**Agent**

|  |  |  |
| --- | --- | --- |
| Name | License | Group |
| Alice | 12004 | 13 |
| Bob | 14043 | 10 |
| Carol | 6500 | 11 |

**SoldProperty**

**Office**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| TType | Id | PPrice | Year | License |
| Land | 1 | 25000 |  | 12004 |
| Condo | 2 | 200000 | 2014 | 14043 |
| TH. | 3 | 1500000 | 2012 | 6500 |
| SFH | 4 | 2450000 | 2008 | 12004 |

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|  |  |  |  |
| --- | --- | --- | --- |
| Group | zipCode | officeFee | agentPercentCommission |
| 11 | 60525 | 500 | 3 |
| 12 | 60140 | 1000 | 4 |
| 13 | 02740 | 700 | 3 |
| 14 | 50727 | 1000 | 5 |

**Customer**

|  |  |  |
| --- | --- | --- |
| Cname | Phone | pID |
| Bill | 3124518000 | 1 |
| Thomas | 4558461254 | 2 |
| Suzy | 4453214512 | 3 |
| Sam | 9546647412 | 4 |
| Andew | 11446 | 5 |

* The underlined attribute is the primary key of a relation

The attribute *group* of table **Agent**is a foreign key to relation **Office**.

*•*

The attribute *pID* of relation **Customer** is a foreign key of the relation **SoldProperty**.

he Attribute *License* of the **SoldProperty** is a foreign key of the relation **Agent**.

**Part 1 Relational Algebra (Total: 20 Points) Question 1.1 (6 Points)**

Write a relational algebra expression that returns the property id and type sold by agent ‘Alice’.

## Question 1.2 (6 Points)

Write a relational algebra expression that returns the total price of all properties sold by agent ‘bob’.

## Question 1.3 (8 Points)

Write a relational algebra expression that returns the agent name that didn’t sell any property.

## Part 2 SQL, Queries and updates (18 points)

## Question 2.1 (4 Points)

Write an SQL statement that creates a new table **Town** that includes information about the town each office is serving. A town information includes *zipcode*, *name,*  positive *taxRate,* and *id* of the properties located in the town *.*  The **Town** is identified by its *zipcode*. If a property is removed from **office** then it is id in **Town** table is set to null.

## Question 2.2 (7 Points)

Write an **SQL query** that returns the sum of the total commission made by ‘Carol’. Each time the agent sell a house they get a commission based on the sale price x the agentPrecentCommission

## Question 2.3 (7Points)

Update all the *taxRate* in **Town** for SFH by reducing it by 1%

## Part 3 ER model (23 points)

A flight management system allows viewing flight information and booking flights. The flight includes the airline code, flight number, price, seating. Each flight takes off and lands in an airport.

The airport has IATA (unique code), city, and type. A customer has a name and a phone. An agent takes care of customers. Each agent has a name and a booking fee.

**Question 3.1**

Create an ER diagram for the flight management system (12 points)

**Question 3.2**

Create the relational schema for the flight management system(11 points)

## Part 4 Normalization and Functional Dependencies (24 Points)

Consider the following relation *R*(*A, B, C, D*) and functional dependencies *F* that hold over this relation.

A→ D

AE → H

DF → BC

E → C

H → E

## Question 4.1 (3 Points)

Determine all the possible candidate key(s) of *R*.

## Question 4.2 (4 Points)

Compute the attribute cover of *X* = *{D, F}* according to *F*.

## Question 4.3 (5 Points)

Compute the canonical cover of *F.* Show each step of the generation process according to the algorithm shown in class.

## Question 4.4 (7 Points)

In which normal form is relation *R, explain briefly* (recall that a relation can be in multiple normal forms).

* 2NF
* 3NF
* BCNF

## Question 4.4 (5 Points)

Use 3NF decomposition algorithm to decompose the table R into relations that are 3NF

**Part 5 Concurrency Control (15 points)**

**Question 5.1** **(7Point)** For each of the following schedules determine which properties the schedule has. For instance, a schedule may be *recoverable* and *cascade-less* (*strict*) or *conflict* or *view serializable*. Consider the following notation for operations of transactions:

*w*1(*A*) transaction 1 write item *A r*1(*A*) transaction 1 read item *A*

*c*1 transaction 1 commit

*a*1 transaction 1 abort

*S*1 = *r*1(*A*)*, w*1(*A*)*, r*2(*B*)*, c*1*, w*2(*B*)*, r*3(*B*)*, w*3(*A*)*, c*3*, r*2(*C*)*, c*2

*S*2 = *r*1(*A*)*, w*2(*B*)*, r*1(*B*)*, c*1*, c*2

*S3* = *w*1(*A*)*, w*2(*A*)*, c*2*, w*1(*A*)*, c*1

**Question 5.2 (4 points)**

Which of the schedule uses timestamps locks? Explain briefly.

**Question 5.3 (4 points)**

Which of the schedule uses a2 phase locking protocol? Explain briefly.