ICS220 22873 Program. Fund.

Assignment 2: Software Implementation

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multiple branches
Each dental branch has an address, phone number, and a manager.

Scenario:

Consider the following problem statement:

A dental company, “Bright Smiles”, has multiple branches (i.e., dental clinics) and would like you to create a software application to help manage the business processes and dental services. Each dental branch has an address, phone number, and a manager. A dental branch offers dental services to patients. Examples of services include cleaning, implants, crowns, fillings, and more. Each of the services has a cost. The clinic keeps track of its patients and staff. The staff includes managers, receptionists, hygienists, and dentists. The patient needs to book an appointment before coming to the clinic. Upon checkout, the clinic charges the patient depending on the services she/he has received. Also, a 5% value-added tax (VAT) is added to the final bill.

Link Github
:https://github.com/shamsaalshu/Assignment-2-Software-Implementation-

1. DentalCompany:
    i. Name: string
    ii. branch:List[Branch]
2. Branch:
    - name :string
    - address:string
    - phone number:string
    - manager:Manger
    - dental services:List[Services]
    - patients:List[Patient]
    - staff:List[Staff]

3. Person:
- firstName: string
- lastName: string
- phoneNumber:string

- gender:Enum
- dateOfBirth:string

    a. Staff (inherits from Person):
        - employeeID:string

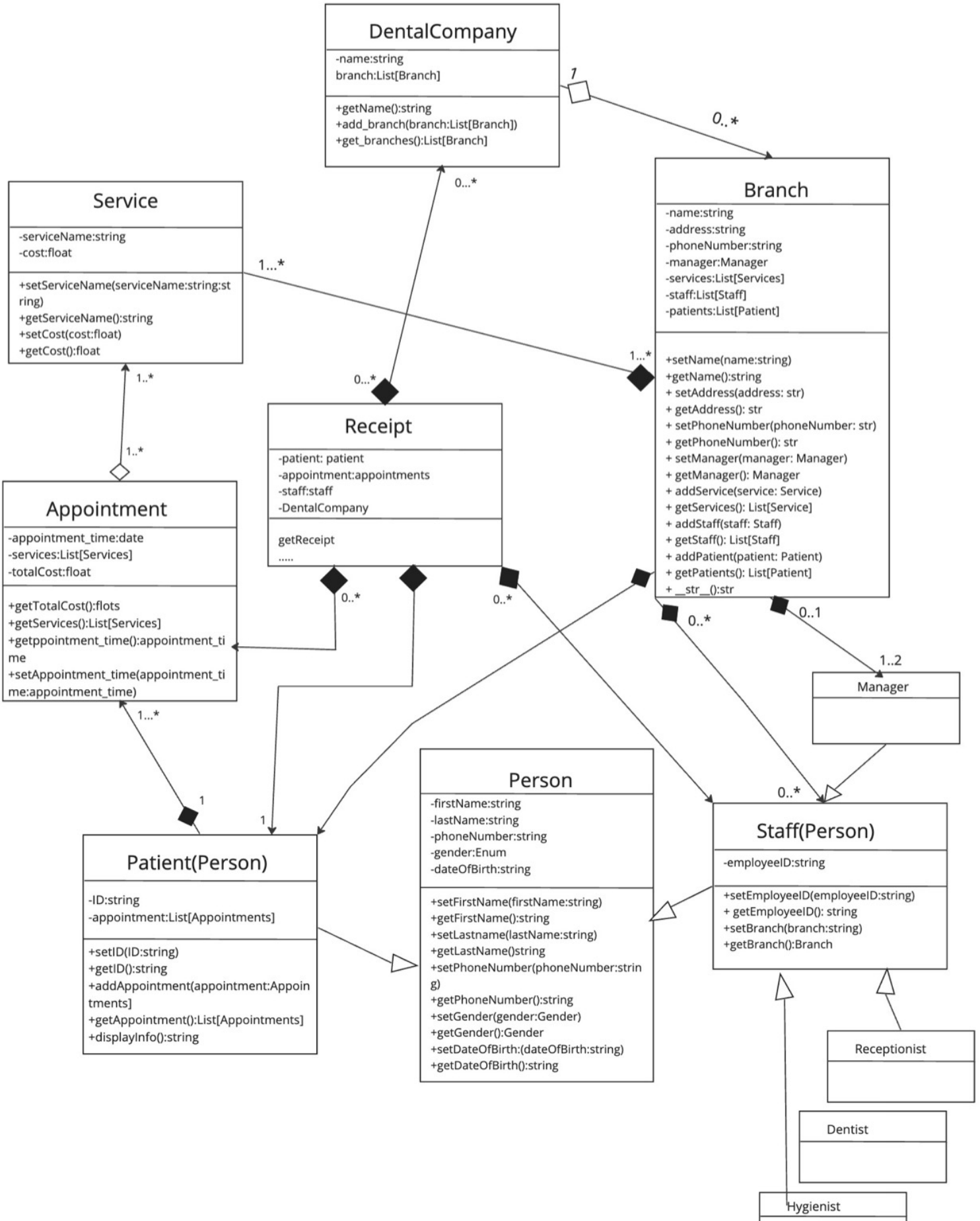
        i. Manager (inherits from StaffMember):
        ii. Receptionist (inherits from StaffMember):
        iii. Hygienist (inherits from StaffMember):
        iv. Dentist (inherits from StaffMember):

    b. Patient (inherits from Person):
        - appointments: List[Appointment]
        - ID:string

4. Appointment:
- services:List[Services]
- dateTime:datetime
- Method: totalCost:float

5. Services:
- serviceName:string
- cost:float

6. Receipt:
- patient:patient
- appointments:appointments
- Staff:staff
- DentalCompany:DentalCompany


DentalCompany
-name:string
branch:List[Branch]
+getName():string
+add_branch(branch:List[Branch])
+get_branches():List[Branch]
1
0..*
Service
-serviceName:string
-cost:float
+setServiceName(serviceName:string:string)
+getServiceName():string
+setCost(cost:float)
+getCost():float
1...*
0...*
Branch
-name:string
-address:string
-phoneNumber:string
-manager:Manager
-services:List[Services]
-staff:List[Staff]
-patients:List[Patient]
+setName(name:string)
+getName():string
+ setAddress(address: str)
+ getAddress(): str
+ setPhoneNumber(phoneNumber: str)
+ getPhoneNumber(): str
+ setManager(manager: Manager)
+ getManager(): Manager
+ addService(service: Service)
+ getServices(): List[Service]
+ addStaff(staff: Staff)
+ getStaff(): List[Staff]
+ addPatient(patient: Patient)
+ getPatients(): List[Patient]
+ __str__():str
1...*
1..*
1..*
Receipt
-patient: patient
-appointment:appointments
-staff:staff
-DentalCompany
getReceipt
.....
0...*
0..*
0..*
0..*
0..1
1..2
Appointment
-appointment_time:date
-services:List[Services]
-totalCost:float
+getTotalCost():flots
+getServices():List[Services]
+getppointment_time():appointment_time
+setAppointment_time(appointment_time:appointment_time)
1...*
Manager
Person
-firstName:string
-lastName:string
-phoneNumber:string
-gender:Enum
-dateOfBirth:string
+setFirstName(firstName:string)
+getFirstName():string
+setLastname(lastName:string)
+getLastName()string
+setPhoneNumber(phoneNumber:string)
+getPhoneNumber():string
+setGender(gender:Gender)
+getGender():Gender
+setDateOfBirth:(dateOfBirth:string)
+getDateOfBirth():string
0..*
1
1
Patient(Person)
-ID:string
-appointment:List[Appointments]
+setID(ID:string)
+getID():string
+addAppointment(appointment:Appointments]
+getAppointment():List[Appointments]
+displayInfo():string
Staff(Person)
-employeeID:string
+setEmployeeID(employeeID:string)
+ getEmployeeID(): string
+setBranch(branch:string)
+getBranch():Branch
Receptionist
Dentist
Hygienist

The code:

```
from datetime import datetime

from enum import Enum


class Gender(Enum):

    MALE = "Male"

    FEMALE = "Female"


class DentalCompany:

    def __init__(self,name):

        self.__name = name  # Initialize the name of the company

        self.branches = []  # Create an empty list to hold the branches


    def getName(self):

        return self.__name  # Return the name of the company


    def add_branch(self, branch):

        self.branches.append(branch)  # Add a branch to the list of
branches


    def get_branches(self):

        return self.branches  # Return the list of branches
```

```
class Branch:

    def __init__(self, name, address, phoneNumber, manager):

        self.__name = name  # Initialize the name of the branch

        self.__address = address  # Initialize the address of the branch

        self.__phoneNumber = phoneNumber  # Initialize the phone number
of the branch

        self.__manager = manager  # Initialize the manager of the branch

        self.__services = []  # Create an empty list to hold the
services offered

        self.__patients = []  # Create an empty list to hold the
patients registered

        self.__staff = []  # Create an empty list to hold the staff
members



    def setName(self, name):

        self.__name = name  # Set the name of the branch



    def getName(self):

        return self.__name  # Get the name of the branch



    # Address

    def setAddress(self, address):

        self.__address = address  # Set the address of the branch



    def getAddress(self):

        return self.__address  # Get the address of the branch
```

```
    # Phone number
    def setPhoneNumber(self, phoneNumber):
        self.__phoneNumber = phoneNumber  # Set the phone number of the
branch

    def getPhoneNumber(self):
        return self.__phoneNumber  # Get the phone number of the branch

    # Manager
    def setManager(self, manager):
        self.__manager = manager  # Set the manager of the branch

    def getManager(self):
        return self.__manager  # Get the manager of the branch

    # Dental services
    def addService(self, Service):
        self.__services.append(Service)  # Add a service to the list of
services offered

    def getServices(self):
        return self.__services  # Get the list of services offered

    # Staff member
    def addStaff(self, staff_member):
```

```
        self.__staff.append(staff_member)  # Add a staff member to the
list of staff members


    def getStaff(self):

        return self.__staff  # Get the list of staff members


    # Patients

    def addPatient(self, patient):

        self.__patients.append(patient)  # Add a patient to the list of
patients


    def getPatients(self):

        return self.__patients  # Get the list of patients


        # String representation of Branch information

    def __str__(self):

        return f"Branch Name: {self.__name}\nAddress:
{self.__address}\nPhone Number: {self.__phoneNumber}\nManager:
{self.__manager.getFirstName()} {self.__manager.getLastName()}"


# Define the Person class with first name, last name, gender and phone
number attributes


class Person:

    def __init__(self, firstName, lastName, phoneNumber, gender,
dateOfBirth):

        self.__firstName = firstName  # Initialize the first name of the
person
```

```
        self.__lastName = lastName  # Initialize the last name of the
person

        self.__phoneNumber = phoneNumber  # Initialize the phone number
of the person

        self.__gender = gender  # Initialize the gender of the person

        self.__dateOfBirth = dateOfBirth




    def setFirstName(self, firstName):

        self.__firstName = firstName  # Set the first name of the person


    def getFirstName(self):

        return self.__firstName  # Get the first name of the person




    # Last name

    def setLastName(self, lastName):

        self.__lastName = lastName  # Set the last name of the person


    def getLastName(self):

        return self.__lastName  # Get the last name of the person


    def setPhoneNumber(self, phoneNumber):

        self.__phoneNumber = phoneNumber

    def getPhoneNumber(self):

        return self.__phoneNumber
```

```
    def setGender(self, gender):
        if isinstance(gender, Gender):
            self.__gender = gender
        else:
            raise ValueError("Invalid gender value")

    def getGender(self):
        return self.__gender

    def getDateOfBirth(self):
      return self.__dateOfBirth

    def getDateOfBirth(self,dateOfBirth):
      self.__dateOfBirth=dateOfBirth


# Define the Staff class as a subclass of Person with an additional
employee ID attribute
class Staff(Person):
    def __init__(self, firstName, lastName, phoneNumber,
gender,dateOfBirth,employeeID):
        # Call the constructor of the Person class to set the first
name, last name, and phone number attributes
        super().__init__(firstName, lastName,
phoneNumber,gender,dateOfBirth)
        # Set the employee ID attribute
```

```
        self.__employeeID = employeeID


    # Define getters and setters for the employee ID attribute
    def setEmployeeID(self, employee_id: str):
        self.__employeeID = employee_id
    def getEmployeeID(self):
        return self.__employeeID


    # Set branch for a staff member
    def setBranch(self, branch: Branch):
        self.__branch = branch
    # Get branch information for a staff member
    def getBranch(self):
       return self.__branch




# Define the Manager, Receptionist, Hygienist, and Dentist classes as
subclasses of Staff with no additional attributes
class Manager(Staff):
    pass


class Receptionist(Staff):
    pass
```

```
class Hygienist(Staff):

    pass


class Dentist(Staff):

    pass


# Define the Patient class as a subclass of Person with an additional
ID attribute and a list of appointments

class Patient(Person):


    def __init__(self, firstName, lastName, phoneNumber, gender,
dateOfBirth, ID):

        # Call the constructor of the Person class to set the first
name, last name, and phone number attributes

        super().__init__(firstName, lastName, phoneNumber, gender,
dateOfBirth)

        # Set the ID attribute and initialize the list of appointments

        self.__ID = ID

        self.__appointments = []




    # Define getters and setters for the ID attribute

    def getID(self):

        return self.__ID


    def setID(self, ID):

        self.__ID = ID
```

```
    # Define getters for the appointments list
    def getAppointments(self):
        return self.__appointments
    # Define a method to add an appointment to the list
    def bookAppointment(self, appointment):
        self.__appointments.append(appointment)
    def displayInfo(self):
      return
f'Name:{self.getFirstName()}{self.getLastName()}\nGender:{self.getGende
r().name}\nPhone number{self.getPhoneNumber()}'



# Define the Appointment class with service and appointment time
attributes
class Appointment:
    def __init__(self, services, appointment_time):
        # Set the list of services and appointment time attributes
        self.__services = services
        self.__appointment_time = appointment_time


     # Define a method to calculate the total cost of the services
    def getTotalCost(self):
        return sum(service.getCost() for service in self.__services)
    # Define getters and setters for the services and appointment time
attributes
    def getServices(self):
        return self.__services
```

```
    def getAppointmentTime(self):
        return self.__appointment_time

    def setAppointmentTime(self, appointment_time):
        self.__appointment_time = appointment_time

# Define the Service class with name and cost attributes
class Service:
    def __init__(self, serviceName, cost ):
        # Set the name and cost attributes
        self.__serviceName = serviceName
        self.__cost = cost

    # Define getters and setters for the name and cost attributes
    def setServiceName(self, serviceName):
        self.__serviceName = serviceName
    def getServiceName(self):
        return self.__serviceName
    # Cost
    def setCost(self, cost):
        self.__cost = cost
    def getCost(self):
        return self.__cost
```

```
# Define the Receipt class with patient, appointments, and dental
company attributes


class Receipt:

   def __init__(self, patient, appointments,staff,DentalCompany):

       # Set the patient, appointments, and dental company attributes

       self.__patient = patient

       self.__appointments = appointments

       self.__staff=staff

       # Calculate the total cost of the appointments using the
getTotalCost method of the Appointment class

       self.__totalCost = sum(appointment.getTotalCost() for
appointment in appointments)

       self.__DentalCompany=DentalCompany


   # Define a method to print the receipt

   def getReceipt(self):

       print("Dental Company:", self.__DentalCompany.getName())

       print(self.__staff.getBranch())

       print("Patient info:") #  print branch information

       print(self.__patient.displayInfo())




       total_cost = 0
```

```
        # Iterate through the appointments and print the appointment
date and services
        for appointment in self.__appointments:
            appointment_date =
appointment.getAppointmentTime().strftime("%Y-%m-%d")
            print("Appointment Date:", appointment_date)
            print()

            print("Services:")
            print("Staff Name:",self.__staff.getFirstName(),
self.__staff.getLastName())
            # Iterate through the services and print the name and cost
            for service in appointment.getServices():
                service_cost = service.getCost()
                total_cost += service_cost
                print(f"{service.getServiceName()}
..................... {service_cost:.2f} AED" )









        # Calculate the VAT and grand total
        vat = total_cost * 0.05
        grand_total = total_cost + vat

        # Print the subtotal, VAT, and total cost
```

```
        print("Subtotal : ",(total_cost),"AED")

        print("VAT (5%): ", (vat),"AED")

        print("Total cost: ",(grand_total),"AED")


from datetime import datetime


def main():

   # Create dental company

   dental_company = DentalCompany('Bright Smiles')


   # Create a manager

   manager = Manager("Mohammed", "Al Shamsi", "056321234", Gender.MALE,
"1 April 1964", "M01")

   manager2= Manager("Maryam","Al
Mansoori","0553793878",Gender.FEMALE,"1 April 1964", "M02")

    # Create a branch and add it to the dental company

   branch1 = Branch("Dubai , Al Diyafa ", "  2nd December St, Villa 123
", "043444197", manager)

   branch2 = Branch("Dubai , Deira"," Khalid Bin Al Waleed Rd ,Villa
34","0423435425",manager2)

   dental_company.add_branch(branch1)

   dental_company.add_branch(branch2)



   # Create services

   cleaning = Service("Cleaning", 150)

   implants = Service("Implants", 5000)
```

```
    crowns = Service("Crowns", 2000)

    fillings = Service("Fillings", 600)


    # Add services to the branch

    branch1.addService(cleaning)

    branch1.addService(implants)

    branch1.addService(crowns)

    branch1.addService(fillings)


    branch2.addService(cleaning)

    branch2.addService(implants)

    branch2.addService(crowns)

    branch2.addService(fillings)


    # Create staff members

    receptionist = Receptionist("Fatima", "Al Ali", "056294739",
Gender.FEMALE, "20 May 1999", "R01")

    hygienist = Hygienist("Ahmed", "Al Mansoori", "0504535603",
Gender.MALE, "20 Aug 1999", "H01")

    dentist = Dentist("Noor", "Al Khaja", "056826495073", Gender.FEMALE,
"20 April 1999", "D01")

    dentist1 = Dentist("Ahmed", "Al Rais", "057291739389", Gender.MALE,
"2021-06-01", "D02")

    dentist2 = Dentist("Fatima", "Al Hashimi" , "05521312412",
Gender.FEMALE, "2021-06-01", "D03")
```

```
    # Associate staff members with the branch
    receptionist.setBranch(branch1)
    hygienist.setBranch(branch1)
    dentist.setBranch(branch1)
    dentist1.setBranch(branch2)
    dentist2.setBranch(branch2)



    # Add staff members to the branch
    branch1.addStaff(receptionist)
    branch1.addStaff(hygienist)
    branch1.addStaff(dentist)
    branch2.addStaff(dentist1)
    branch2.addStaff(dentist2)



    # Create patients
    #branch 1
    patient1 = Patient("Khalid", "Al Suwaidi", "055445829", Gender.MALE,
"20 May 1999", "P01")
    #branch2
    patient2 = Patient("Mariam", "Al Hashimi", "059299991",
Gender.FEMALE, "3 May 1790", "P02")



    # Add patients to the branch
```

```
    branch1.addPatient(patient1)

    branch2.addPatient(patient2)


    # Create appointments

    appointment1 = Appointment([cleaning, fillings], datetime(2023, 4,
15, 10, 0))

    appointment2 = Appointment([crowns], datetime(2023, 4, 15, 11, 0))


    # Add appointments to patients

    patient1.bookAppointment(appointment1)

    patient2.bookAppointment(appointment2)


    # Create a receipt


    receipt = Receipt(patient1, [appointment1], dentist, dental_company)

    receipt2 = Receipt(patient2, [appointment2], dentist2,
dental_company)




    # Print the receipt

    receipt.getReceipt()


    print()

    print()

    print()

    receipt2.getReceipt()
```

```
if __name__ == "__main__":
    main()
```

The output:

```
Dental Company: Bright Smiles
Branch Name: Dubai , Al Diyafa
Address:          2nd December St, Villa 123
Phone Number: 043444197
Manager: Mohammed Al Shamsi
Patient info:
Name:KhalidAl Suwaidi
Gender:MALE
Phone number055445829
Appointment Date: 2023-04-15

Services:
Staff Name: Noor Al Khaja
Cleaning ..... 150.00 AED
Fillings ..... 600.00 AED
Subtotal :  750 AED
VAT (5%):  37.5 AED
Total cost:  787.5 AED
```

Dental Company: Bright Smiles

Branch Name: Dubai , Deira

Address: Khalid Bin Al Waleed Rd ,Villa 34

Phone Number: 0423435425

Manager: Maryam Al Mansoori

Patient info:

Name:MariamAl Hashimi

Gender:FEMALE

Phone number059299991

Appointment Date: 2023-04-15

Services:

Staff Name: Fatima Al Hashimi

Crowns ..... 2000.00 AED

Subtotal : 2000 AED

VAT (5%): 100.0 AED

Total cost: 2100.0 AED

I have created a more organized, modular, and efficient codebase by making use of relationships such as association, composition, and inheritance. Let me elaborate on these connections and describe how they improve the code's readability and efficiency:

1. Aggregation between DentalCompany and Branch:A dental company has multiple branches, but the branches can exist independently of the dental company. If the dental company is deleted, the branches can still exist on their own.
2. the association between Appointment and Service is an example of a many-to-many aggregation association. Aggregation represents a "whole/part" relationship where one class (the whole) contains or is

composed of multiple instances of another class (the parts). In this case, an Appointment can have multiple Service instances (the parts), and each Service instance can be associated with multiple Appointment instances.

3. Composition between Branch and Manager:As explained earlier, a branch has a manager, and the manager's lifecycle is dependent on the branch's lifecycle.
4. Composition between Branch and Staff:A branch has a list of staff members, and each staff member is associated with a specific branch. The staff's lifecycle is dependent on the branch's lifecycle.
5. Composition between Branch and Patient:A branch has a list of patients registered at that branch. The patients are associated with a specific branch, and their lifecycle is dependent on the branch's lifecycle.
6. Inheritance between Person and its subclasses (Staff, Patient):The Person class serves as the base class for both Staff and Patient classes, and they inherit attributes and methods from the Person class.
7. The Receipt class has a patient ,appointments,staff ,DentalCompany attribute that holds a reference to a Patient , appointments ,staff and DentalCompany objects. This relationship can be described as a "has-a" "composition" relationship .This means that a Receipt object is composed of or has references to objects from these classes to represent the details of a specific receipt, such as the patient who received the services, the appointments when the services were provided, the staff member who provided the services, and the dental company where the services were provided.

I find that composition relationships better represent real-world relationships and provide stronger "has-a" connections.Using Composition aids me in ensuring that my code is consistent and that my data is correct. Composition relationships also help me model "part-whole" relationships in the real world, which makes my code more accurate to life and enhances its quality. Inheritance offers additional benefits, such as code reusability and accurate modeling of real-world relationships. By allowing a subclass to inherit properties and methods from a superclass, I can encourage code reuse and reduce the need for duplication. Subclasses can inherit properties and behaviors from their superclasses, just as real-world objects inherit properties and behaviors from their parents. This facilitates the creation of a more realistic and effective code structure.

In the program, I structured multiple classes, each representing a specific aspect of the clinic.

DentalCompany: Represents the dental company, containing the name of the company and a list of branches. I added methods to add branches and retrieve the list of branches.

Branch: Represents a clinic branch, with attributes such as name, address, phone number, and manager. I included lists of services, patients, and staff. I provided methods to add and retrieve services, patients, and staff.

Person: A base class representing a person, with attributes like first name, last name, phone number, gender, and date of birth. I created setter and getter methods for each attribute.

Staff: A subclass of Person, representing a staff member in the clinic. It has an additional attribute, employee ID, and a method to set and get the associated branch.

Manager, Receptionist, Hygienist, Dentist: Subclasses of Staff, representing different roles in the clinic.

Patient: A subclass of Person, representing a patient in the clinic. It has an additional attribute, ID, and a list of appointments. I provided methods to book appointments and retrieve the list of appointments.

Appointment: Represents an appointment, with attributes like services and appointment time. I included methods to calculate the total cost of services, and set and get the services and appointment time.

Service: Represents a dental service, with attributes like service name and cost. I created setter and getter methods for each attribute.

Receipt: Represents a receipt, with attributes like patient, appointments, staff, and dental company. I added a method to print the receipt, including details like services, costs, and VAT.

In the main function of the program, I demonstrated how to create instances of these classes and establish relationships between them. For example, I created a dental company, branches, services, staff members, patients, and appointments. I then associated staff members with branches, added patients and appointments, and finally generated receipts for the appointments.

I made sure the code effectively showcases the use of inheritance, composition, and association relationships to model a real-life scenario, making it easier to

understand and maintain. The classes are well-organized, and methods and attributes are appropriately named, contributing to the code's readability.

In the program, I carefully structured multiple classes to create a comprehensive and organized dental clinic management system. The Branch class includes services, patients, and staff lists to facilitate archiving all necessary information for each branch. This design choice enhances the system's management and maintenance capabilities and enables efficient access to relevant data.

By incorporating these lists into the Branch class, I ensured that the system can swiftly retrieve information related to the services offered, patient records, and staff members working at a specific branch. This level of organization not only improves the efficiency of the dental clinic management system but also streamlines the process of adding or updating information within the system.

I included several test cases to demonstrate the functionality of the program:

1. Addition of a branch to the dental company
2. Addition of dental services, staff, and patients to a branch
3. Addition of patients booking appointments
4. Addition of a patient to a branch
5. Creating a new appointment

At the end, I incorporated the ability to print two different receipts for different patients in different branches to showcase the program's effectiveness in generating the required information. This comprehensive dental clinic management system caters to various aspects of managing a dental practice, ensuring a smooth and efficient operation.

During the process of making a management system for a dental clinic using object-oriented programming, I learned a number of important ideas and methods, including:

- I learned to design classes and objects that represent key components of the system, such as DentalCompany, Branch, Person, Staff, Manager, Receptionist, Hygienist, Dentist, Patient, Appointment, Service, and Receipt.

- I learned to implement inheritance by creating subclasses (e.g., Staff, Manager, Receptionist, Hygienist, Dentist) that inherit properties and methods from a parent class (e.g., Person).

- I learned to employ encapsulation, concealing a class's internal implementation details through private attributes (e.g., __name, __address, __phoneNumber) and offering public methods (getters and setters) to access and modify these attributes.

- I learned to establish composition and association relationships between classes, such as adding services, staff members, and patients to a Branch or linking appointments with patients.

- I learned to utilize enumeration (Enum) to define a collection of named values, like Gender in this case, which aids in assigning valid values to attributes.

- I learned to work with the datetime module for handling dates and times, such as creating and formatting appointment times.

- I learned to conduct calculations and manipulations with objects, like determining the total cost of appointments and producing receipts.

- I learned to create a main function (main()) to execute the code, showcasing the system's functionality by generating instances of the classes, setting their attributes, and invoking their methods. This function also tests the implemented features and verifies their proper operation.

- In conclusion, the experience of constructing a dental clinic management system using object-oriented programming principles has deepened my comprehension of these concepts and enhanced my capacity to apply them in practical situations.