Software Engineering
Homework 2 – Designing UML Class Diagram

***Objectives**:* Practicing of the following concepts:

- Identification of the different classes from the requirements
- Definition of attributes and methods within classes
- Specification of hierarchies (inheritance) and class associations and their multiplicity
- Apply GRASP design principles

System description: Consider the below description of a hotel reservation system.

Abu Dhabi Star Hotel (DSH) has total 64 rooms. Each room has a room number and a fixed daily rate depending on its type. DSH has three types of room: *standard* – daily rate AED 650; *executive* – daily rate AED 820; and *superior* – daily rate AED 1250. Each room is equipped with three accessories: *an electrical iron*, *a hair dryer*, and *a coffee maker*. These accessories are controlled by a sensor installed in each room and recorded in the hotel system. If an accessory is taken out of the room, the sensor immediately detects this, and the system updates the database of the room accordingly. Once an accessory is taken into the room, the sensor also detects this, and the hotel system updates the database. The system knows if a room has all 3 accessories, or some of them are missing.

The hotel has two types of customers: corporate customers and individual customers. To make a reservation, customers first contact the reservation staff of the hotel. They can reserve a room for a particular period. The staff enters the customer details such as name, phone number, credit card details if the customer is new, and the reservation information such as room type, check-in and check-out dates, and the number of guests to the system. For the corporate customer, credit card details are not required, instead, the name of the company should be provided. The hotel provides 10% discount to its corporate customers. The hotel also provides airport shuttle services for its customer. It keeps track which customer should be picked up from the airport and when. Similarly, it knows which customer should be dropped at the airport and when. The rate of the airport shuttle is fixed. Customer could request for the shuttle service either during their reservation or later after check-in.

The system starts processing of room reservation once it receives the reservation request. The system searches for the available room(s) and makes the reservation for the customer if room(s) is available. The system registers the customer details into the system by creating an account if the customer is new to the hotel. If the customer already exists, it simply proceeds for the reservation by retrieving the customer account without creating a new account. For the individual customer, the system then automatically verifies the credit card validity and the availability of the required funds from the issuing bank of the credit card. The bank sends an "approve" message if everything goes fine. The system then confirms the reservation, creates a reservation portfolio, a reservation number is assigned, and the room(s) becomes unavailable for that period to other customers. A customer may have more than one reservation portfolio, that is, one portfolio for each reservation, but he/she will have only one account regardless the number of reservation he/she makes. For the corporate customers, no bank approval is required. However, if the bank sends a "declined" message, the system does not make any reservation for the individual customer. In either case, the system produces a message regarding the outcome of the reservation process (confirmed or declined reservation). The staff then forwards this message to the customer.

When the customer checks in, the hotel desk staff finds the reservation by either entering the reservation number or the customer name. The desk staff then enters the scanned copy of the customer identity card

or passport into the system and includes this with the reservation portfolio. The system then checks if the allocated room has all three accessories. If any accessory is missing, the system produces a message to the room service staff to supply the missing accessory in the room immediately. It then prints a *room access card* for the customer, and records the room number in the reservation portfolio along with a note that the customer has checked in. The reservation portfolio includes the room number, time and date of the check-in, and the access card information.

When a customer checks out, the hotel desk staff either enters the room number or the reservation number into the system. The system then finds the reservation portfolio, checks if any accessory has been taken out of the room, finds the room rate and the total number of days the customer stayed, computes the total cost of the reservation, and prepares an invoice (bill). For the missing accessory, the system automatically finds the price, and includes it in the invoice. During the check-out, the invoice also includes the shuttle service fee if the customer has used the service, and any unpaid bill from the restaurant. The system can retrieve this information from the reservation portfolio. The system releases the room.

Once the invoice is prepared, it is attached with the reservation portfolio and the customer account is updated accordingly. Corporate customers have the choice to make the payment later. Individual customer pays the invoice at the time of check-out. The payment can be made either by cash or by credit card. Once the payment is made by credit card, the system gets the approval from the card issuing bank by automatic connecting with the bank, and the customer account as well as the reservation portfolio are updated with the payment information accordingly. Finally, it generates a receipt.

The service manager manages its two shuttle buses and room services of the hotel. Every day the service manager checks for the requests already made for the shuttle services. Based on this information, she prepares a schedule and assigns drivers to the shuttle buses based on the service requests. The system knows which driver is using which shuttle bas and when. Drivers are permanent-staff of the hotel. Their salary is based on yearly salary rate. The hotel has two types of cleaning staff: daily-staff and permanent-staff. The service manager also prepares schedule for cleaning and assigns rooms to each cleaning staff in a monthly roster. She checks periodically every day through the system which room needs servicing urgently. Based on this information, she also schedules urgent service for the room. The system keeps track which cleaning staff of the hotel cleans which room and which day. Based on the number of rooms a daily-staff cleans per day, their salary is calculated weekly. Their salary rate is based on per room they clean. However, for the permanent-staff of the hotel, the salary is based on the yearly salary rate, but the system records which rooms a permanent staff cleans and on which day. At the end of each month the cleaning staff and drivers get their salary slips. The salary slip includes all information such as total salary amount, days worked, yearly salary, or room cleaning rate, etc.

The general manager of the hotel can generate various summary reports. The system can produce a summary report on average occupancy rate of a room each month, total customers in the hotel in a day/week, average occupancy rate per room, average shuttle requests per day/week, total number of missing accessories each week/month, etc.

Student tasks:

1. Develop a design class diagram of the above system. Include generalization, aggregation, association wherever appropriate. Define complete operations and attributes of each class including multiplicity.
2. Explain your design logics and show through several examples how, and where, you have applied the GRASP design principles to improve your design by assigning responsibilities to the right classes, reducing the coupling, increasing the cohesion, … etc.