Name	CWID

Homework Assignment
3

November 2nd, 2016
Due on November 14th, 12:30pm (noon)

CS425 - Database Organization
Results

Please leave this empty!

3.1	3.2	3.3	Sum

Instructions

- Try to answer all the questions using what you have learned in class
- Some questions are marked as bonus. You do not have to answer these questions to get full points for the assignment. However, you can get bonus points for these questions!

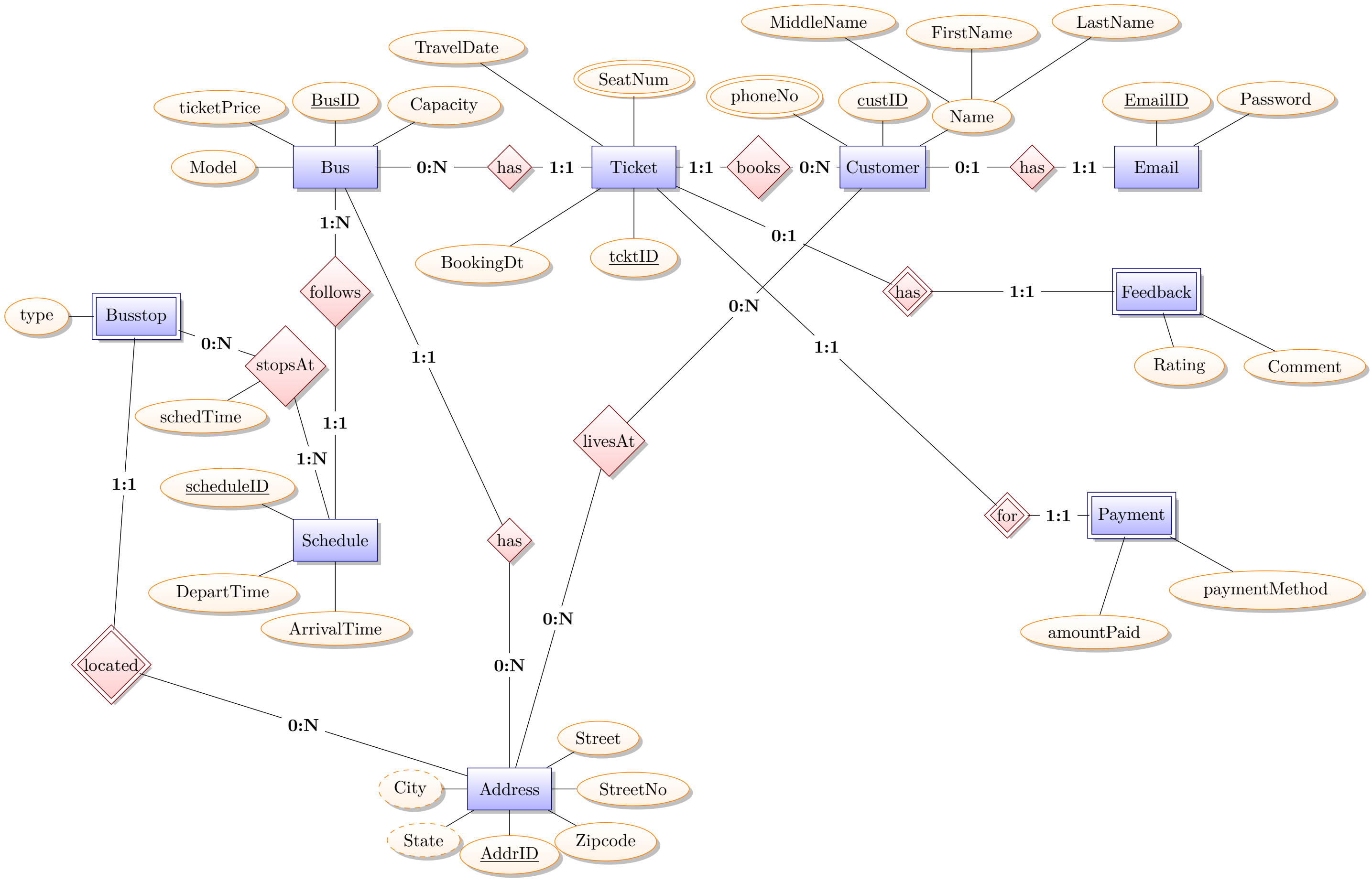
Part 3.1 Modelling (Total: 60 Points)

Question 3.1.1 (60 Points)

Build a conceptional model for an **Online Bus Ticket Booking System**. The solution should be presented as an **ER-diagram**. Base your design on the following requirements.

- The database should record information about Customers, Emails, Addresses, Tickets, Buses, Bus Schedules, Bus Stops, Purchase Feedback, and Payments.
- A **Customer** has a name which consists of *firstName*, *middleName* and *lastName*. **Customers** are identified by a unique *custID*. A **Customer** can have one or more *phoneNumbers*.
  - **Customers** can book any number of **Tickets** (including none). **Customers** may provide **Feedback** for each booking (optional). For every booking, a **Customer** has to make a **Payment**.
- An **Address** consists of a unique *addrID*, *street*, *streetNumber*, *city*, *state* and *zipcode*. The attributes *city* and *state* can be derived from the attribute *zipcode*.
  - A **Customer** can be associated with any number of **Addresses** and there may be multiple **Customers** living at the same **Address**. There may be some **Addresses** which are not be associated with any **Customer**.
- An **Email** consists of unique *emailID* and a *Password*.
  - A **Customer** may or may not have an **Email** and every **Email** belongs to a single owner (customer). We assume that a **Customer** can have only one **Email**.
- A **Bus** is identified using a *busNumber*. A **Bus** has a *capacity*, *model* and a *ticketPrice*.
  - A **Bus** may follow several **Schedules**.
- A **Bus Stop** has is uniquely identified by the **Address** it is located at. A **Bus stop** has a *type* (either *sheltered* or *simple*).
- A **Schedule** includes an *ArrivalTime*, *DepartureTime*, and a unique *scheduleID*.
  - A **Schedule** is associated with one or more **Bus stops**. For each such association we record the *scheduled time* of the bus stopping at this **Bus stop**.
- A **Ticket** has its unique *ticketId*. **Tickets** also have a *bookingDate* and *travelDate*. A **Ticket** may has one or more *seatNumbers*.
  - Each **Ticket** may be associated with a single **Feedback**.
  - Every **Ticket** has a **Bus** associated with it, while a **Bus** may have many different **Tickets** associated with itself.
- A **Payment** is identified by the **Ticket** for which the payment was made. It consists of the *amountPaid* and *paymentMethod* (Credit Card, E-Check, etc.)
- Every **Purchase Feedback** is uniquely identified by the **Ticket** for which the feedback is given. For each **Purchase Feedback** we store a *rating* and a *comment*.

Solution

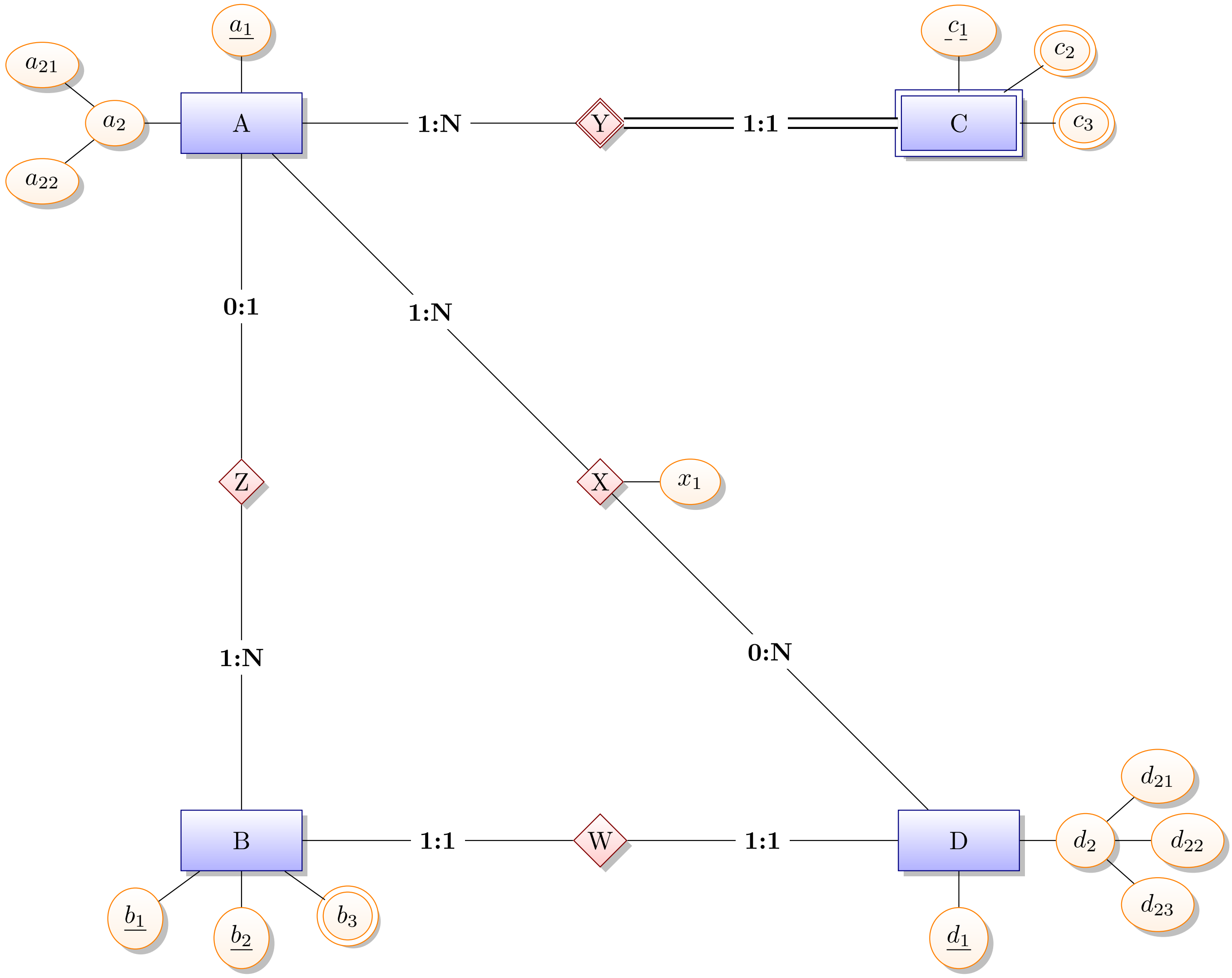

MiddleName
FirstName
LastName
TravelDate
SeatNum
phoneNo
custID
Name
EmailID
Password
ticketPrice
BusID
Capacity
Model
Bus
0:N
has
1:1
Ticket
1:1
books
0:N
Customer
0:1
has
1:1
Email
1:N
BookingDt
tcktID
0:1
has
1:1
Feedback
Rating
Comment
type
Busstop
follows
0:N
stopsAt
0:N
1:1
1:1
schedTime
1:1
livesAt
1:1
1:N
scheduleID
Schedule
has
for
1:1
Payment
DepartTime
ArrivalTime
paymentMethod
amountPaid
0:N
located
0:N
0:N
Street
City
Address
StreetNo
State
AddrID
Zipcode

Part 3.2 Translation of ER into Relational Model (Total: 40 + 10 BONUS Points)

Question 3.2.1 (40 Points)

Take the following ER-model and translate it into a relational schema using the rules presented in class. Present the relational schema as an SQL script (assume that all attributes are of data type `INT`). Present the results of the following intermediate steps in this order:

1. Translate strong entities + unnest composite attributes
2. Translate weak entities
3. Translated multi-valued attributes
4. Translate relationships



Solution

1st Step (strong entities)

```
CREATE TABLE A (
   a1 INT PRIMARY KEY,
   a21 INT,
   a22 INT
);

CREATE TABLE B (
   b1 INT,
   b2 INT,
   PRIMARY KEY (b1,b2)
);

CREATE TABLE D (
   d1 INT PRIMARY KEY,
   d21 INT,
   d22 INT,
   d23 INT
);
```

2nd Step (weak entities)

```
CREATE TABLE A (
   a1 INT PRIMARY KEY,
   a21 INT,
   a22 INT
);

CREATE TABLE B (
   b1 INT,
   b2 INT,
   PRIMARY KEY (b1,b2)
);

CREATE TABLE C (
   c1 INT,
   a1 INT,
   FOREIGN KEY a1 REFERENCES A,
   PRIMARY KEY(a1, c1)
);

CREATE TABLE D (
   d1 INT PRIMARY KEY,
   d21 INT,
   d22 INT,
   d23 INT
);
```

3rd Step (multivalued attributes)

```
CREATE TABLE A (
   a1 INT PRIMARY KEY,
   a21 INT,
   a22 INT
);

CREATE TABLE B (
   b1 INT,
   b2 INT,
   PRIMARY KEY (b1,b2)
);

CREATE TABLE B3 (
   b1 INT,
   b2 INT,
   b3 INT,
   FOREIGN KEY (b1, b2) REFERENCES B,
   PRIMARY KEY (b1, b2, b3)
);

CREATE TABLE C (
   c1 INT,
   a1 INT,
   FOREIGN KEY a1 REFERENCES A,
   PRIMARY KEY(a1, c1)
);

CREATE TABLE C2 (
   c1 INT,
   a1 INT,
   c2 INT,
   FOREIGN KEY (c1, a1) REFERENCES C,
   PRIMARY KEY (c1, a1, c2)
);

CREATE TABLE C3 (
   c1 INT,
   a1 INT,
   c3 INT,
   FOREIGN KEY (c1, a1) REFERENCES C,
   PRIMARY KEY (c1, a1, c3)
);

CREATE TABLE D (
   d1 INT PRIMARY KEY,
   d21 INT,
   d22 INT,
   d23 INT
);
```

4th Step (relationships)

```
CREATE TABLE A (
   a1 INT PRIMARY KEY,
   a21 INT,
   a22 INT,
   b1 INT,
   b2 INT,
   FOREIGN KEY (b1,b2) REFERENCES B
);

CREATE TABLE B (
   b1 INT,
   b2 INT,
   PRIMARY KEY (b1,b2)
);

CREATE TABLE B3 (
   b1 INT,
   b2 INT,
   b3 INT,
   FOREIGN KEY (b1, b2) REFERENCES B,
   PRIMARY KEY (b1, b2, b3)
);

CREATE TABLE C (
   c1 INT,
   a1 INT,
   FOREIGN KEY a1 REFERENCES A,
   PRIMARY KEY(a1, c1)
);

CREATE TABLE C2 (
   c1 INT,
   a1 INT,
   c2 INT,
   FOREIGN KEY (c1, a1) REFERENCES C,
   PRIMARY KEY (c1, a1, c2)
);

CREATE TABLE C3 (
   c1 INT,
   a1 INT,
   c3 INT,
   FOREIGN KEY (c1, a1) REFERENCES C,
   PRIMARY KEY (c1, a1, c3)
);

CREATE TABLE D (
   d1 INT PRIMARY KEY,
   d21 INT,
   d22 INT,
   d23 INT
   b1 INT,
   b2 INT,
    FOREIGN KEY (b1, b2) REFERENCES B
);

CREATE TABLE X (
    a1 INT,
    d1 INT,
    x1 INT,
    PRIMARY KEY (a1, d1),
    FOREIGN KEY (a1) REFERENCES A,
    FOREIGN KEY (d1) REFERENCES D
);
```

Question 3.2.2 (10 (BONUS) Points)

Consider the following relations and for each determine in which normal form the relation is (relation can be in multiple normal forms). Please consider the following normal forms: 1NF, 2NF, 3NF and BCNF.

1. $R(A, B, C, D)$ and the Functional Dependencies are $A \rightarrow B, C \rightarrow BD, B \rightarrow C$
2. $R(A, B, C, D, E)$ and the Functional Dependencies are $AC \rightarrow BE, A \rightarrow D, B \rightarrow A, BC \rightarrow D$
3. $R(A, B, C, D, E)$ and the Functional Dependencies are $AC \rightarrow BE, A \rightarrow C, BC \rightarrow D, B \rightarrow A$
4. $R(A, B, C, D)$ and the Functional Dependencies are $C \rightarrow B, B \rightarrow AC, A \rightarrow BD$

Solution

1. The relation is in 1NF and 2NF.
2. The relation is in 1NF only.
3. The relation is in 1NF, 2NF, 3NF and BCNF.
4. The relation is in 1NF, 2NF, 3NF and BCNF.