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Name	CWID

Homework Assignment 3

November 8th, 2019

Due on November 18th, 2019 11:59pm (CST)

CS425 - Database Organization

Please leave this empty!

3.1	3.2	3.3	Sum

Instructions

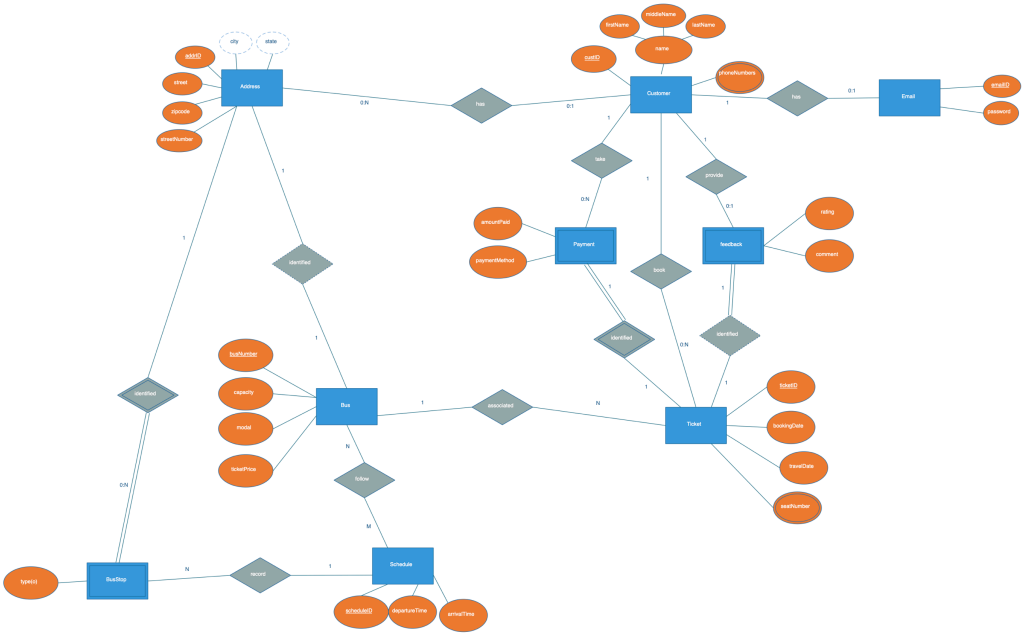
- Try to answer all the questions using what you have learned in class

Part 3.1 Modeling (Total: 35 Points)

Question 3.1.1 (35 Points)

Build a conceptional model for an **Online Bus Booking System**. The solution should be presented as an **ER-diagram**. Design your ER diagram with 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** 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 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 have 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 *comment*.


addrID
street
zipcode
streetNumber
city
state
Address
has
0:N
0:1
custID
firstName
middleName
lastName
name
phoneNumbers
Customer
has
0:1
Email
emailID
password
take
provide
1
1
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amountPaid
paymentMethod
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Ticket
ticketID
bookingDate
travelDate
seatNumber
follow
N
M
0:N
N
1
typeId
BusStop
record
Schedule
scheduleID
departureTime
arrivalTime

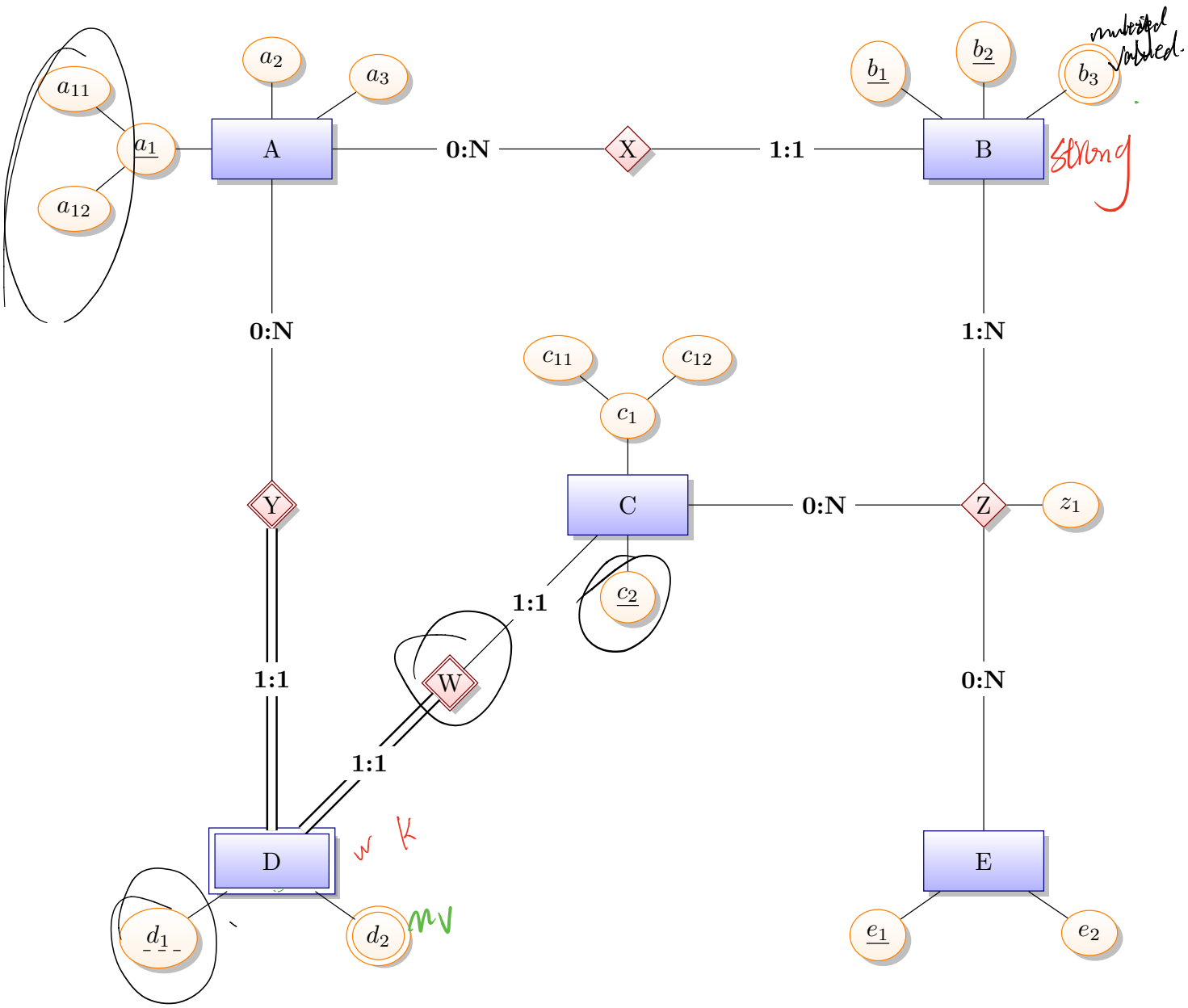
c

Part 3.2 Translation of ER into Relational Model (Total: 35 Points)

Question 3.2.1 (35 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



Step 1 Strong Entities

```
create table A {
    a11 int,
    a12 int,
    a2  int,
    a3  int,
    primary key (a11, a12)
}
create table B {
    b1  int,
    b2  int,
    b3  int,
    primary key (b1, b2)
}

create table C {
    c11 int,
    c12 int,
    c2  int,
    primary key c2.
}
create table E {
    e1 int,
    e2 int,
    primary key e1
}
```

Step 2 weak Entities

create table D (

d_1 ..,

d_2 ..,

c_2 ..,

a_{11} ..,

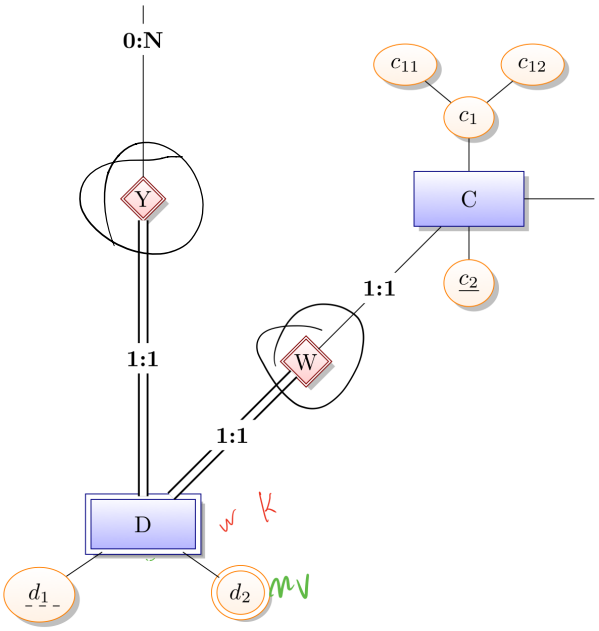
a_{12} ..,

primary key (a_{11}, a_{12}, c_2, d_1),

foreign key c_2 references C,

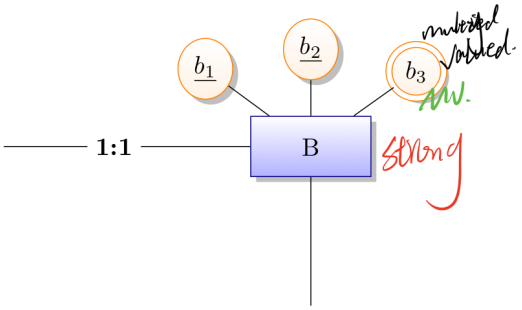
foreign key a_{11}, a_{12} references A

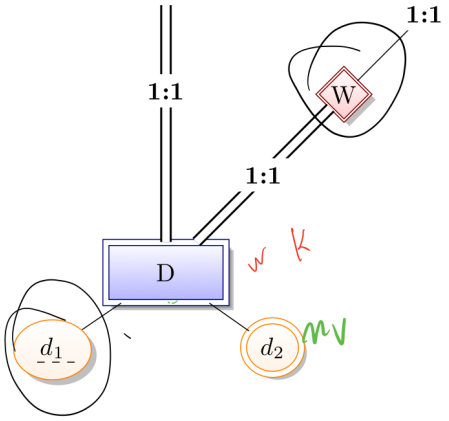
);



step 3 multi-valued attributes

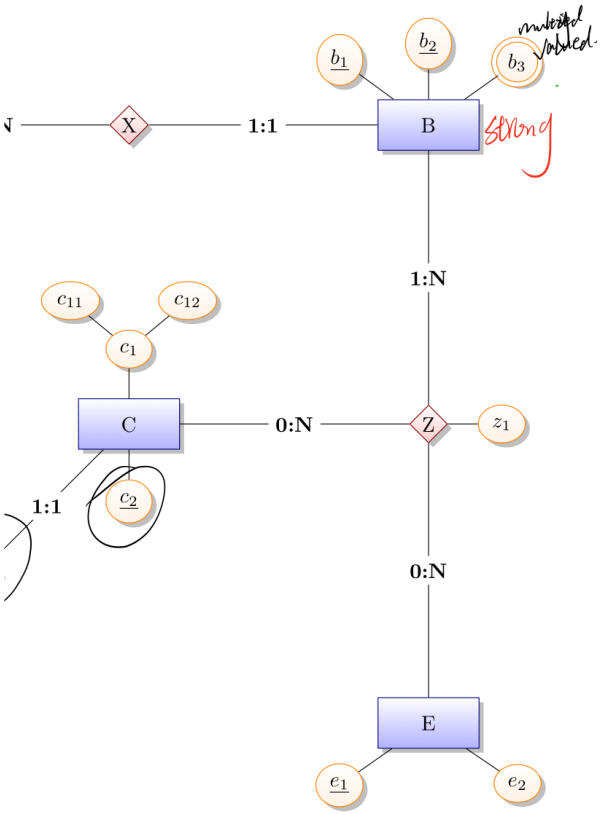
```
create table B3 (
    b1 int,
    b2 int,
    b3 int,
  primary key (b1, b2, b3),
  foreign key (b1, b2) references B
);

create table D2 (
    d1 int,
    d2 int,
    c2 int,
    a11 int,
    a12 int,
  primary key (d1, d2, c2, a11, a12),
  foreign key (d1, c2, a11 a12)
    references D.
```





Step 4 relationships

```
create table Z {
    b1 int,
    b2 int,
    c2 int,
    e1 int,
    z1 int,
primary key (b1, b2, c2, e1),
foreign key b1, b2 references B,
foreign key c2 references C
foreign key e1 references E.
}
```



Part 3.3 Normalization (Total: 30 Points)

Question 3.3.1 (30 Points)

Considering the following relations, determine the candidate key(s) and normal form for each relation (note that a 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 $C \rightarrow B, B \rightarrow D, A \rightarrow BD$
2. $R(A, B, C, D, E)$ and the Functional Dependencies are $A \rightarrow B, B \rightarrow C, AC \rightarrow D$
3. $R(A, B, C, D, E)$ and the Functional Dependencies are $A \rightarrow BC, D \rightarrow E, AB \rightarrow CD$
4. $R(A, B, C, D, E)$ and the Functional Dependencies are $A \rightarrow C, B \rightarrow C, AB \rightarrow DE, BC \rightarrow AD$
5. $R(A, B, C, D, E)$ and the Functional Dependencies are $AC \rightarrow BE, A \rightarrow D, B \rightarrow A, BC \rightarrow D$
6. $R(A, B, C, D)$ and the Functional Dependencies are $C \rightarrow B, B \rightarrow AC, A \rightarrow BD$

1. candidate key: AC, the relation is 1 NF

2. Candidate Key: AE the relation is 1 NF

3. candidate key: A, AB the relation is 1NF, 2NF

4. Candidate key: B, AB, BC, the relation is 1NF.

5. candidate key: AC, BC the relation is 1NF

6. Candidate key: A, B, C the relation is 1NF, 2NF