ICS220 Program. Fund.

Assignment 1: Software Modelling - UML Use Case and UML Class diagrams  
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***UML Use-Case Diagram***

**Customer**: This is the person that initiates the system

**Mechanic**: This is the person that will take care of fixing/repairing a customers’ car. Therefore, they interact with the use case “request service” to know what services the user requested, and they interact with the use case “repair vehicle” to know what request they must process and how many vehicles they must repair.

Diagram

Description automatically generated

***UML Use-Case Descriptions:***

Upon entering the garage, the garage clerks register the customer into the system. Once the customer is registered with their personal details and vehicle details, they can be authenticated and proceed to request a service via the system. Once the customer requests a service, they are given a request ID which can be used by the customer, the garage clerk, and the mechanic for reference. The next step involves the mechanic signaling to the system they are ready to repair a vehicle and they get all the requests ID. Therefore, the mechanic can start repairing vehicles as per the customer’s request. Finally, the customer asks the garage clerk for their bill and their total price is calculated and displayed in the form of a receipt.

**Customer Registration:** This use case represents the start of the customers journey when it comes to repairing their vehicle. The way this use case works is that a garage clerk registers the customer via their cell phone number. When the customer is being registered, they provide their personal details and vehicle details to be stored for future reference.

**Customer Authentication:** The customers credentials are authenticated before they can use the system

**Request Services:** This use case represents the steps taken when the customer decides that they want to request specific services to be done on their vehicle. In this use case the customer is also provided with a request ID which can also be accessed by the mechanic and garage clerk for references.

**Repairing Vehicle:** In this use case the mechanic accesses the request of users to see what work he/she has ahead of him/her. They are also able to update the status of customers’ requests in this use case

**Bill Management:** This use case is triggered when the customer asks for their receipt. The garage clerk searches the system for the customers information, their vehicle information, the mechanic information, the requested services, and calculating the discounts if applicable

**Apply discount:** This use case is extended in the case that the customer wants a discount and has a loyalty card

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| --- | --- |
| Use Case | Customer registration |
| Trigger | The customer wants to be registered into the system |
| Main Scenario: |  |
|  | The customer signals to the garage clerk that they want to be registered into the system |
|  | The garage clerk asks the customer for their cell phone number |
|  | The customers give the garage clerk their cell phone number |
|  | The garage clerk asks the customer their personal details |
|  | The customer gives the garage clerk their personal details |
|  | The garage clerk enters the customers personal details into the system |
|  | The garage clerk asks the customers for their vehicle details |
|  | The customers give the garage clerk their vehicle details |
|  | The garage clerk enters the vehicle details into the system |
|  | The garage clerk asks the customer to verify the details |
|  | The customer verifies the details |
|  | The garage clerk saves the customers registration |
|  | The garage clerk allows the customer to enter their password |
|  | The customer enters their password |
|  | The garage clerk saves the customers registration |
|  | The customer is successfully registered |
| Exceptions: |  |
| 10a. | 1. There is a mistake in the details entered by the garage clerk 2. The customer asks the garage clerk to fix the mistake |
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| --- | --- |
| Use Case | Authenticate Customer |
| Trigger | The system needs to authenticate the customer |
| Precondition: | The customer is registered with the garage clerk |
| Main Scenario: |  |
|  | The systems ask the customer to enter their credentials to be authenticated |
|  | The user enters their credentials |
|  | The system verifies the entered credentials |
| Exceptions: |  |
| 2a. | 1. The user enters the wrong credentials 2. The system displays an error message 3. The user is asked to re-enter their credentials |

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| Use Case | Requesting Services |
| Trigger | The customer wants to request a service from the garage |
| Main Scenario: |  |
|  | <<Invoke Authenticate Customer use case>> |
|  | The customer signals to the system that they want to request a service from the garage |
|  | The system searches for the customers vehicle information |
|  | The system displays customers vehicle information |
|  | The customer verifies their vehicle information |
|  | The system asks the user to pick from the available services |
|  | The customer picks from the available services |
|  | The system asks the user to confirm their chosen service/s |
|  | The system asks the user to select the date and time for the service/s |
|  | The user selects the date and time that is convenient for them |
|  | The system verifies the chosen date and time |
|  | The system finalizes the service request produces a request confirmation and a request ID for the customer |
| Exceptions: |  |
| 7a. | 1. The desired service is not available 2. Use case is terminated |
| 9a. | 1. The selected date/time is unavailable 2. The user is projected with an error message 3. The user chooses a different date/time else the use case is terminated |

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| Use Case | Repair Vehicle |
| Trigger: | The mechanic is ready to repair the vehicles |
| Main Scenario: |  |
|  | Mechanic signals to the system that they are ready to repair a vehicle |
|  | The system finds and displays the request IDs |
|  | The mechanic approves the request ID |
|  | The mechanic repairs the vehicle |
|  | The mechanic updates the request status to “Vehicle Repaired” |
| Exceptions: |  |
| 2a. | 1. There are no current requests 2. The use case terminates |

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| Use Case | Billing Management |
| Trigger | The customer wants a receipt of their service |
| Pre-condition |  |
| Main Scenario: |  |
|  | The customer signals to the garage clerk that they want the bill to the services |
|  | The customers provide the garage clerk with their cell phone number |
|  | The garage clerk searches for the customer person details and vehicle details through their cell phone number |
|  | The garage clerk enters the details into the receipt |
|  | The garage clerk enters today’s date into the receipt |
|  | The garage clerk asks the customers for the request ID |
|  | The customer gives the garage clerk the request ID |
|  | The garage clerk enters the request ID into the system to find the users request |
|  | The garage clerk asks the customer to confirm that these are his/her requested service/s |
|  | The customer confirms his/her requested service/s |
|  | The system adds up the services requested by the user with their respective prices |
|  | The system calculates the tax |
|  | >>Extends Apply Discount use case << |
|  | The system calculates the final price of the respective services requested with the tax and discounted amount if extended |
|  | The system displays the final receipt |
| Exceptions: |  |
| 8a. | 1. The garage clerk enters the wrong request ID 2. The garage clerk asks the user for their request ID again 3. The garage clerk re-enters the request ID |
| 10a. | 1. In the case that these are not the customers requested services 2. The garage clerk asks the customer to provide their request ID 3. The garage clerk checks the system via the request ID what services the customer requested |

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| --- | --- |
| Use Case | Apply Discount |
| Trigger | The customer wants to add a discount |
| Pre-condition | The customer must have requested a receipt for their chosen service/s |
| Main Scenario: |  |
|  | The garage clerk asks the customer to provide their loyalty card |
|  | The customer provides their loyalty card |
|  | The garage clerk verifies the loyalty card |
|  | The garage clerk adds discounted amount into the receipt |
| Exceptions: |  |
| 2a. | 1. The loyalty card provided by the user is invalid or expired 2. The system produces an error message 3. The garage clerk asks the user to re-enter the loyalty card details else, the use case is terminated |

***Classes:***

I have identified these 6 classes that will be necessary to print the data/information on the bill.

***These 6 classes are:***

* Person, Customer, Mechanic, Vehicle, Car, and Service

***Relationships Between Classes***

***Customer and Mechanic inherits from Person and Car inherits from Vehicle:***

Inheritance occurs between the class person and the classes customer and mechanic. Mechanic is a Person and Customer is a Person. Both mechanic and customer classes inherit all the attributes of person and have their own attributes.

Moreover, the vehicle class and car class where the vehicle is the parent class and car are the child class. Car is a Vehicle. Car inherits all the attributes from vehicle and has its own attributes too!

***Relationship between Customer and Mechanic:***

Moreover, we can see a binary association between customer and mechanic. A customer can have no mechanic, or many mechanics helping repair their vehicle. They can have no mechanic if their request is yet to be processed and they can have multiple mechanics repairing their vehicle if the job needs several mechanics. Similarly, a mechanic can have no customers or multiple customers. They can have no customers if it is a slow day with not many customers coming into the garage and they can have multiple customers if it’s a busy day with many customers coming in to repair their vehicles. Therefore, we can see a many to many binary associations between these two classes.

***Relationship between Customer and Service:***

Additionally, we can see a binary association between service and customer. A customer can request multiple services and in the same way a service can be requested by multiple customers. Therefore, we can see a many to many binary associations between these two classes.

***Relationship between Mechanic and Service:***

Furthermore, one mechanic can provide multiple types of services, and many mechanics can provide the same type of service. Therefore, we can see a many to many binary associations between these two classes.

**UML Class Diagrams:**

Diagram

Description automatically generated

***Objects:***

***Text

Description automatically generated with medium confidence***

***Table

Description automatically generated***

***Code for creating classes and the objects:***

from enum import Enum

# Define Gender as an Enum

class Gender(Enum):

MALE = 'Male'

FEMALE = 'Female'

class Person: #define the class (this will be a parent class)

# initialize the class objects with the specified attributes

def \_\_init\_\_(self, firstName, lastName, gender, dateOfBirth, email):

self.\_firstName = firstName

self.\_lastName = lastName

self.\_gender = gender

self.\_dateOfBirth = dateOfBirth

self.\_email = email

# create setters and getters for each of the attributes defined above

def setFirstName(self, firstName):

self.\_firstName = firstName

def getFirstName(self):

return self.\_firstName

def setLastName(self, lastName):

self.\_lastName = lastName

def getLastName(self):

return self.\_lastName

def setGender(self, gender):

self.\_gender = gender

def getGender(self):

return self.\_gender

def setDateOfBirth(self, dateOfBirth):

self.\_dateOfBirth = dateOfBirth

def getDateOfBirth(self):

return self.\_dateOfBirth

def setEmail(self, email):

self.\_email = email

def getEmail(self):

return self.\_email

def \_\_str\_\_(self):

return "First Name: " + self.\_firstName + ", Last Name: " + self.\_lastName + ", Gender: " + str(self.\_gender) + ", Date of Birth: " + str(self.\_dateOfBirth) + ", Email: " + self.\_email

class Customer(Person): #define the child class

# initialize the class objects with the specified attributes

def \_\_init\_\_(self, firstName, lastName, gender, dateOfBirth, email, cellPhoneNumber):

super().\_\_init\_\_(firstName, lastName, gender, dateOfBirth, email)

self.\_cellPhoneNumber = cellPhoneNumber

# create setters and getters for each of the attributes defined above

def setCellPhoneNumber(self, cellPhoneNumber):

self.\_cellPhoneNumber = cellPhoneNumber

def getCellPhoneNumber(self):

return self.\_cellPhoneNumber

def \_\_str\_\_(self):

return super().\_\_str\_\_() + ", Cell Phone Number: " + self.\_cellPhoneNumber

class Mechanic(Person): #define the child class class

# initialize the class objects with the specified attributes

def \_\_init\_\_(self, firstName, lastName, gender, dateOfBirth, email, mechanicID):

super().\_\_init\_\_(firstName, lastName, gender, dateOfBirth, email)

self.\_mechanicID = mechanicID

# create setters and getters for each of the attributes defined above

def setMechanicID(self, mechanicID):

self.\_mechanicID = mechanicID

def getMechanicID(self):

return self.\_mechanicID

def \_\_str\_\_(self):

return super().\_\_str\_\_() + ", Mechanic ID: " + self.\_mechanicID

# Define EngineType as an Enum

class EngineType(Enum):

Gasoline = 'Gasoline'

Diesel = 'Diesel'

Electric = 'Electric'

Hybrid = 'Hybrid'

class Vehicle: #define the class vehicle (this will be a parent class)

# initialize the class objects with the specified attributes

def \_\_init\_\_(self, vehicleID, make, model, yearOfModel, color, engineType):

self.\_vehicleID = vehicleID

self.\_make = make

self.\_model = model

self.\_yearOfModel = yearOfModel

self.\_color = color

self.\_engineType = engineType

# create setters and getters for each of the attributes defined above

def setVehicleID(self, vehicleID):

self.\_vehicleID = vehicleID

def getVehicleID(self):

return self.\_vehicleID

def setMake(self, make):

self.\_make = make

def getMake(self):

return self.\_make

def setModel(self, model):

self.\_model = model

def getModel(self):

return self.\_model

def setYearOfModel(self, yearOfModel):

self.\_yearOfModel = yearOfModel

def getYearOfModel(self):

return self.\_yearOfModel

def setColor(self, color):

self.\_color = color

def getColor(self):

return self.\_color

def setEngineType(self, engineType):

self.\_engineType = engineType

def getEngineType(self):

return self.\_engineType

def \_\_str\_\_(self):

return "Vehicle ID: "+str(self.\_vehicleID)+", Make: "+self.\_make+", Model: "+self.\_model+", Year of Model: "+str(self.\_yearOfModel)+", Color: "+self.\_color+", Engine Type: "+self.\_engineType.value

#Define NumberOfDoors as enum

class NumberOfDoors(Enum):

TWO = '2 Doors'

FOUR = '4 Doors'

class Car(Vehicle): #define the child class class

# initialize the class objects with the specified attributes

def \_\_init\_\_(self, vehicleID, make, model, yearOfModel, color, engineType, numberOfDoors):

super().\_\_init\_\_(vehicleID, make, model, yearOfModel, color, engineType)

self.\_numberOfDoors = numberOfDoors

# create setters and getters for each of the attributes defined above

def setNumberOfDoors(self, numberOfDoors):

self.\_numberOfDoors = numberOfDoors

def getNumberOfDoors(self):

return self.\_numberOfDoors

def \_\_str\_\_(self):

return "Vehicle ID: "+str(self.\_vehicleID)+", Make: "+self.\_make+", Model: "+self.\_model+", Year of Model: "+str(self.\_yearOfModel)+", Color: "+self.\_color+", Engine Type: "+self.\_engineType.value+", Number of Doors: "+self.\_numberOfDoors.value

#Define NumberOfMechanics as enum

class NumberOfMechanics(Enum):

ONE = 1

TWO = 2

THREE = 3

FOUR = 4

FIVE\_OR\_MORE = 5

class Service: #define the class

# initialize the class objects with the specified attributes

def \_\_init\_\_(self, name, description, price, approximateDuration, numberOfMechanics):

self.\_name = name

self.\_description = description

self.\_price = price

self.\_approximateDuration = approximateDuration

self.\_numberOfMechanics = numberOfMechanics

# create setters and getters for each of the attributes defined above

def setName(self, name):

self.\_name = name

def getName(self):

return self.\_name

def setDescription(self, description):

self.\_description = description

def getDescription(self):

return self.\_description

def setPrice(self, price):

self.\_price = price

def getPrice(self):

return self.\_price

def setApproximateDuration(self, approximateDuration):

self.\_approximateDuration = approximateDuration

def getApproximateDuration(self):

return self.\_approximateDuration

def setNumberOfMechanics(self, numberOfMechanics):

self.\_numberOfMechanics = numberOfMechanics

def getNumberOfMechanics(self):

return self.\_numberOfMechanics

def \_\_str\_\_(self):

return "Name: "+self.\_name+", Description: "+self.\_description+", Price: "+str(self.\_price)+", Approximate Duration: "+str(self.\_approximateDuration)+" hours, Number of Mechanics Required: "+str(self.\_numberOfMechanics.value)

#Customer object with the given attributes

customer = Customer(firstName="James", lastName="Jones", gender=Gender.MALE.name, dateOfBirth="16/04/1992", email="james.jones@gmail.com", cellPhoneNumber="816-897-9862")

print(customer)

#Mechanic object with the given attributes

mechanic = Mechanic(firstName="Hans", lastName="K", gender=Gender.MALE.name, dateOfBirth=[21, 3, 1989], email="hans.k@gmail.com", mechanicID="00012891456")

print(mechanic)

#Car object with the given attributes

car = Car(vehicleID="AD-89034", make="Nissan", model="Altima", yearOfModel=[2014], color="Silver", engineType=EngineType.Gasoline, numberOfDoors=NumberOfDoors.FOUR)

print(car)

#Service object with the given attributes

service = Service(name="Oil Replacement", description="This is the process of removing old dirty oil from the vehicle and replacing it with clean oil", price=120.00, approximateDuration=0.75, numberOfMechanics=NumberOfMechanics.ONE)

print(service)

***The output which is printing the objects created:***

First Name: James, Last Name: Jones, Gender: MALE, Date of Birth: 16/04/1992, Email: [james.jones@gmail.com](mailto:james.jones@gmail.com), Cell Phone Number: 816-897-9862

First Name: Hans, Last Name: K, Gender: MALE, Date of Birth: [21, 3, 1989], Email: [hans.k@gmail.com](mailto:hans.k@gmail.com), Mechanic ID: 00012891456

Vehicle ID: AD-89034, Make: Nissan, Model: Altima, Year of Model: [2014], Color: Silver, Engine Type: Gasoline, Number of Doors: 4 Doors

Name: Oil Replacement, Description: This is the process of removing old dirty oil from the vehicle and replacing it with clean oil, Price: 120.0, Approximate Duration: 0.75 hours, Number of Mechanics Required: 1

Name: Diagnostics, Description: This is the process of checking a vehicle's systems and components to help identify issues and rectify them., Price: 15.0, Approximate Duration: 1.0 hours, Number of Mechanics Required: 1

Name: OilFilterParts, Description: This is the of buying the necessary parts for an oil filter change., Price: 35.0, Approximate Duration: 0.25 hours, Number of Mechanics Required: 1

Name: Tire Replacement, Description: This is the process of changing a faulty/damaged tire, Price: 100.0, Approximate Duration: 1.0 hours, Number of Mechanics Required: 2

Name: Tire, Description: This is the process of buying a new tire, Price: 160.0, Approximate Duration: 0.5 hours, Number of Mechanics Required: 1

***Summary of learning:***

I believe that this assignment helped me put my knowledge to test. I was able to reflect on the different topics we have learned and apply them to a specific real-world scenario. This was an assignment that I was extremely invested and excited about because it maps out the beginning of my journey in creating object-oriented programs. Upon learning about how to create classes and instances of classes I was able to deduce the scenario in the assignment and think about it from a programmer’s perspective. I had so many different ideas of different implementations of the billing system however at the end I was able to choose the ideas that felt the most systematic and efficient (in terms of use cases).

Additionally, the use cases I write were effective because I went through different drafts, and I tried to envision my place in that situation where I have to take my car to the garage. By putting myself in that scenario making the use case became easier because I could clearly see the different steps that I must take (scenarios of each use case) and where things can potentially go wrong (exceptions).

Furthermore, in terms of relationships I was hesitant at first to identify the different relationships apart from inheritance because they were newly introduced. However, by examining the classes, objects, and the context it became easier to identify associations between several classes.

This assignment consisted of several drafts which is shown in the GitHub repository link. This represents my gradually progression on this assignment. I made sure that my work was precise

I learned how turn my ideas of the billing system into a well-documented and running python code. I was able to create the different classes with their attributes and create instances of these the classes. Additionally, I learned that by having child classes inherit from parent classes it made writing the code easier, and more manageable. This is because I did not have to repeat huge chunks of code instead, I could use the super().

***Github repository:***

Link: <https://github.com/aishalihwaidi/Assignment-1-ICS-220>