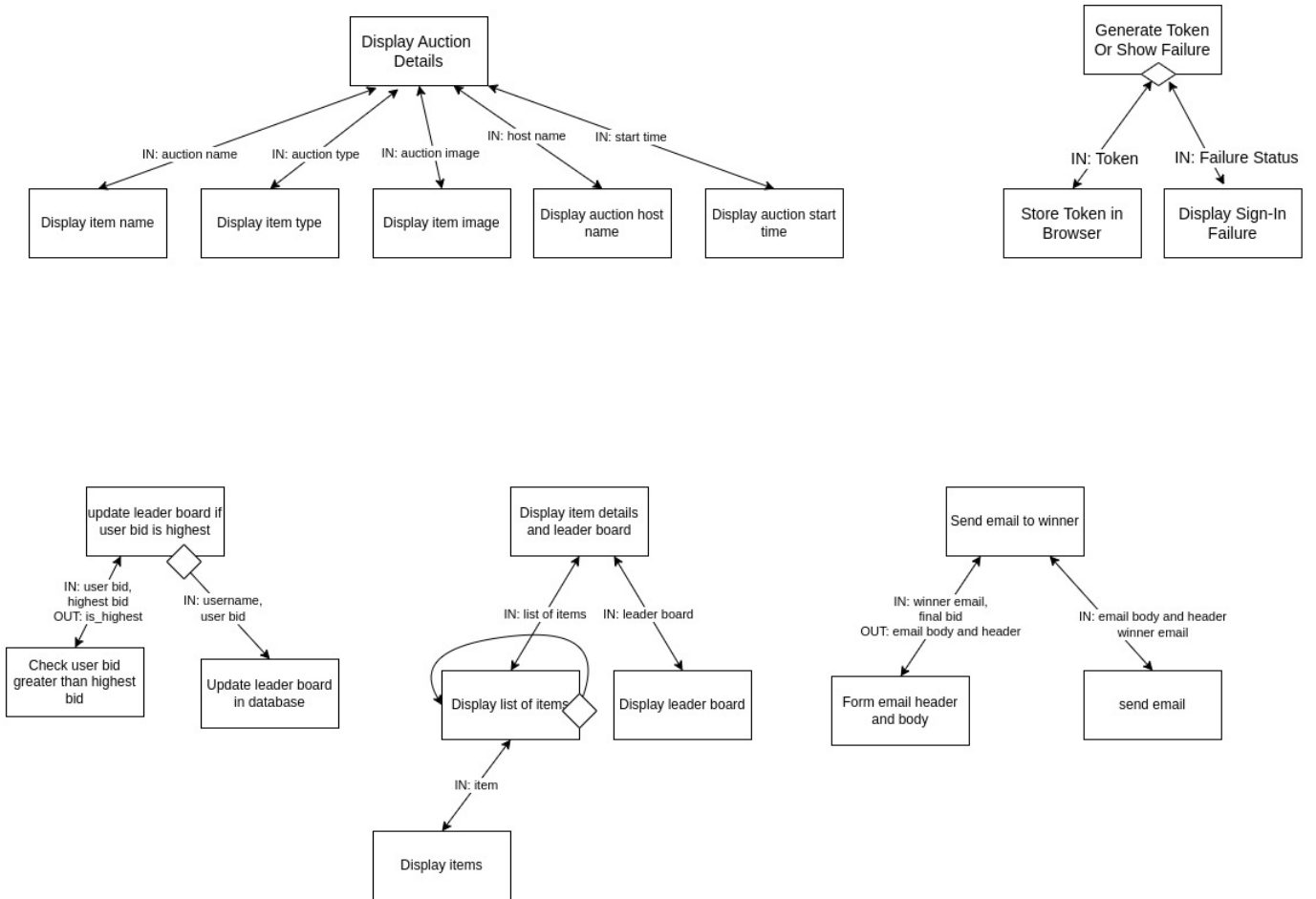


Figure 4: Factoring Output Modules

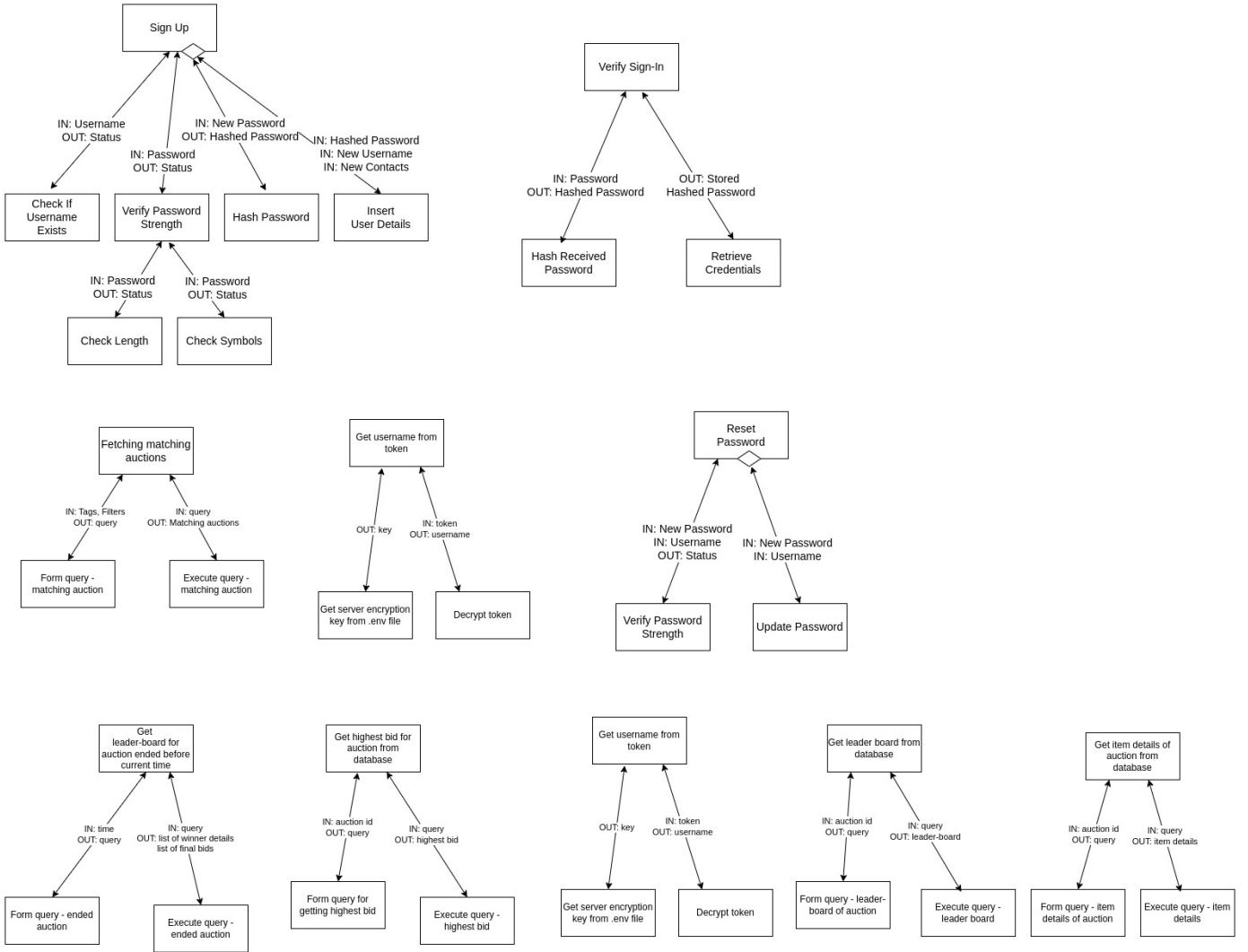
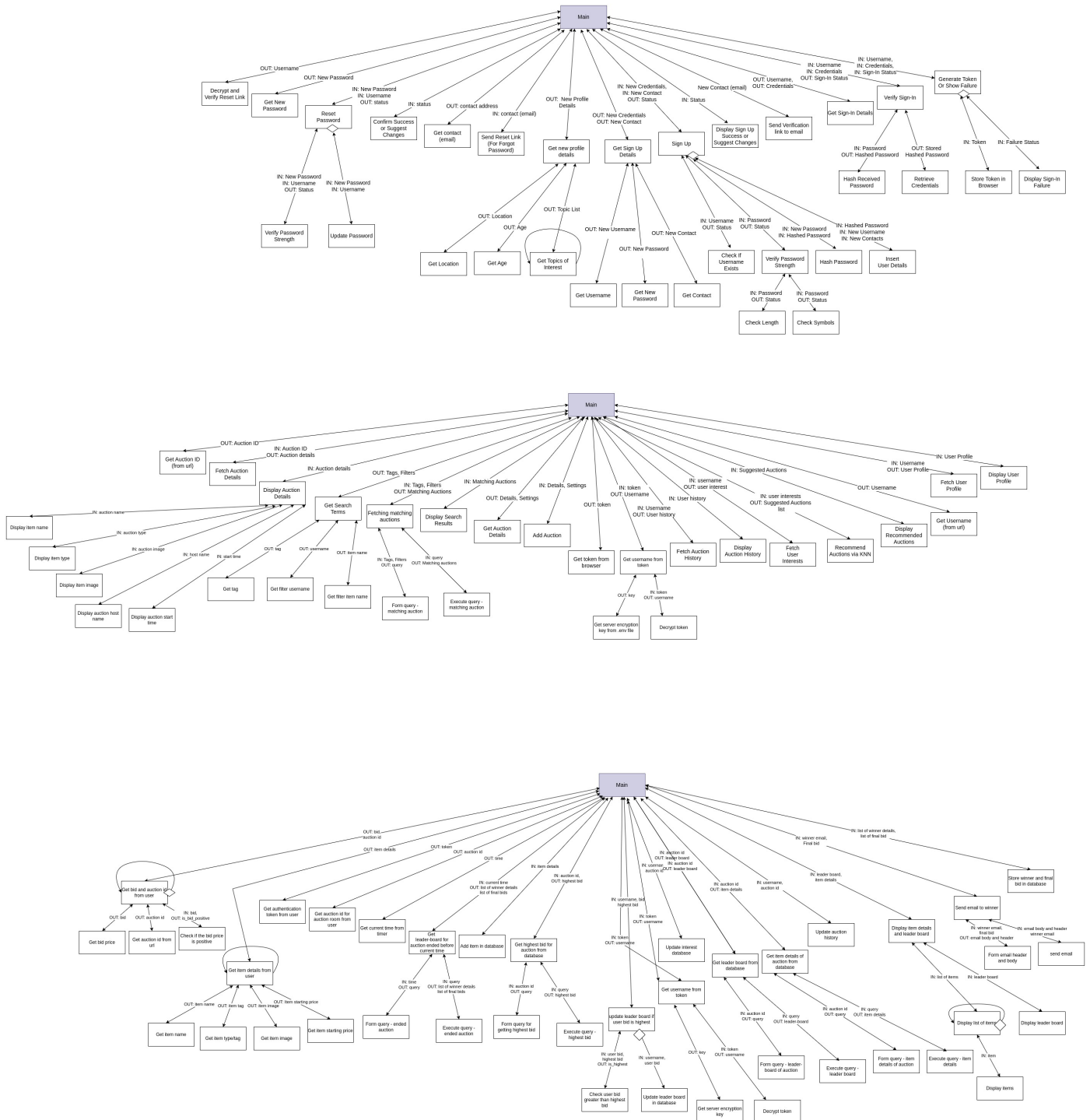


Figure 5: Factoring Central Transform Modules



functional cohesiveness as it passes on information towards the main module and continuously loops in anticipation. The subordinate modules are mostly functionally cohesive for information and are logically cohesive when the module is triggered by an action. Again, these modules have significant coupling, especially at the central module as it takes in multiple parameters. But again, coupling is significantly reduced due to clearly defined entry points and parameters which are passed on.

3. **Updates:** These subsystems consist of a central module and two subordinate modules. The central module fetches information (sometimes conditionally) from a transform module and instructs another output module to update/execute certain instructions. This is similar to the Query Triad except that the final subordinate module is not obligated to inform the central module. Again most such modules are functionally cohesive except when the first subordinate module is action-dependent (in which case it is logically cohesive). Low coupling is observed in such subsystems as number of interconnections are small and weak due to effective parameterization.

We now provide a brief justification for the type of cohesion and coupling expected in the above module in regards to our software. We also refer to the previous trends whenever applicable:

- **Bid Main:** This module is responsible for the compiling the bid object parameters from the user provided the user has positively responded to the bidding option. This serves as a central composite module as referred to in (2). The following 3 modules serve as subordinates to this module.
- **Get Bid Price:** This module is responsible for receiving bidding price and answers to the **Bid Main** module.
- **Get Auction ID (URL):** This module is responsible for receiving the corresponding auction_id to the **Bid Main** module.
- **Positive Bid:** This module is logically cohesive as it checks if the present bidding value is positive with respect to the present highest bid. This again serves as a subordinate to the **Bid Main** module.
- **Item Main:** Similar to the previous subsystem, this serves as the central module of the subsystem described in (2) with the following 4 modules serving as subordinates. This serves as a composite module that collects item information to be added in the auction room.
- **Get Item Name:** This module fetches the item name for **Item Main**.
- **Get Item Tags:** This module fetches relevant tags for the item for **Item Main**.
- **Get Item Image:** This module fetches the associated image for the item for **Item Main**.
- **Get Item Starting Price:** This module fetches the item's base price for **Item Main**.
- **Get Auth Token:** This module authenticates a user entering the auction room via the user's current authentication token. This is a simple input module which is functionally cohesive and has low coupling with the main module through a single parameter - auth_token.
- **Get Auction ID (Room):** This module fetches the auction room for a user joining the room through a link. This module is an input module with functional cohesiveness and low coupling with the main module.
- **Get Current Time:** This module fetches current time for all time sensitive operations with main module. This module is an input module with temporal cohesiveness. It can be argued that this module has high coupling with the main modules and associated time-dependent modules. This is intuitive as cohesiveness and coupling are oppositely correlated.

- **Get End Leaderboard (end initiated):** This module is triggered when the auctioneer ends the auction before the specified time. Note that this serves as the central module of the Query Triad subsystem. Although we would expect this module to be functionally cohesive, we can argue that this module leans more towards temporal cohesiveness due to its massive dependence on time. Again by correlation, we see that this tightly coupled with the main module and the time-fetching module.
- **Query for End Auction:** This serves as the transform module that forms the query when the auction ends. Refer the Query Triad subsystem for further information.
- **Execute Query for End Auction:** This serves as the transform module that executes the above query.
- **Add Item to Database:** This module adds an item to the common database for items for further recommendations and preferences. This is a simple input module with functional cohesiveness and has low coupling with the main module.
- **Get Highest Bid:** This module again serves as the central module of the Query Triad subsystem. Please refer to subsystem (1) for further details. The following two modules are transform modules and form and execute the necessary query.
- **Query for Highest Bid:** This module forms the query to extract the highest bid for an auction.
- **Execute Query for Highest Bid:** This module executes the above query.
- **Update Leaderboard for Bid:** This module serves as the central module for the subsystem described in (3). We also comment this module has added bit of complexity due to the conditional invoking of the subsequent module to update the leader board. The following 2 modules are subordinate modules.
- **Check User with Greater Bid:** This module checks if the user has a bid greater than the present highest bid.
- **Update Leaderboard with Bid:** This module is conditionally activated when the user's bid is the new highest bid appropriately updates the database.
- **Get Username:** This module is responsible for retrieving the username of the user from their respective tokens. This module calls a subordinate routine to receive an encryption key to decode the token. In this sense, this structure is similar to the subsystem described in (1) with the expectation that it always receives a key from the subordinate query routine.
- **Get Encryption Key:** This module serves as a query routine although it is strictly an input module.
- **Decrypt Token:** This module "executes" the above query in the form decryption.
- **Update Interest:** This module is a simple output module that updates the present interests of the user. This module is therefore functionally cohesive and has minimal coupling with the main module.
- **Get Leaderboard for View:** This module serves as a central module for the Query Triad System with the subsequent two modules serving as its subordinates.
- **Query for Leaderboard:** This module frames the query for the leaderboard module.
- **Execute Query for Leaderboard:** This module executes the above query framed.

- **Get Auction Item List:** This module serves as a central module for the Query Triad System with the subsequent two modules serving as its subordinates.
- **Query for Item List:** This module frames the query to fetch item list related to the auction.
- **Execute Query for Item List:** This module executes the above query to provide all prospective items in an auction.
- **Update Auction History:** This module is a simple output module that updates the auction history of the user who has executed a successful bid. This module is again functionally cohesive and has low coupling with the main module.
- **Display for Auction Room:** This module is responsible for constructing views for interested bidders. We factor this composite module into smaller independent portions to remove unnecessary coupling with its subordinates. This module is functionally cohesive and remains virtually independent during the time of the auction.
- **Display Item List:** This module fetches the item list for the auction through call routines to individual lists as described below.
- **Display Item:** This module displays an item object with its full description to the user including its current status of sale.
- **Display Leaderboard:** This module highlights the current bids placed by interested bidders.
- **Notify Winner:** This module serves as the central module described in subsystem (3) with the following two modules as its subordinates.
- **Email Template:** This module frames the template including the body of the letter along with the parameters concerning the winner of the auction.
- **Send Email:** This output module serves as an “update” as it sends the email to the appropriate address.
- **Store Auction End:** This module is a simple output module that updates the winners of auctions to the database after the end of the auction. As a result, this module is functionally cohesive and is loosely coupled with the main module.

Module Count

The following table summarizes the instances of each module type:

Module Type	Count
Input	10
Output	8
Transform	12
Coordinate	2
Composite	9

Module Interfaces

```
class auction {
    uuid id;
    uuid creator;
    time start_time;
    time end_time;
```

```

    int start_price;
    int current_price;
    int min_increment;
    bool visibility;
    uuid key;
    int time_since_last_bid;
    uuid winner;
    vector<int> tags;
    string name;
    string description;
    string image;
    vector<pair<uuid, int>> bids;

    void init(
        int start_price,
        int min_increment,
        time start_time,
        time end_time,
        bool visibility,
        uuid creator,
        vector<int> tags
    );
    int get_current_price();
    int set_current_price(int price);
    bool get_visibility();
    bool check_key(uuid key);
};

class user {
    uuid id;
    string name;
    string email;
    string password;
    string phone;

    void init(string name, string email, string password, string phone);
    vector<uuid> get_all_created_auctions;
    vector<uuid> get_all_bidded_auctions;
    vector<uuid> generate_auctions(int count);
    uuid create_auction(
        int start_price,
        int min_increment,
        time start_time,
        time end_time,
        bool visibility,
        vector<int> tags
    );
    bool bid(uuid auction_id, int price, uuid key);
    bool delete_auction(uuid auction_id);
    bool edit_name(string name);
    bool edit_email(string email);
    bool edit_password(string password);
    bool edit_phone(string phone);
};

```

Error Prone Modules

Output Module:

Store Auction End seems error-prone it has the most information that is being generated. Note that all other output

modules have exactly one parameter so one must consider the type of data that is taken into account whilst computing

$$dc = loc * (inflow * outflow)^2$$

.

Input Module:

Get Item Image is most error-prone due to similar reasoning as above.

Transform Module:

Exec Query for Item List is most error prone as it must handle a query with substantial complexity (high inflow) and must subsequently generate a detailed list of all items in the auction (high outflow).