

**Course Title:** Software Requirements Engineering

**Course Code:** SENG471

**Assignment Number:** 3

**Report Title:** Modelling of Requirements

**Team Name:** Big Data Energy

**Student's Names:** Nathan Godard, Qifeng Li, Erik Skoronski, Justin Tijunelis\*

<b>1 Introduction</b>	<b>3</b>
<b>2 Methodology</b>	<b>3</b>
<b>3 Discussion</b>	<b>4</b>
<b>4 Appendices</b>	<b>5</b>
4.1 Appendix A: Models of Functional Requirements	5
4.1.1: UML Use Case Diagram for Manager User Type	5
4.1.2: UML Use Case Diagram for Customer User Type	6
4.1.3: UML Use Case Diagram for Sales Representative User Type	7
4.1.4: BPMN for Adding a Vehicle to the System	8
4.1.5: BPMN for Associating Customer with Salesperson	9
4.1.6: BPMN for Adding a User to the System	10
4.1.7: SADT for System Interactions with Manager	11
4.1.8: SADT for System Interaction with Sales Representative	11
4.1.9: SADT for System's Interactions with Customer	12
4.1.10: Activity Diagram for Registering a Vehicle Sale	13
4.1.11: Class Diagram of Relevant Components in System	14
4.1.12: ERD Model of Proposed Database	15
4.1.13: DFD for User Data Collection from Customer Interaction	16
4.1.14: ET Diagram for Customer Saving a Favorite Car	17
4.1.15: ET Diagram for Manager Viewing Statistics	17
4.1.16: SM Diagram for Vehicle	18
4.1.17: R-Net Diagram for Customer Marking a Car as Favorite	19
4.2 Appendix B: Exhaustive List of Use Cases	20
4.3 Appendix C: Data Collection Records	23
4.3.1: First Interview Data: CADA Sales Manager	23
4.3.2: Second Interview Data: User Interface Expert	24
4.3.3: Third Interview Data: CADA Senior Service Employee	25
4.3.4: Fourth Interview Data: User Interface Consultant	26

## **1 Introduction**

This report illustrates the analysis of a real-world problem through modelling requirements by Big Data Energy (“BDE” or “we” or “us”). The dealerships of CADA have found that customers take a long time to decide on color palettes of vehicles in person, and have requested car-customization viewing software. Their current software lacks fundamental features that should be implemented if CADA was to have a new software developed. In this report we will outline the new system we will develop, and the models of various aspects in the application domain we developed in order to analyze the requirements. This report focuses almost exclusively on the front-end features and navigation, along with the communication between the front-end and back-end of the system. Back end components and hardware devices (other than a database system) were determined to be out of scope for this report, as none of the experts we interviewed mentioned any backend requirements that are in place at this stage. Additionally, they did not mention any hardware ideas or specifications at this stage.

## **2 Methodology**

To develop the models of the proposed system we followed a process of collecting information and then model design. We collected our information through a series of four different interviews. In our interviews, we collected information from a sales manager at CADA, a user interface (UI) expert, a CADA senior service employee, and a UI consultant. Copious notes were taken on each interview, and organized into an extensive list of desired use cases of the system. It was quickly noted that the information gathered from the interviews consisted almost entirely of front-end concerns and desired use cases, with little or no information given on back-end requirements or components. This list was further developed into a series of models, highlighting design components for each element of the system.

We used various modelling techniques for the analysis. Three comprehensive use case diagrams were created to show system features from a user-view. In addition to this, we made three comprehensive SADT activity diagrams to show the entire system from a system-view. SADT data diagrams were determined to be unnecessary, since the data flow is simple, and the remainder of the diagrams model data flow more effectively than SADT data diagrams would. For each use case, we also created a R-Net, ET, SM, Activity, or BPMN diagram to investigate the use case in greater detail. The diagram type was chosen based on the type of information being presented. We also developed an ERD to model the data being collected and stored by the system. A class diagram was developed to better model and evaluate the functionalities and responsibilities of different system components.

### **3 Discussion**

Throughout the modeling process, BDE generated use case, BPMN, SADT, activity, UML, ERD, DFD, SM, R-Net, and ET diagrams to model the CADA system. These diagrams helped to paint a clearer picture of the software system and all of its components. The models created were able to demonstrate the logic behind the subcomponents of the system and thus reveal the logic that will be used for implementation of the entire system.

Throughout the process of creating the models, we learned that it was not wise to have each group member working on diagrams simultaneously. The reason being that all of the diagrams were related and many depended almost entirely on others. We also discovered that working on all of the diagrams at the same time led to many inconsistencies and forced the team to go through all the diagrams together to create a consistent format and remove any contradictions. The team also made a mistake in the presentation of said diagrams, where different members were assigned to different responsibilities that were not related to which diagrams they created. This was a problem because members were generating descriptions for diagrams that they did not create, again, leading to some ambiguity.

While the team did face some difficulties in modeling the system, the end result led to a much clearer view of the system's properties and how implementation of the system would carry out. Overall, the team learned many lessons in organizing and streamlining the process of modeling software systems. Going forward, the team plans to take the lessons learned from the modeling done for this system and apply it to future projects to ensure efficient and high quality modeling.

## 4 Appendices

### 4.1 Appendix A: Models of Functional Requirements

#### 4.1.1: UML Use Case Diagram for Manager User Type



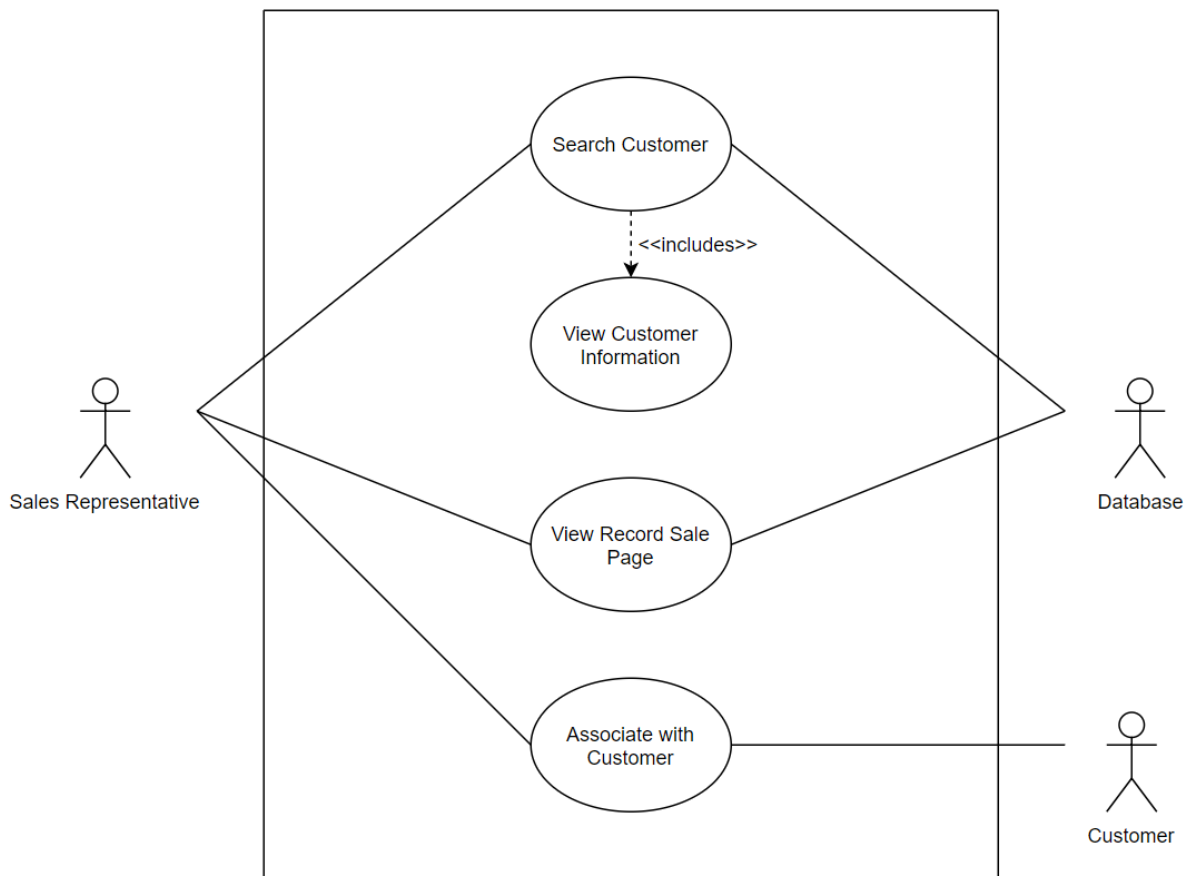
The above diagram shows all the use cases for a manager within our system. All interactions happen with the database as the other actor. Each use case is a process which is available to the manager. This kind of diagram was chosen as it best shows what capabilities managers have within the system.

#### 4.1.2: UML Use Case Diagram for Customer User Type



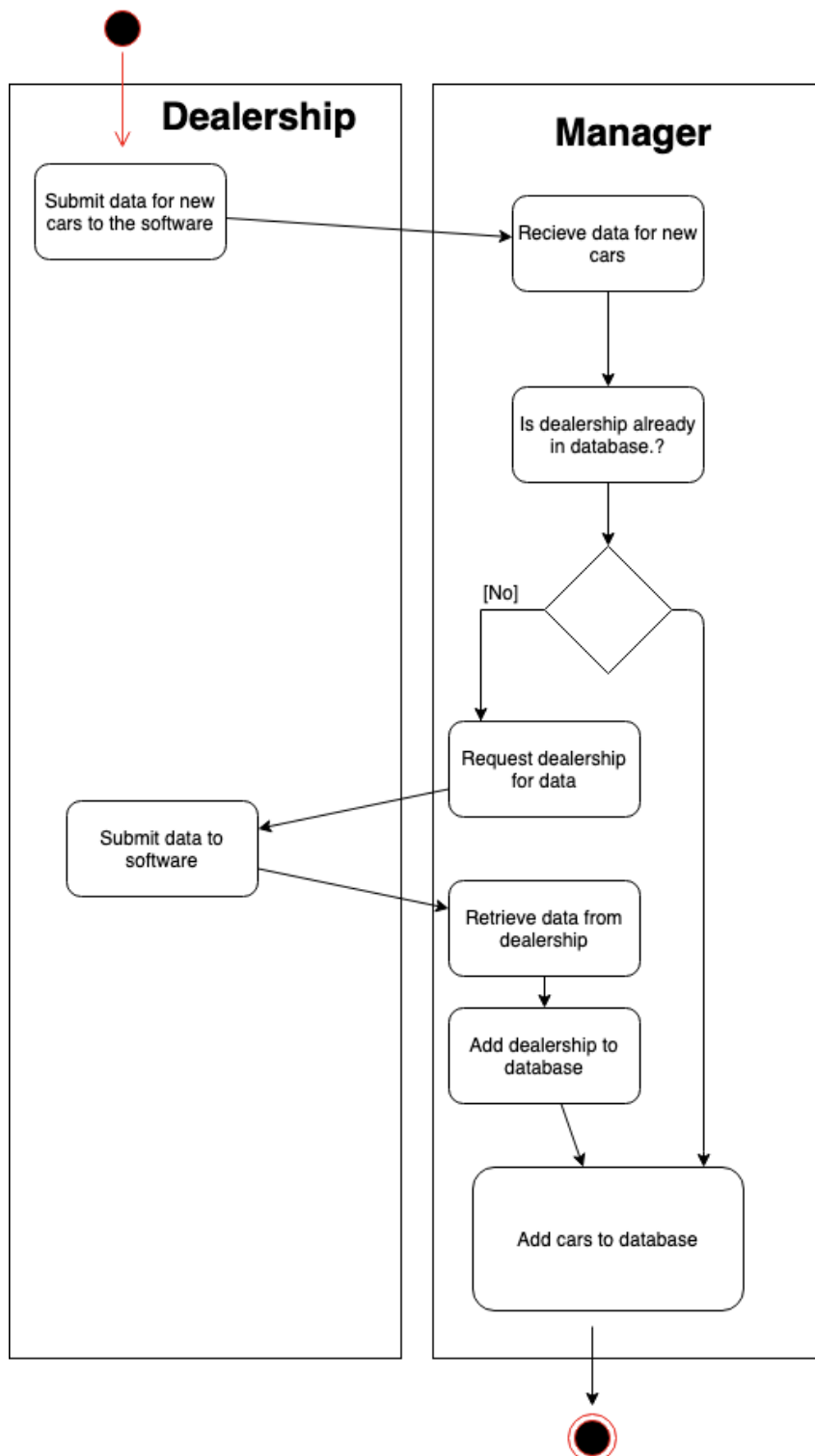
The above diagram shows all the use cases for a customer within our system. All interactions happen with the database as the other actor. Each use case is a process which is available to the customer. This kind of diagram was chosen as it best shows what capabilities customers have within the system.

#### 4.1.3: UML Use Case Diagram for Sales Representative User Type



The above diagram shows all the use cases for a sales representative within our system. All interactions happen with the database as the other actor. Each use case is a process which is available to the sales representative. This kind of diagram was chosen as it best shows what capabilities sales representatives have within the system.

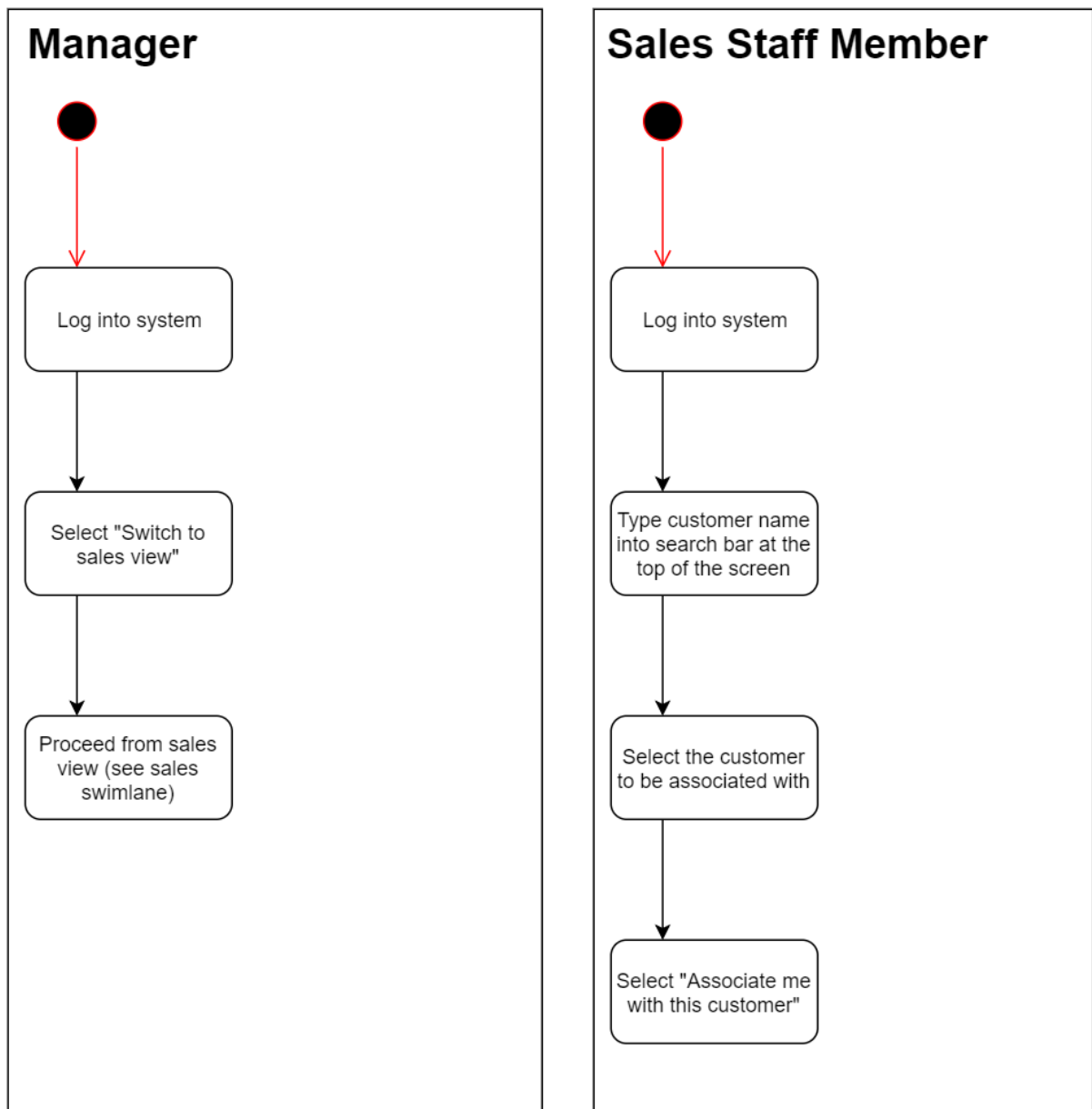
#### 4.1.4: BPMN for Adding a Vehicle to the System



The above diagram shows the process that a dealership and manager must engage in to add new cars to the database. This kind of diagram was chosen because it best shows what must be done for the dealer and manager, without being too technical.

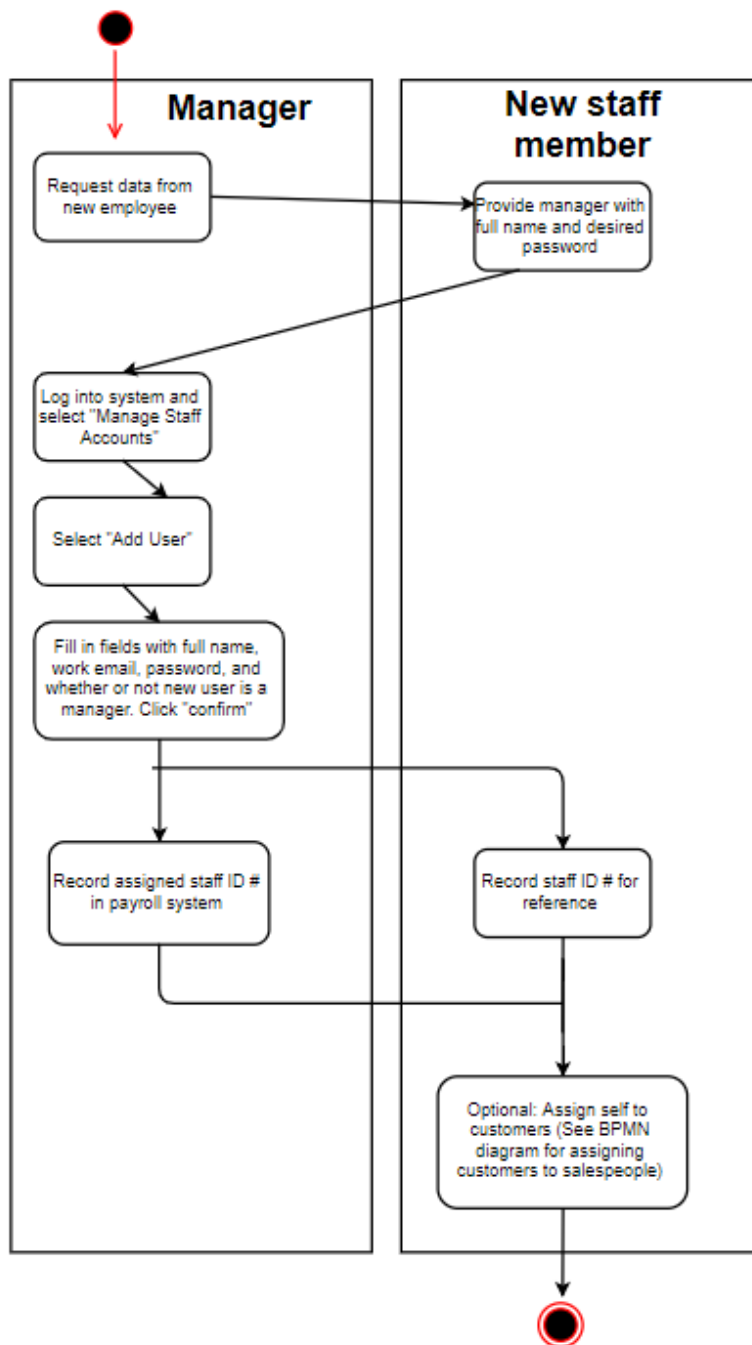


#### 4.1.5: BPMN for Associating Customer with Salesperson



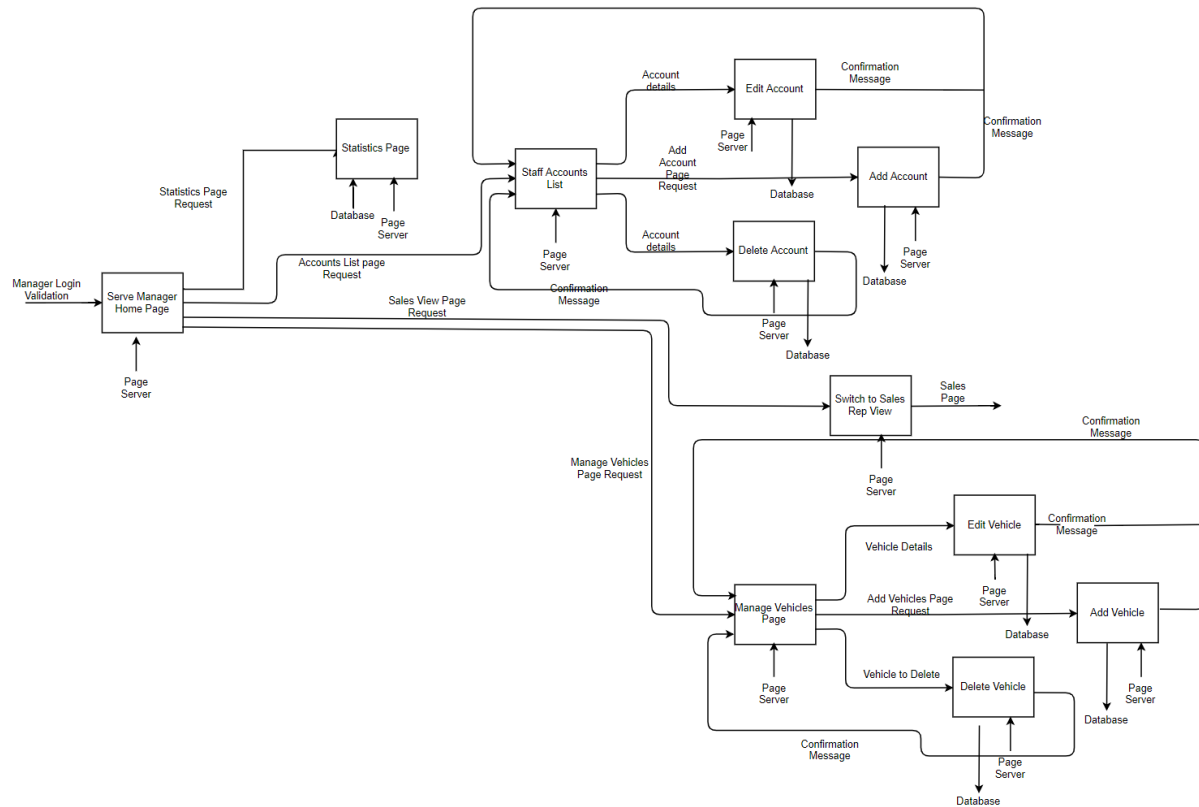
The above diagram shows the process that a sale staff member must engage in to associate with a customer. It also shows what a manager must do to view a sales staff member and their customers. This kind of diagram was chosen because it best shows what must be done for the sales staff member and manager, without being too technical.

#### 4.1.6: BPMN for Adding a User to the System

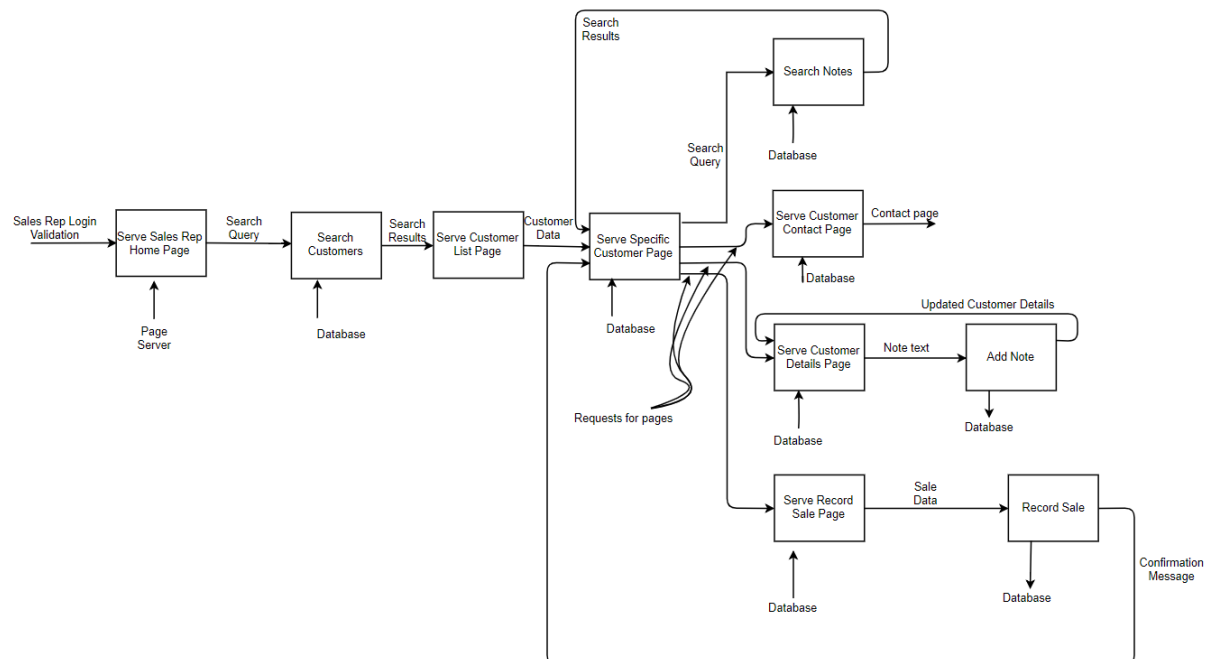


The above diagram shows the process that a manager and new staff member must engage in to add staff members to the database. This kind of diagram was chosen because it best shows what must be done for the new staff member and manager, without being too technical.

#### 4.1.7: SADT for System Interactions with Manager



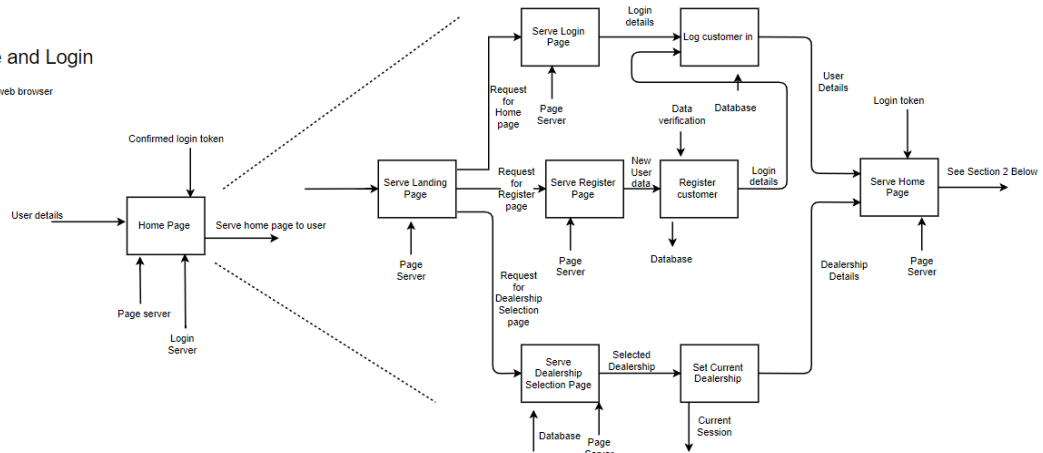
#### 4.1.8: SADT for System Interaction with Sales Representative



#### 4.1.9: SADT for System's Interactions with Customer

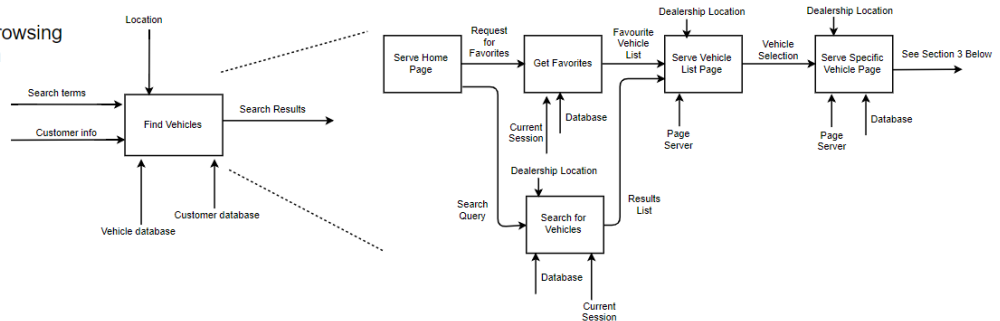
##### Section 1: Home and Login

Can be accessed: From any web browser



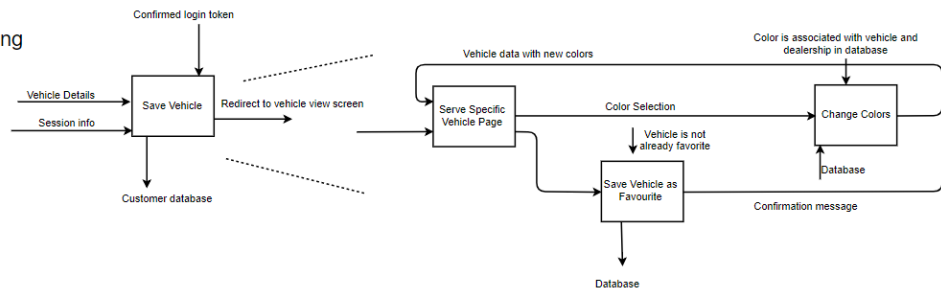
##### Section 2: Vehicle Browsing and Selection

Can be accessed: From home page



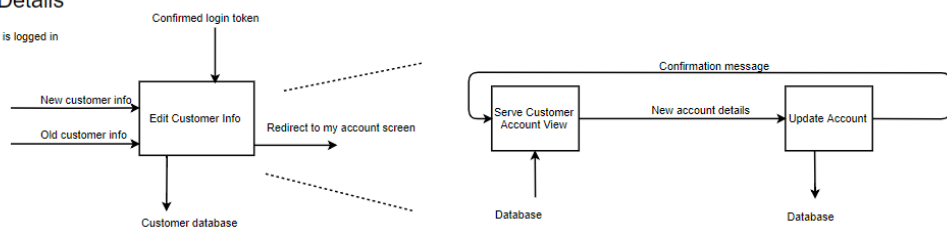
##### Section 3: Vehicle Customization and Saving

Can be accessed: From specific vehicle page



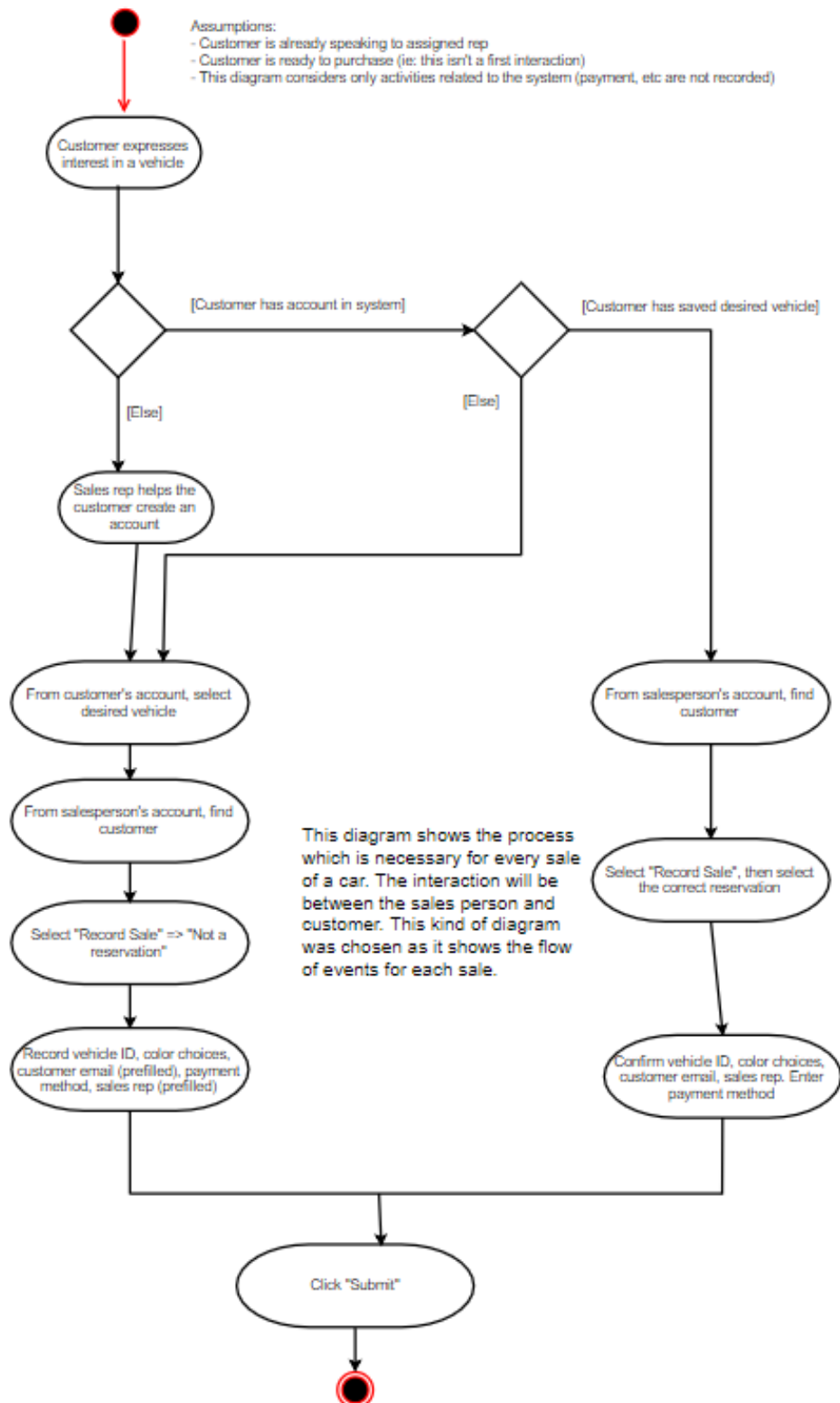
##### Section 4: Edit Account Details

Can be accessed: From any screen after user is logged in

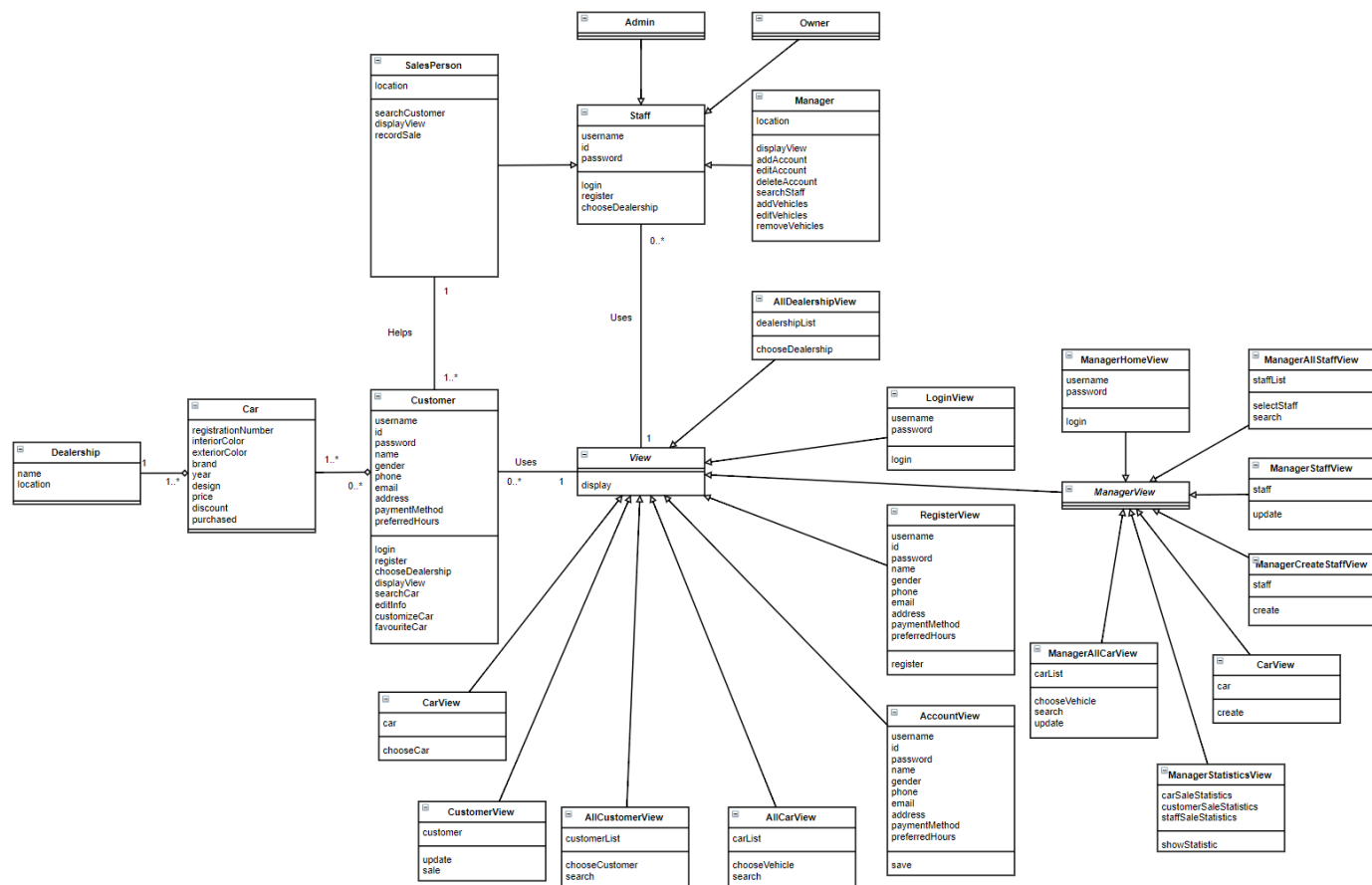


The above diagrams, 4.1.7, 4.1.8, and 4.1.9, show all the use cases from a system perspective as opposed to a user perspective. 4.1.7 focuses specifically on the manager; 4.1.8 focuses specifically on the sales representative; 4.1.9 focuses specifically on the customer. This kind of diagram was chosen as it aids in the design of the overall system by breaking down each individual use case.

#### 4.1.10: Activity Diagram for Registering a Vehicle Sale

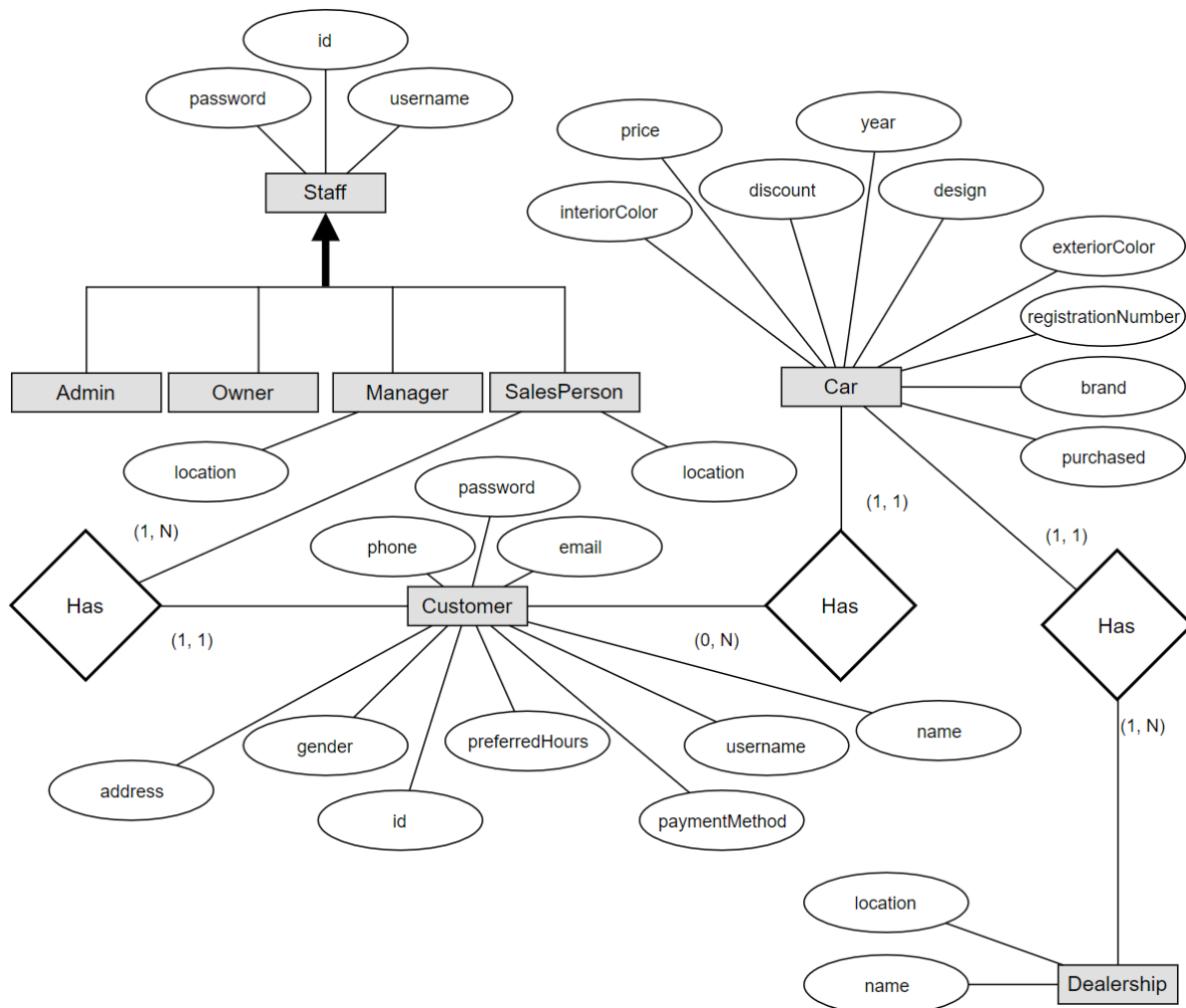


#### 4.1.11: Class Diagram of Relevant Components in System



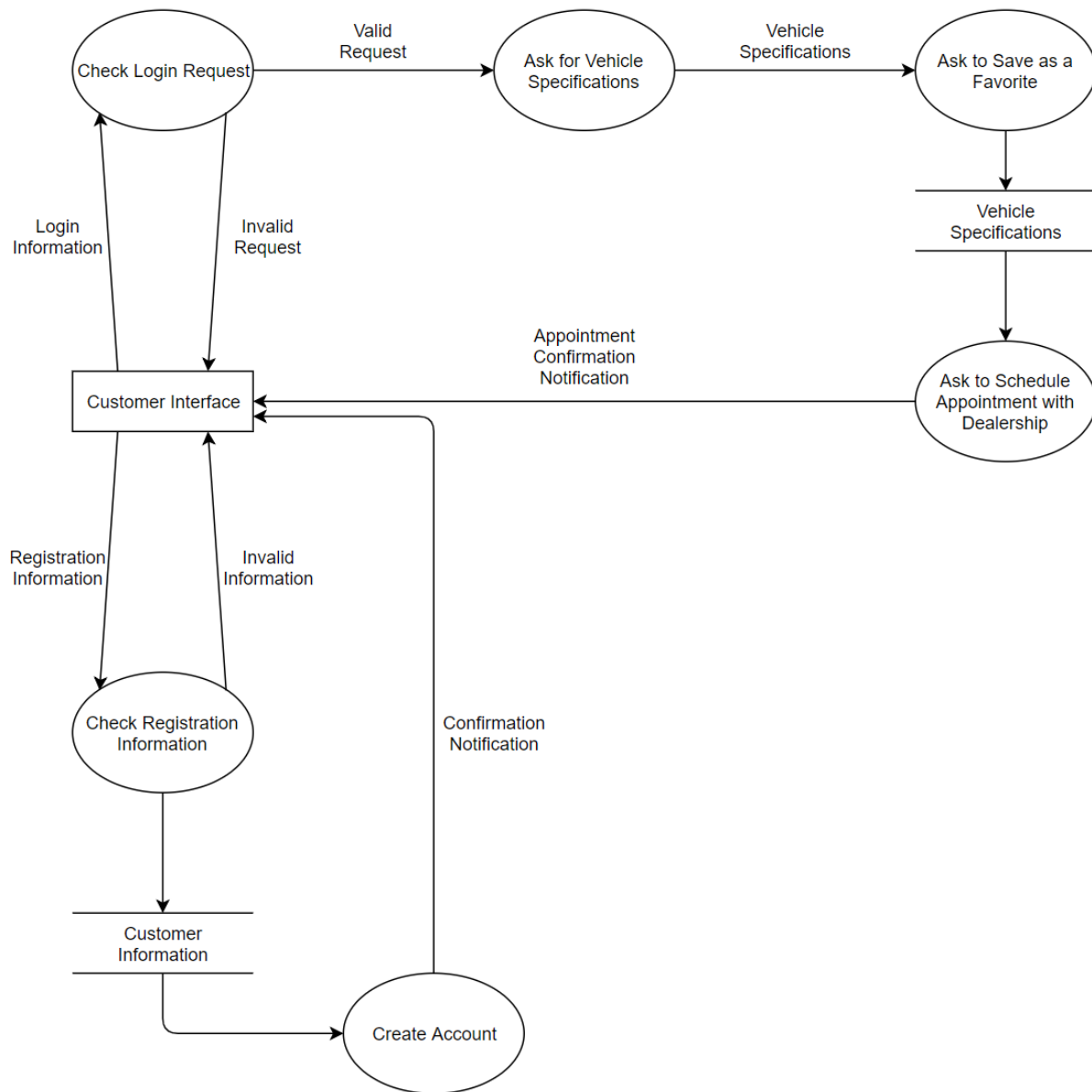
The above diagram shows all the classes which will be included in the system. Each class has an associated list of attributes and functions which relate to that class. This type of diagram was chosen as it provides an overarching view of the system's data components.

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The above diagram shows the structure of the data which will be stored in the database accompanying the system. Each relation has attributes and many relationships will generate additional relations. This type of diagram was chosen as it best represents the data and relations between data for the system.

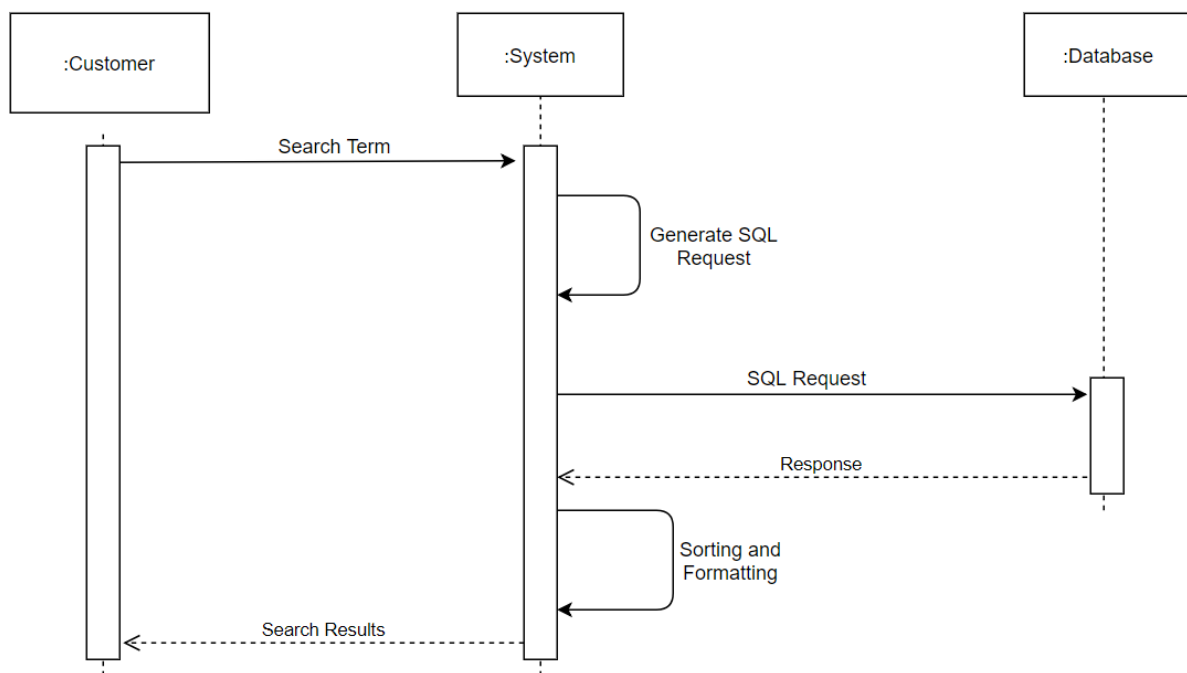
#### 4.1.13: DFD for User Data Collection from Customer Interaction



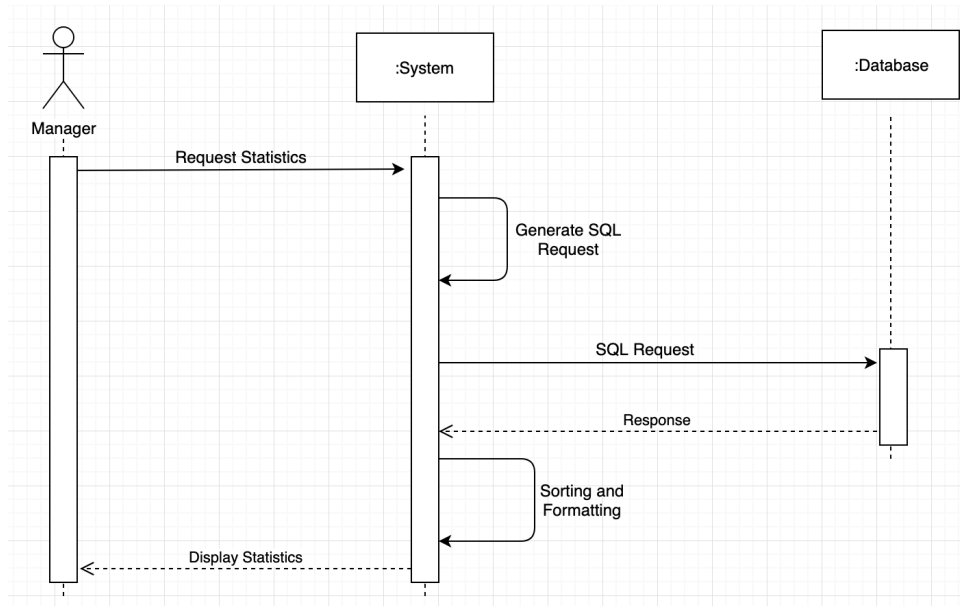
The above diagram shows the flow and storage of data that occurs as a customer interacts with the system. This diagram was chosen because it shows the key data flow and storage that occurs in the system. Most other parts of the system have little to no data storage and this diagram illustrates the majority of important data flow.



4.1.14: ET Diagram for Customer Saving a Favorite Car

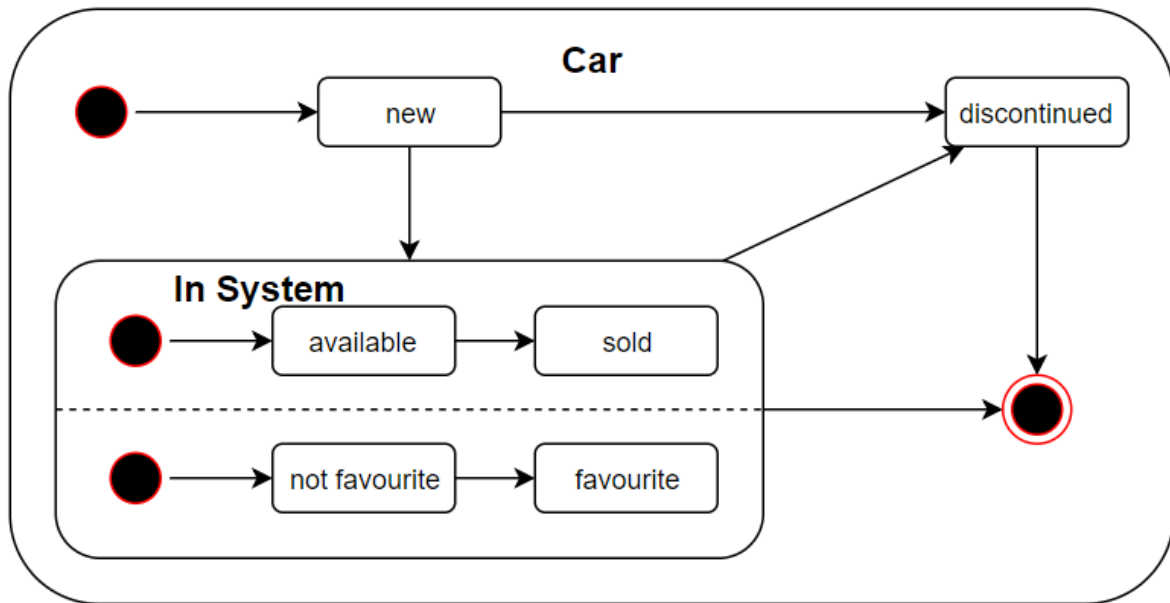


4.1.15: ET Diagram for Manager Viewing Statistics



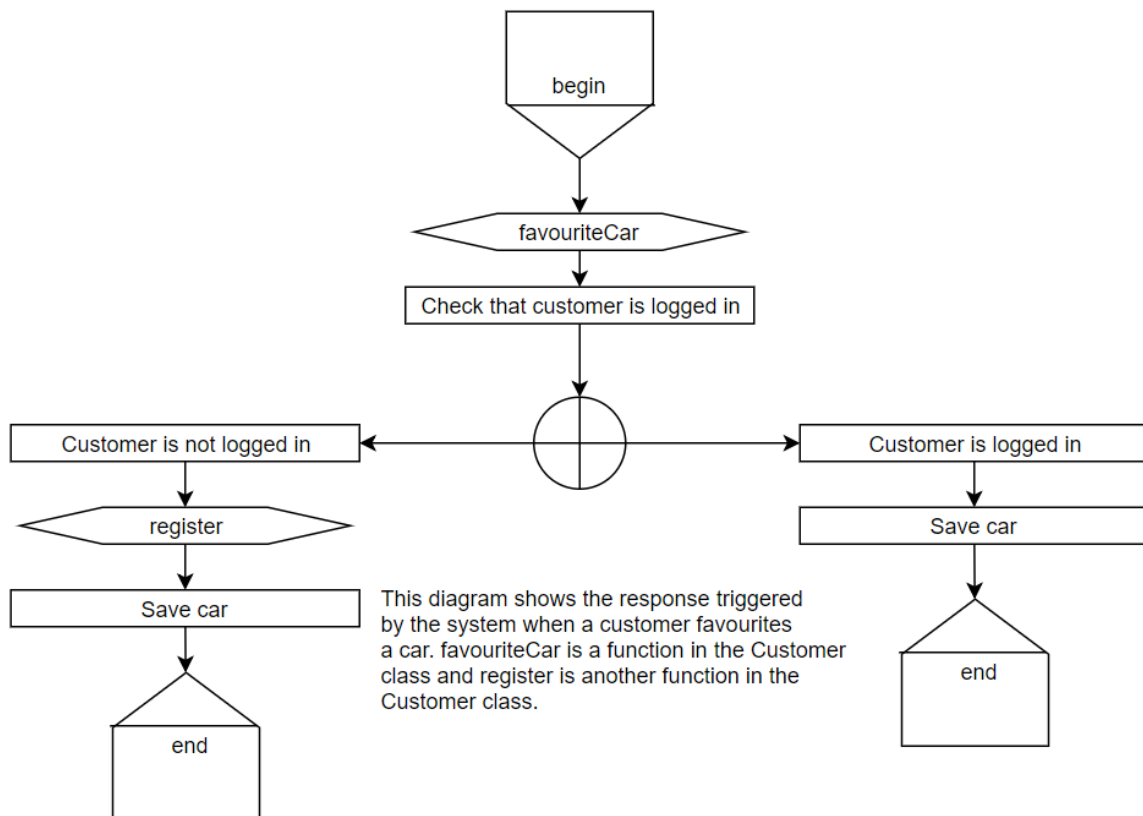
The above two diagrams break down the two processes; 4.1.14 focus solely on a customer saving a car; 4.1.15 focuses solely on a manager viewing statistics. This kind of diagram was chosen for both processes as they best showcase the use cases where the database must be accessed to retrieve or store information for the user.

#### 4.1.16: SM Diagram for Vehicle



The above diagram shows the potential states of the Car data class in the system. This diagram was chosen because it best describes the properties of the Car data class in the system, which is one of the most important data pieces in the entire system.

#### 4.1.17: R-Net Diagram for Customer Marking a Car as Favorite



The above diagram shows system actions and responses that occur as a customer marks a car as a favourite. This diagram was chosen because shows the key control flow that occurs in the system when the customer makes these selections.

## 4.2 Appendix B: Exhaustive List of Use Cases

All pages contain:

- Logo (clickable. If logged in, redirects to page 2. Else, redirects to page 1)
- Back button (except for home page)

### Page 1 (Same for all account types)

1. Log in
  - a. Enter email, password
  - b. GOTO Page 2
2. Register
  - a. Choose email, password, dealership, gender\*, age\*, billing address\*, phone, current vehicle, DND hours\* (\* = optional)
  - b. GOTO Customer Page 2
3. Choose Dealership
  - a. Search by city, dealership name (unified search bar)
  - b. GOTO Customer Page 2

## Customer

All pages contain:

- Either login button or my account button

### Page 2: Vehicle Search

1. Search for vehicle
2. If logged in - Browse saved favourites
3. GOTO Page 3

### Page 3: View Vehicles

1. Can scroll through vehicles matching results
2. View: Make, model, price, discounts (if any), year, new/used, kms (if used)
3. Click on vehicle: GOTO Page 4

### Page 4: View specific vehicle

1. See 2 pictures of vehicle: one of inside, one of outside
2. See all functional requirements of vehicle
3. If logged in - "Save as favourite" button
4. See color palette with all color options - interactive. Images change by clicking on colors (Note that every color selection gets sent to database for data analysis)

### Page 5: My account

1. Editable fields with all fields available in create account screen
2. Save + cancel buttons

# Sales Representative

## Page 2: Customer Search

1. Search for customer by name, email
2. Get list of results
  - a. Click on a customer: GOTO Page 3

## Page 3: Customer Page (\* = editable)

1. Button: View customer contact information - GOTO Page 4
2. Section: Quick Look: Sales rep assigned to customer, customer's reservations
3. Button: Associate me with this customer
4. Button: Details: GOTO page 5
5. Button: Record sale: Pop-up: required to select which reservation, or not from reservations: GOTO page 6
6. Section: Notes\* (these are searchable by keywords)

## Page 4: Customer Contact Information

1. Customer email, phone, DND hours
2. Button: Customer Details: GOTO Page 5

## Page 5: Customer Details

1. Customer's favourites, current vehicle, purchase history, payment preferences\*, notes (can add notes but not edit)

## Page 6: Record Sale Page

1. Required to fill out all the following info, (prefilled if there was a reservation):
  - a. Vehicle ID (from vehicle database: encodes price, make, model, year, all functional reqs), colors, customer email (prefilled), payment method, sales rep (prefilled)

# Dealership Manager

## Page 2: Manager Landing Page

1. Button: View Statistics - GOTO Page 3
2. Button: Manage Staff Accounts - GOTO Page 4
3. Button: Switch to sales view - GOTO Sales Rep Page 2, add "back to management view" button
4. Button: Manage Vehicles - GOTO Page 9

## Page 3: Statistics

1. View purchasing and color selection statistics

**Page 4: Manage Staff Accounts**

1. Button: Add new account - GOTO Page 5
2. Button: Edit existing account - GOTO Page 6
3. Button: Delete existing account - GOTO Page 6

**Page 5: New Staff Account**

1. Fields to fill in: Name, email, password, staff ID (not editable - assigned by the system), manager (boolean)
2. Button: Confirm
3. Button: Cancel

**Page 6: Search for existing account**

1. Search bar: find existing account
2. Section: search results
3. If came here from edit button: GOTO page 7
4. If came here from delete button: GOTO page 8

**Page 7: Edit existing account**

1. Page 5 with pre-filled fields

**Page 8: Delete existing account**

1. ARE YOU SURE?
2. Buttons: yes/no
3. Reset account password to random string

**Page 9: Manage Vehicles**

1. Button: Add Vehicle - GOTO Page 10
2. Button: Edit Existing Vehicle - GOTO Page 11

**Page 10: Add Vehicle**

1. Searchable drop down menu: All vehicles in Canada-wide system
2. Drop down (select all that apply) menu based on previous selection: Color options offered at this dealership
3. Input: Price
4. Input: Discount
5. Buttons: Save or Cancel

**Page 11: Edit Existing Vehicle**

1. Drop down: Color options offered at this dealership
2. Input: Price
3. Input: Discount
4. Buttons: Save or Cancel

## 4.3 Appendix C: Data Collection Records

### 4.3.1: First Interview Data: CADA Sales Manager

#### Interview 1: Zahra

- Similar project but roles are different
- Sales manager at calgary dealership representing CADA
- Customer sets for in dealership
  - Sales person gets assigned
  - Tries to help with choosing car
  - Takes 2-5 visits
  - At the end there is a purchase
- How will system help doing job
  - Mostly color choices
  - Same as last time
    - Brochures are not enough
- An account will be needed
  - We will need 3 levels of accounts for staff:
    - Service manager, owner of dealership
- Data that needs to be kept - majority of what she knows
  - Name, gender, age, contact info, billing address, phone etc.
  - 20 digit customer id to all customers including potential customers
  - Customer can log in
    - Can also use web browser as a guest
  - Should be able to integrate with databases for other dealerships
  - Login database is what we are hosting
    - We design the database
    - Server responsibility can be negotiated
  - Additional data for each customer
    - Latest purchase or car
      - Brand, year, color, design, picture profile, price range before and after discount
    - Financing options - down payment, loans etc for desired cars
      - Not just with us, keeps track of total car purchase records
    - Most recent purchase is not just with us
      - Don't care who they purchase from
    - Visit history for customers (how many times needed to purchase car)
      - Designated sales person associated with each customer
        - 10 digit id of the sales person
        - Each customer has a unique sales person
  - Owner and Manager wants to have full access
    - Security flag should be set when their information is modified
    - Can add to history but cannot modify history

- Nobody can modify visit history
- Sales person
  - Cannot modify but can add - flagged if they modify
  - Can also add information to desired price range / colour / customization options
- Last person - has to do with loans????
  - Looks at visit history
- Anyone can add visit history and desired information
- Designated sales person should be notified if there is a change in the database regarding a customer
- Owner and manager should not be in charge of database
- The database regarding colors and cars are from manufacturers
  - Separate from our database
  - Selection of color combination must be automatically recorded
    - Should have more than option - can choose maybe three combinations

#### 4.3.2: Second Interview Data: User Interface Expert

##### Interview 2

- Ui should be intuitive
  - We define this
  - Explain how this is done in the report
  - Must have graphic displays of color palettes
  - Must be able to paint selected color onto interior and exterior
  - Each color user picks must be recorded - selected into customer account
  - System should also interact with the database
    - Less than 100 ms for timing when accessing database
      - Database interactions store customer ID,
- Same UI for everyone
- What are we modelling with this info (NATHAN THINKS: use case for customer: buttons you can press: Use case models)
  - We need to color car - apparently all we need
- How many pages are needed aside from main page
  - Should have more pages - also have buttons
    - Can use anything i want for page design
  - Generating on screen
    - Less than 7 items per screen
      - One button is an item - text box is another item
  - Attract attention of customer
    - Use bolded font
- GUI must be simple and easy to follow (SUPER IMPORTANT AND TALKED ABOUT LOTS)
- If guest, don't store choices



- Items to have on each screen - up to us
  - Use this model such that it would be more intuitive
    - Explain this in the report (provide justification for layout choices and detail how it looks)
- Other things for customer to do on the site - list of specific use cases
  - Nothing special
  - Different people should have different accounts
  - I can use 3D picture or a real picture
  - Main focus is completely on coloring the car
- Intuitive is very important
- Graphic displays of color palettes (for website)
- Visual displays of visual and exterior
  - Up to use if we want it to be combined or have an option for both interior and exterior
    - Just have the reason of why I made it be separate
    - Dropdown menu is one item
- Record information of selected color under customers

#### 4.3.3: Third Interview Data: CADA Senior Service Employee

##### Interview 3: CADA - Senior service person

- Represents CADA - senior service person at dealership
- First meeting is about the main functionality of the whole system
- Details were revealed from last interview
  - We hope you can record the final color combinations into the database (create a purchase history)
  - Save exterior and interior
- Sales person will use this for their work - can recommend old models?
  - Create account for customer (name, gender, age, contact, available times [when to call], current vehicle (color, etc), current and expected maintenance)
  - Email, phone number
  - Record their available time
  - Record information of all their old cars
    - Model brand, how much they are willing to pay for maintenance
    - Desired discount, desired price, how they want to pay for automobile
  - How: 4 Types of information? Easy for sales people to see it/edit
  - Chat with customer - choose the category
    - Have options and choose options
    - Basically make it easy for sales person to pull up customer info
    - Have a window to type in extra information - something like a note
    - Just a starting idea - **we can change this** and make it better
  - I want to see a list of customers when i login and see all their specific information - for the salesperson

- Specific - customer can connect to specific dealership
  - Don't just connect them to every dealership
  - We hope customer can access their account at home
    - Can only modify their private information (probably don't want customer to see how much data we are collecting about them?)
- I want to be able to login and write a note about the customer while i'm talking to them
- No cost information is provided here
- Quality is number one and cost is a small thing in terms of this project
- 3 or 4 levels of accounts because of admins and people
  - We want different access levels
- Top admins cannot modify existing information
- Service manager and owner can create reports

NOTE FROM NATHAN:

I think what the below is saying is just that the customer is not able to see all the data we've collected about them. It's a single account, and a single account in the database, but the items that a salesperson (or higher) can see about a customer are very different than the items a customer can see about themselves

- Each user should have 2 accounts in the background???
  - Customer can access account and sales person (designated) can also access a customer account
    - Maybe 2 accounts for one customer
    - 2 user interfaces then
      - One for users while the other is for sales person
    - Other sales person shouldn't be able to access this customer's account
  - Make everything reasonable
    - If the whole logic is good we'll get full marks

#### 4.3.4: Fourth Interview Data: User Interface Consultant

Stanley - Interview 4: UI consultant

- Represents user experience with the firm - consultant?
- What is the UI supposed to look like on the dealership side?
  - No constraints on the dealership side
  - Very few hard requirements
  - Principle thing is to keep it simple and intuitive (include a definition of intuitive)
- SalesPerson:
  - See customer data
  - Manager owner perspective
    - Data analysis presumably?

- Modify available car models and colors associated (this contradicts what we were told earlier)
- Customer could come in without knowing about the software
  - So salesperson account should be able to guide the customer along
    - So should include most customer functionalities
      - This is not needed for upper management levels
- Strict UI requirements
  - Nothing at all - make sure it looks clean - make a clean UML
- Showing color palettes to customer
  - 3D modelling is preferred
  - 2D static pictures can also work?
  - Just choose one and justify it
- No cost information once again
- Use icons to represent thing
  - Be careful what icons to use due to different interpretation of icons
  - Make purpose of application obvious
- We can use the logos for all the car models
- Use CADA logo in the corner of our software
- Customers at one dealership should not be able to see models from other dealerships - separate
- Owner should be able to see what models and colors are popular - data analysis interface for seeing statistics and etc (in their dealership specifically)
- We have access to all dealership information
- Is there a website users can use online
  - Is not needed for a dealership specific site
  - Requirements are the same as previously mentioned requirements
  - Login first or last?
    - Depends on which one is more user friendly