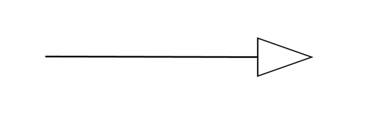
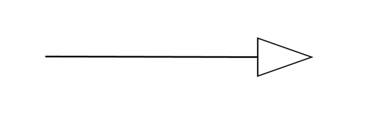
**UML class diagram:**

|  |
| --- |
| Employee |
| -department: str  -jobTitle: str  -basicSalary: int |
| Beth yw Diagram UML: Gan gynnwys Saeth a Symbol Diagram UML+displayDetails(): str |

|  |
| --- |
| Person |
| -id: int  -name: str  -dob: datetime  -age: int  -passportDetails: str |
| +displayDetails(): str |



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|  |
| --- |
| Manager |
| -salespersons: List[Salesperson] |
| +addSalesperson(salesperson: Salesperson)  +removeSalesperson(salesperson: Salesperson)  +displayDetails(): str |

|  |
| --- |
| Salesperson |
| -sales: List[Sale] |
| +addSale(sale: Sale)  +calculateCommission(): int  +displayDetails(): str |

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|  |
| --- |
| Sale |
| -salesperson: Salesperson  -car: Car  -salePrice: int  -saleDate: datetime.date |
| +\_\_str\_\_(): str |

|  |
| --- |
| Car |
| -id: int  -name: str  -price: int  -type: str  -fuelCapacity: int  -maxSpeed: int  -color: str |
| +displayDetails(): str |

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|  |
| --- |
| Application |
| -employees  -cars |
| +showEmployeeDetails  +showCarDetails  +showSalesDetails |



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**Description:**

* Application has a 0-to-many relationship with Employee, as an application instance can manage multiple employees (which includes Managers and Salespersons).
* Application has a 0-to-many relationship with Car, as an application instance can manage multiple cars.
* Manager has a 0-to-many aggregation relationship with Salesperson, as one manager can supervise multiple salespersons, but a salesperson might not have a manager assigned.
* Salesperson has a 0-to-many composition relationship with Sale, as one salesperson can have multiple sales, but it's also possible that a salesperson hasn't made any sales.
* Sale has a 1-to-1 relationship with Car, as each sale is linked to a single car.

Inheritance relationships:

* Employee inherits from the Person class.
* Manager and Salesperson inherit from the Employee class. This indicates that these classes share common attributes and behaviors with the Employee class.

Aggregation relationship:

* The Manager class has an aggregation relationship with the Salesperson class. This means that a Manager object can have multiple Salesperson objects associated with it. If a Manager object is destroyed, the associated Salesperson objects are not destroyed but can exist independently.

Composition relationship:

* There is a composition relationship between Salesperson and Sale class. The Salesperson class has a list of Sale objects called sales. This list represents the sales made by the salesperson. The salesperson object owns these sales, and when the salesperson object is destroyed, the sales associated with that salesperson will also be destroyed.

Association relationships:

* The Sale class is associated with Car class. This means that a Sale object is connected to a Car object (which was sold).
* The Application class is associated with both the Employee and Car classes. This means that the Application object interacts with multiple instances of Employee and Car objects.

**Assumptions:**

* An Employee object can be a Manager or a Salesperson.
* A Manager can have multiple Salesperson objects associated with them.
* A Salesperson can have multiple Sale objects associated with them.
* Each Sale object is associated with exactly one Salesperson and one Car.
* The Application object interacts with multiple Employee and Car objects but does not own them.

**Python:**

import tkinter as tk  
import pickle  
import datetime  
from typing import List  
from enum import Enum  
  
  
class CarType(Enum):  
 Hatch = 1  
 Sedan = 2  
 SUV = 3  
  
  
# Person class definition  
class Person:  
 # Constructor method for the Person class  
 def \_\_init\_\_(self, id: int, name: str, dob: datetime.date, age: int, passportDetails: str):  
 self.id = id  
 self.name = name  
 self.dob = dob  
 self.age = age  
 self.passportDetails = passportDetails  
  
 # Method to display the details of a Person  
 def displayDetails(self) -> str:  
 return f"ID: {self.id}, Name: {self.name}, DOB: {self.dob}, Age: {self.age}, Passport Details: {self.passportDetails}"  
  
  
# Employee class definition (inherits from Person)  
class Employee(Person):  
 # Constructor method for the Employee class  
 def \_\_init\_\_(self, id: int, name: str, dob: datetime.date, age: int, passportDetails: str, department: str, jobTitle: str, basicSalary: int):  
 super().\_\_init\_\_(id, name, dob, age, passportDetails)  
 self.department = department  
 self.jobTitle = jobTitle  
 self.basicSalary = basicSalary  
  
 # Method to display the details of an Employee (overrides Person's displayDetails)  
 def displayDetails(self) -> str:  
 return f"{super().displayDetails()}, Department: {self.department}, Job Title: {self.jobTitle}, Basic Salary: {self.basicSalary}"  
  
  
# Car class definition  
class Car:  
 # Constructor method for the Car class  
 def \_\_init\_\_(self, id: int, name: str, price: int, type: str, fuelCapacity: int, maxSpeed: int, color: str):  
 self.id = id  
 self.name = name  
 self.price = price  
 self.type = type  
 self.fuelCapacity = fuelCapacity  
 self.maxSpeed = maxSpeed  
 self.color = color  
  
 # Method to display the details of a Car  
 def displayDetails(self) -> str:  
 return f"ID: {self.id}, Name: {self.name}, Price: {self.price}, Type: {self.type}, Fuel Capacity: {self.fuelCapacity}, Max Speed: {self.maxSpeed}, Color: {self.color}"  
  
# Manager class definition (inherits from Employee)  
class Manager(Employee):  
 # Constructor method for the Manager class  
 def \_\_init\_\_(self, id: int, name: str, dob: datetime.date, age: int, passportDetails: str, department: str, jobTitle: str, basicSalary: int):  
 super().\_\_init\_\_(id, name, dob, age, passportDetails, department, jobTitle, basicSalary)  
 self.salespersons: List[Salesperson] = []  
  
 # Method to add a Salesperson to the Manager's list  
 def addSalesperson(self, salesperson):  
 self.salespersons.append(salesperson)  
  
 # Method to remove a Salesperson from the Manager's list  
 def removeSalesperson(self, salesperson):  
 self.salespersons.remove(salesperson)  
  
 # Method to display the details of a Manager (overrides Employee's display\_details)  
 def displayDetails(self) -> str:  
 return f"{super().displayDetails()}, Number of Salespersons: {len(self.salespersons)}"  
  
# Salesperson class definition (inherits from Employee)  
class Salesperson(Employee):  
 # Constructor method for the Salesperson class  
 def \_\_init\_\_(self, id: int, name: str, dob: datetime.date, age: int, passportDetails: str, department: str, jobTitle: str, basicSalary: int):  
 super().\_\_init\_\_(id, name, dob, age, passportDetails, department, jobTitle, basicSalary)  
 self.sales: List[Sale] = []  
  
 # Method to add a Sale to the Salesperson's list  
 def addSale(self, sale):  
 self.sales.append(sale)  
  
 # Method to calculate commission for the Salesperson  
 def calculateCommission(self) -> int:  
 commission = 0  
 for sale in self.sales:  
 profit = sale.salePrice - sale.car.price  
 commission += 0.065 \* profit  
 return commission  
  
 # Method to display the details of a Salesperson (overrides Employee's displayDetails)  
 def displayDetails(self) -> str:  
 return f"{super().displayDetails()}, Sales: {len(self.sales)}, Commission: {self.calculateCommission()}"  
  
# Sale class definition  
class Sale:  
 # Constructor method for the Sale class  
 def \_\_init\_\_(self, salesperson, car, salePrice: int, saleDate: datetime.date):  
 self.salesperson = salesperson  
 self.car = car  
 self.salePrice = salePrice  
 self.saleDate = saleDate  
 # Method to display the details of a Sale  
 def \_\_str\_\_(self):  
 return f"Salesperson ID: {self.salesperson.id}, Car ID: {self.car.id}, Sale Price: {self.salePrice}, Sale Date: {self.saleDate}"  
  
# Function to save data to a file  
def save\_data\_to\_file(data, filename):  
 with open(filename, 'wb') as file:  
 pickle.dump(data, file)  
  
# Function to load data from a file  
def load\_data\_from\_file(filename):  
 try:  
 with open(filename, 'rb') as file:  
 data = pickle.load(file)  
 return data  
 except FileNotFoundError:  
 return []  
  
# Function to find an employee by their ID  
def findEmployeeById(employees, id):  
 for employee in employees:  
 if employee.id == id:  
 return employee  
 return None  
  
# Function to find a car by its ID  
def findCarById(cars, id):  
 for car in cars:  
 if car.id == id:  
 return car  
 return None  
  
# Function to display employee details by their ID  
def displayEmployeeDetails(employees, id):  
 employee = findEmployeeById(employees, id)  
 if employee:  
 return employee.displayDetails()  
 else:  
 return "Employee not found"  
  
# Function to display car details by its ID  
def displayCarDetails(cars, id):  
 car = findCarById(cars, id)  
 if car:  
 return car.displayDetails()  
 else:  
 return "Car not found"  
  
# Function to display sales details of a salesperson by their ID  
def displaySalesDetails(employees, id):  
 employee = findEmployeeById(employees, id)  
 if employee and isinstance(employee, Salesperson):  
 salesDetails = [str(sale) for sale in employee.sales]  
 return "\n".join(salesDetails)  
 else:  
 return "Salesperson not found"  
  
# Function to calculate salaries for a manager and their salespersons  
def calculateSalaries(manager):  
 manager\_commission = 0  
 for salesperson in manager.salespersons:  
 for sale in salesperson.sales:  
 profit = sale.salePrice - sale.car.price  
 manager\_commission += 0.035 \* profit  
 manager\_salary = manager.basic\_salary + manager\_commission  
  
 salespersons\_salaries = {}  
 for salesperson in manager.salespersons:  
 commission = salesperson.calculate\_commission()  
 salespersons\_salaries[salesperson.name] = salesperson.basic\_salary + commission  
  
 return manager\_salary, salespersons\_salaries  
  
  
# Application class definition  
class Application(tk.Tk):  
 def \_\_init\_\_(self, employees, cars):  
 super().\_\_init\_\_()  
 self.title("Car Sales Management System")  
 self.geometry("800x600")  
 self.employees = employees  
 self.cars = cars  
  
  
 # Create widgets  
 self.label\_id = tk.Label(self, text="Enter ID:")  
 self.entry\_id = tk.Entry(self)  
 self.btn\_employee\_details = tk.Button(self, text="Show Employee Details", command=self.showEmployeeDetails)  
 self.btn\_car\_details = tk.Button(self, text="Show Car Details", command=self.showCarDetails)  
 self.btn\_sales\_details = tk.Button(self, text="Show Sales Details", command=self.showSalesDetails)  
 self.text\_output = tk.Text(self, wrap=tk.WORD)  
  
 # Layout widgets  
 self.label\_id.grid(row=0, column=0, padx=5, pady=5, sticky=tk.W)  
 self.entry\_id.grid(row=0, column=1, padx=5, pady=5, sticky=tk.W)  
 self.btn\_employee\_details.grid(row=1, column=0, padx=5, pady=5, sticky=tk.W)  
 self.btn\_car\_details.grid(row=1, column=1, padx=5, pady=5, sticky=tk.W)  
 self.btn\_sales\_details.grid(row=1, column=2, padx=5, pady=5, sticky=tk.W)  
 self.text\_output.grid(row=2, column=0, columnspan=3, padx=5, pady=5, sticky=tk.W + tk.E + tk.N + tk.S)  
  
 # Method to show employee details when the "Show Employee Details" button is clicked  
 def showEmployeeDetails(self):  
 id = int(self.entry\_id.get())  
 details = displayEmployeeDetails(self.employees, id)  
 self.text\_output.delete('1.0', tk.END)  
 self.text\_output.insert(tk.END, details)  
  
 # Method to show car details when the "Show Car Details" button is clicked  
 def showCarDetails(self):  
 id = int(self.entry\_id.get())  
 details = displayCarDetails(self.cars, id)  
 self.text\_output.delete('1.0', tk.END)  
 self.text\_output.insert(tk.END, details)  
  
 # Method to show sales details when the "Show Sales Details" button is clicked  
 def showSalesDetails(self):  
 id = int(self.entry\_id.get())  
 details = displaySalesDetails(self.employees, id)  
 self.text\_output.delete('1.0', tk.END)  
 self.text\_output.insert(tk.END, details)  
  
# Test cases  
susan = Manager(47899, "Susan Meyers", datetime.date(1978, 6, 12), 44, "123456789", "Accounting", "Manager", 37500)  
mark = Salesperson(39119, "Mark Jones", datetime.date(1989, 4, 30), 34, "987654321", "IT", "Salesperson", 26000)  
joy = Salesperson(81774, "Joy Rogers", datetime.date(1992, 12, 8), 30, "123987456", "Manufacturing", "Salesperson", 24000)  
  
susan.addSalesperson(mark)  
susan.addSalesperson(joy)  
  
jazz = Car(1, "Jazz VX3", 55000, "Hatch", 40, 180, "Blue")  
mark3 = Car(2, "Mark3 SX3", 84000, "Sedan", 50, 220, "Red")  
wagoner = Car(3, "Wagoner ZX3", 125000, "SUV", 60, 240, "Black")  
  
# Joy's sales  
joy.addSale(Sale(joy, wagoner, 155000, datetime.date(2023, 5, 4)))  
joy.addSale(Sale(joy, jazz, 57800, datetime.date(2023, 5, 5)))  
joy.addSale(Sale(joy, jazz, 55000, datetime.date(2023, 5, 10)))  
joy.addSale(Sale(joy, mark3, 89000, datetime.date(2023, 5, 15)))  
joy.addSale(Sale(joy, mark3, 93000, datetime.date(2023, 5, 20)))  
  
# Mark's sales  
mark.addSale(Sale(mark, jazz, 58000, datetime.date(2023, 5, 3)))  
mark.addSale(Sale(mark, jazz, 58000, datetime.date(2023, 5, 12)))  
mark.addSale(Sale(mark, wagoner, 158000, datetime.date(2023, 5, 18)))  
mark.addSale(Sale(mark, wagoner, 158000, datetime.date(2023, 5, 22)))  
mark.addSale(Sale(mark, wagoner, 158000, datetime.date(2023, 5, 25)))  
  
print(susan.displayDetails())  
print(mark.displayDetails())  
print(joy.displayDetails())  
  
print(jazz.displayDetails())  
print(mark3.displayDetails())  
print(wagoner.displayDetails())  
  
  
if \_\_name\_\_ == "\_\_main\_\_":  
 employees = [susan, mark, joy]  
 cars = [jazz, mark3, wagoner]  
 app = Application(employees, cars)  
 app.mainloop()

**Explanation:**

Classes:

1. CarType: An enumeration class to define car types.
2. Person: A class for a general person with attributes like id, name, date of birth, age, and passport details.
3. Employee: A subclass of Person representing employees with additional attributes like department, job title, and basic salary.
4. Car: A class for cars with attributes like id, name, price, type, fuel capacity, max speed, and color.
5. Manager: A subclass of Employee representing managers. It has an additional attribute, salespersons, to store the list of Salespersons managed by the manager.
6. Salesperson: A subclass of Employee representing salespersons. It has an additional attribute, sales, to store the list of sales made by the salesperson.
7. Sale: A class for sales with attributes like salesperson, car, sale price, and sale date.
8. Application: A tkinter-based GUI application class that allows users to view employee, car, and sales details.
   1. GUI Application: The Application class extends the tkinter Tk class to create a GUI for the Car Sales Management System. The GUI includes input fields, buttons, and a text area to display the information requested by the user.
   2. Button commands: The Application class has methods (showEmployeeDetails, showCarDetails, and showSalesDetails) that are executed when their corresponding buttons are clicked. These methods use the utility functions to fetch and display the relevant information in the text area.
9. Button commands: The Application class has methods (showEmployeeDetails, showCarDetails, and showSalesDetails) that are executed when their corresponding buttons are clicked. These methods use the utility functions to fetch and display the relevant information in the text area.

When a user interacts with the GUI, they can enter an ID and click the appropriate button to view employee details, car details, or sales details. The application will get the relevant information using the utility functions and display it in the text area.

**Github: https://github.com/alyalootah/Final**