Project for Database Design

Phase II. Relational Schema

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0. Pre-Illumination

For clearly describing the relational schema design, we separate this report into four sections. In Section 1 we modify the original EER diagram and explain what are changed, respect to our Phase I EER diagram. And then, in Section 2 we give the relational schemas converted from our Phase I EER diagram with detailed mapping step by step. Section 3 is the documentation of relational schemas. This documentation mainly describes data type and format for each attribute in each relational schema. We also explain our assumptions for the documentation in this section. Finally, a short summary is given at the end of this report.

1. Modified EER diagram

We have added an attribute ***event_staff_id*** as primary key in the union entity type ***EVENT_STAFF***. The attribute has been added as a surrogate key to implement relational model for the union entity type. Foreign keys will be added in the corresponding relations of the super-class entity types.

The modification does not mean that the original design is incorrect. Actually, our original design is more close to real life. But when we implement, we want to make the process easier. Besides, the new way will not affect the functionality of this database. The modified EER diagram is shown in Figure on the second last page.

2. Mapping Relational Schemas

We use seven-step algorithm to convert the basic EER model constructs into relations.

The following are detailed mapping process.

2.1 Mapping of Regular Entity Types, Specializations.

For every strong Entity E in the ER schema we map it and its attributes directly into a relation.

Here, EMPLOYEE is the superclass and specialised into HOUSE_KEEPING, CONCIERGE, RECEPTION, LICENSED_EMP, MANAGEMENT, DINING subclasses. Each of these subclasses are made into relations with Emp_ID as the primary key and foreign key referring to the EMPLOYEE relation. The attributes of the corresponding subclass are also mapped to this relation. Also, address is a composite attributes in the employee entity. We map the Atomic attributes of the composite attribute into the employee relation.

EMPLOYEE

Emp_ID	Name	Age	Salary_rate	Street_no	Street_name	city	state	Zip_code

HOUSE_KEEPING

Emp_ID	Yrs_experience

CONCIERGE

Emp_ID	Yrs_experience

RECEPTION

Emp_ID

LICENSED_EMP

Emp_ID	Licensed_emp_type

MANAGEMENT

Emp_ID	Title

DINING

Emp_ID	Shift_type

Similarly, DINING entity is the superclass to the specialised subclasses CATERING, BUFFET, FINE_DINING and LOUNGE/BAR. A separate relation is created for each of these subclasses with Emp_id as the primary key and foreign key referring to the DINING relation. The attributes of the corresponding subclasses are also mapped into this relation.

CATERING

Emp_ID

BUFFET

Emp_ID

FINE_DINING

Emp_ID

LOUNGE/BAR

Emp_ID

All strong entity types are mapped directly into a separate relation with their corresponding attributes. One of the key attributes of the strong entity type is chosen as the primary key of the relation. The relations of the strong entity types are mapped to their corresponding relations are shown below.

ROOM

Room_no	Price_per_night	Room_type	Bed_type

BILL

Bill_id	Bill_amount	Date_issued

EVENT

Event_ID	Event_staff_ID	Manager_ID	Time	Date

CLIENT

Client_ID

ORGANIZATION

Client_ID

INDIVIDUAL

Client_ID	D_O_B	Sex	Name

The EVENT_STAFF is a union type of the superclasses LICENSED_EMP, MANAGEMENT and CATERING. Here, we Event_staff_ID is the primary key of the EVENT_STAFF relation and is also called the surrogate key. Hence we add Event_staff_ID as a foreign key in each of the superclasses namely LICENSED_EMP, MANAGEMENT, CATERING of the union type EVENT_STAFF.

EVENT_STAFF

Event_staff_ID	On-Call_no

LICENSED_EMP

Emp_ID	Event_staff_ID	Licensed_emp_type

MANAGEMENT

Emp_ID	Event_staff_ID	Title

CATERING

Emp_ID	Event_staff_ID

2.2 Mapping of Weak Entity Types

For each weak entity type W in the ER schema with owner entity type E, we create a relation R and include all simple attributes (or simple components of composite attributes) of W as attributes of R. In addition, include as foreign key attributes of R, the primary key attribute(s) of the relation(s) that correspond to the owner entity type(s); this takes care of mapping the identifying relationship type of W. The primary key of R is the combination of the primary key(s) of the owner(s) and the partial key of the weak entity type W, if any.

The mapping of the weak entity types CHECKIN, PAYMENT, ACCOUNT are shown below:

CHECKIN

Room_no	Checkin_date	Bill_ID	Receptionist_ID	Individual_ID	Check_out_date	Lounge_access	Key_type	Time

PAYMENT

Bill_ID	Payment_ID	Client_ID	date	Time	Amount	Type

ACCOUNT

Client_ID	Account_No	Account_type

2.3 Mapping of Binary 1:1 Relationship Types

The mapping method is exhibited in the following table.

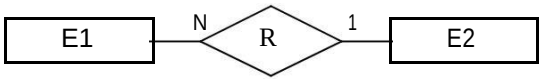
Relation	Mapping Method
	We use *Foreign key approach* to map this relationship. Since on E2 side, the relationship is total participation, we include the primary key of E1 as a foreign key in E2.

CHECKIN

Room_no	Checkin_date	Bill_ID	Receptionist_ID	Individual_ID	Check_out_date	Lounge_access	Key_type	Time

2.4 Mapping of Binary 1:N Relationship Types

The mapping method is exhibited in the following table.

Relation	Mapping Method
	We use Foreign key approach to map this relationship. The *N-side* of this relationship type is E1. Thus we include the primary key of the relation E2 as foreign key in relation E1.

CHECKIN

Room_no	Checkin_date	Bill_ID	Receptionist_ID	Individual_ID	Check_out_date	Lounge_access	Key_type	Time

PAYMENT

Bill_ID	Payment_ID	Client_ID	date	Time	Amount	Type

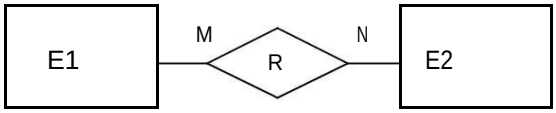
ACCOUNT

Client_ID	Account_No	Account_type

EVENT

Event_ID	Event_staff_ID	Manager_ID	Time	Date

2.5 Mapping of Binary M:N Relationship Types

Relation	Mapping Method
	Relationships of this Many to Many type are mapped directly to a new relation S. The Primary key of the relation S will be the combination of the primary keys of relation E1 and relation E2. The foreign key attributes are the individual primary key attributes of the relations E1 and E2.

SERVES

Event_staff_ID	Event_ID

CONTAINS

Client_ID	Account_no	Bill_ID

HOLDS

Event_ID	Organizational_ID	Deposit

CLEANS

Housekeeping_ID	Room_no	Date	Time

2.6 Mapping of Multi-valued Attributes

For each Multivalued attribute A in Entity E we create a separate relation R. The Relation R will include an attribute corresponding to the multivalued attribute and the primary P of the entity E it is from as a foreign key S of the relation R referring to that entity E. The primary of the new relation formed is a combination of the multivalued attribute the A and S.

Here, languages and licenses_obtained are the multivalued attributes corresponding to entities RECEPTION and LICENSED_EMP. Also, Phone_no and Membership_no are the multi valued attributes corresponding to the enitity Individual. Hence, we create a separate relation for each of them as shown below.

LANGUAGES

Emp_ID	License_obtained

LICENSES_OBTAINED

Emp_ID	Language

PHONE_NO

Client_ID	Phone_no

MEMBERSHIP_NO

Client_ID	MEMBERSHIP_NO

2.7 Mapping of N-ary Relationship Types

PREPARES is the relation corresponding to the ternary relationship type PREPARES that connects three entity types, namely BILL, ACCOUNTANT and EVENT. We use Bill_ID as the primary key of this relation. All the columns are foreign key attributes for the three participating entity types correspondingly.

PREPARES

Bill_ID	Accountant_ID	Event_ID

2.8 Final Relation Schema of Hospital Database

After seven steps mapping, we can get the final result of relation schema.

Besides, we point out foreign keys by arrows from foreign key to the original keys between two relations.

Figure on the last page displays all the relational schemas converted from Phase I EER diagram.

3. Documentation for schemas

3.1 Explanation for format design

After mapping the EER diagram into relation schema that can be implemented in a relational DBMS like Oracle, we should also design the format of each attribute in every relation. Here we suppose that all the assumptions, explanations and limitations in phase I are also suitable for the design in this phase. Thus, we shall not repeat them. In this section, we only explain our assumptions for the data types and formats in the documentation. The rules are shown as follows:

- All IDs are 9 digit Integers unless specified otherwise in the format tables below.
- All Age related attributes are Integers that lie in the range [0, 200].
- All Years of experience related attributes are Integers that lie in the range [0, 50].
- All the Date attributes are in the format 'MM/DD/YYYY'.
- All the Time attributes are in the format 'HH-MM-SS'
- All the phone number attributes are 9 digit Integers that are to be represented in '(xxx)xxx-xxxx' format.

3.2 Format for Every Relation

Table 3 gives data type and format for each attribute in each relational schema.

Table 3. Format for Each Attribute (example)

Relation Names	Attributes	Date Type
EMPLOYEE	Emp_id	Integer
	Name	String <= 20 chars
	Age	Integer [0, 200]
	Salary_rate	Float
	Street_No	Integer
	Street_Name	String <= 20 chars
	City	String <= 20 chars
	State	String <= 20 chars
	Zip_code	String <= 6 chars

Relation Names	Attributes	Date Type
HOUSE_KEEPING	Emp_id	Integer
	Yrs_experience	Integer [0, 50]

Relation Names	Attributes	Date Type
CONCIERGE	Emp_id	Integer
	Yrs_experience	Integer [0, 50]

Relation Names	Attributes	Date Type
LICENSED_EMP	Emp_id	Integer
	Event_staff_id	Integer
	Licensed_employee_type	String {‘ACCOUNTANT’, ‘TECH_SUPPORT’}

Relation Names	Attributes	Date Type
RECEPTION	Emp_id	Integer

Relation Names	Attributes	Date Type
MANAGEMENT	Emp_id	Integer
	Event_staff_id	Integer
	Title	String <= 20 chars

Relation Names	Attributes	Date Type
DINING	Emp_id	Integer
	Shift_type	Char {m, a, e, n}

Relation Names	Attributes	Date Type
LICENSES_OBTAINED	Emp_id	Integer
	License_obtained	String <= 20 chars

Relation Names	Attributes	Date Type
LANGUAGES	Emp_id	Integer
	Language	String <= 20 chars

Relation Names	Attributes	Date Type
LOUNGE_BAR	Emp_id	Integer

Relation Names	Attributes	Date Type
FINE_DINING	Emp_id	Integer

Relation Names	Attributes	Date Type
BUFFET	Emp_id	Integer

Relation Names	Attributes	Date Type
CATERING	Emp_id	Integer
	Event_staff_id	Integer

Relation Names	Attributes	Date Type
EVENT_STAFF	Event_staff_id	Integer
	On-call_no	Integer 4 digits

Relation Names	Attributes	Date Type
EVENT	Event_id	Integer 4 digits
	Event_staff_id	Integer
	Manager_id	Integer
	Time	Time
	Date	Date

Relation Names	Attributes	Date Type
SERVES	Event_staff_id	Integer
	Event_id	Integer 4 digits

Relation Names	Attributes	Date Type
ROOM	Room_no	Integer 4 digits
	Price_per_night	Float
	Room_type	String <= 20 chars
	Bed_type	String <= 20 chars

Relation Names	Attributes	Date Type
CLEANS	Housekeeping_id	Integer
	Room_no	Integer 4 digits
	Time	Time
	Date	Date

Relation Names	Attributes	Date Type
CHECKIN	Room_no	Integer 4 digits
	Checkin_date	Date
	Bill_id	Integer 6 digits
	Receptionist_id	Integer
	Individual_id	Integer 6 digits
	Checkout_date	Date
	Lounge_access	Boolean
	Key_type	String {‘card’, ‘digital'}
	Time	Time

Relation Names	Attributes	Date Type
CLIENT	Client_id	Integer 6 digits

Relation Names	Attributes	Date Type
INDIVIDUAL	Client_id	Integer 6 digits
	d_o_b	Date
	Sex	String <= 20 chars
	Name	String <= 20 chars

Relation Names	Attributes	Date Type
PHONE_NO	Client_id	Integer 6 digits
	Phone_no	Integer

Relation Names	Attributes	Date Type
MEMBERSHIP_NO	Client_id	Integer 6 digits
	Membership_no	Integer

Relation Names	Attributes	Date Type
ORGANIZATION	Client_id	Integer 6 digits

Relation Names	Attributes	Date Type
BILL	Bill_id	Integer 6 digits
	Bill_amount	Float
	Date_issued	Date

Relation Names	Attributes	Date Type
PAYMENT	Bill_id	Integer 6 digits
	Payment_id	Integer
	Client_id	Integer 6 digits
	Time	Time
	Date	Date
	Amount	Float
	Type	String <= 20 chars

Relation Names	Attributes	Date Type
PREPARES	Bill_id	Integer 6 digits
	Accountant_id	Integer
	Event_id	Integer 4 digits

Relation Names	Attributes	Date Type
ACCOUNT	Client_id	Integer 6 digits
	Account_no	Integer
	Account_type	String <= 20 chars

Relation Names	Attributes	Date Type
CONTAINS	Client_id	Integer 6 digits
	Account_no	Integer
	Bill_id	Integer 6 digits

Relation Names	Attributes	Date Type
HOLDS	Event_id	Integer 4 digits
	Organization_id	Integer
	Deposit	Float

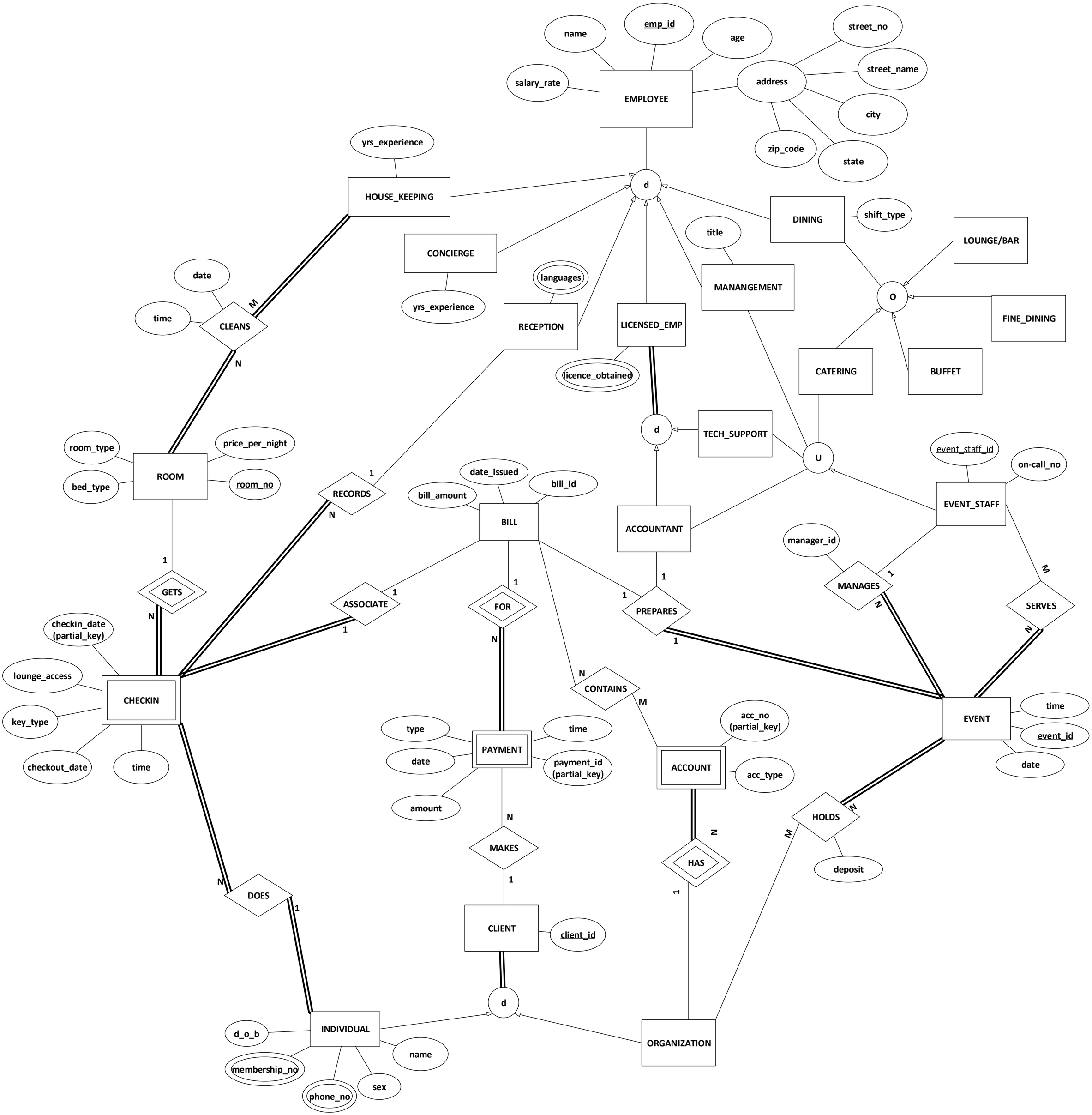
3.3 Implement the Database

Use SQL to create Relation Schema and constraints in Oracle.

4. Conclusion

In this report we discussed and drew the relational schemas for Database of XXX. We also give the data type and format for each attribute in each schema. Then we explain our assumptions in the documentation. This report analyzed the

logical model of Database. The next step is to implement this database. In the future, we may change some design when facing practical difficulties and other requests.


name
emp_id
age
street_no
street_name
salary_rate
EMPLOYEE
address
city
zip_code
state
yrs_experience
HOUSE_KEEPING
d
DINING
shift_type
title
CONCIERGE
LOUNGE/BAR
date
languages
MANANGEMENT
time
CLEANS
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yrs_experience
RECEPTION
LICENSED_EMP
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d
TECH_SUPPORT
room_type
price_per_night
ROOM
bed_type
room_no
1
RECORDS
N
U
event_staff_id
on-call_no
date_issued
bill_id
bill_amount
BILL
ACCOUNTANT
EVENT_STAFF
manager_id
1
MANAGES
N
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SERVES
N
1
GETS
N
1
ASSOCIATE
1
1
FOR
N
1
PREPARES
1
checkin_date
(partial_key)
lounge_access
CHECKIN
key_type
checkout_date
time
N
CONTAINS
M
type
time
PAYMENT
date
payment_id
(partial_key)
amount
acc_no
(partial_key)
ACCOUNT
acc_type
EVENT
time
event_id
date
HOLDS
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M
deposit
N
MAKES
1
N
HAS
1
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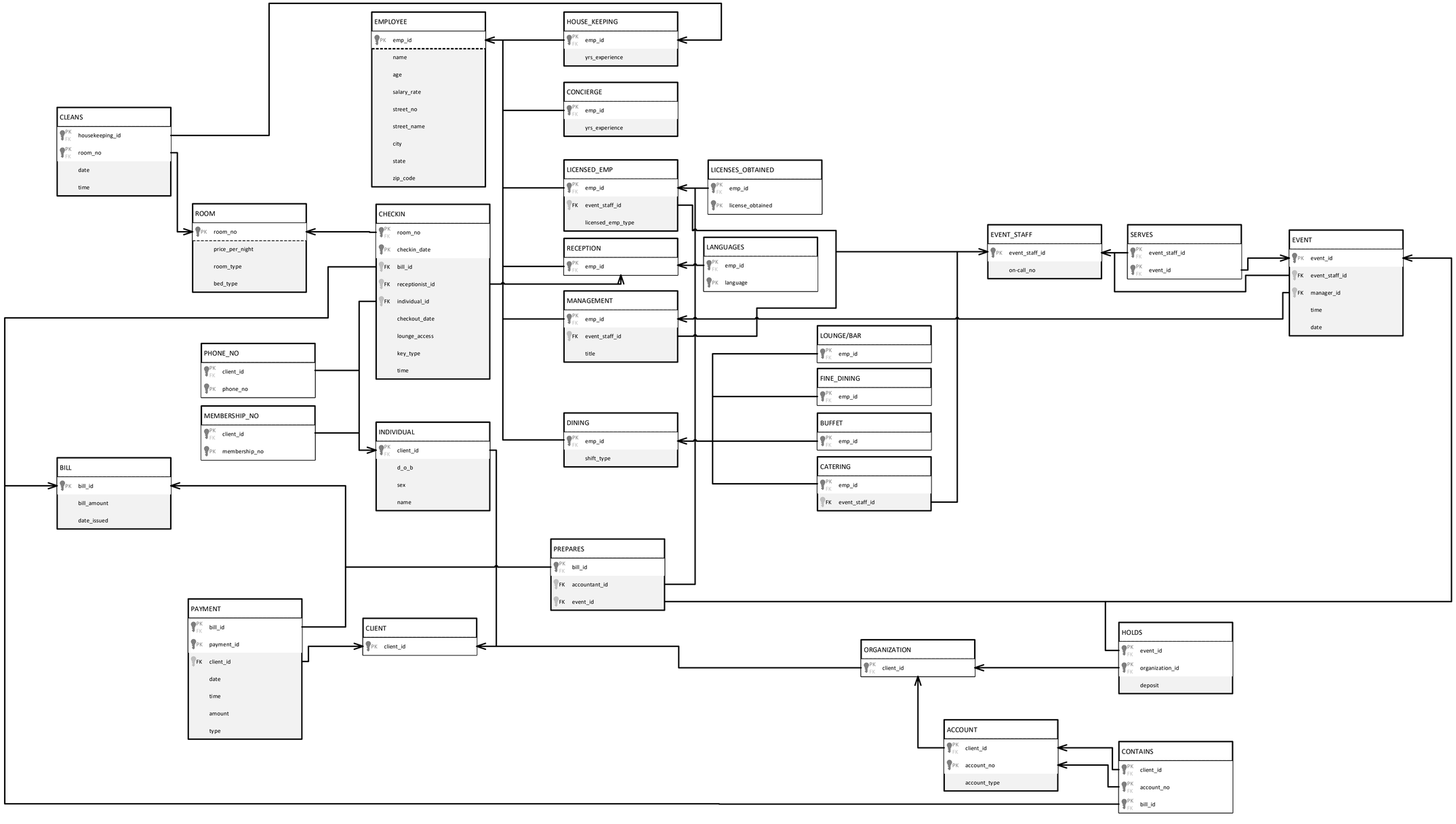
DOES
1
CLIENT
client_id
d
d_o_b
INDIVIDUAL
name
membership_no
phone_no
sex
ORGANIZATION


EMPLOYEE
PK emp_id
name
age
salary_rate
street_no
street_name
city
state
zip_code
HOUSE_KEEPING
PK FK emp_id
yrs_experience
CONCIERGE
PK FK emp_id
yrs_experience
CLEANS
PK FK housekeeping_id
PK FK room_no
date
time
ROOM
PK room_no
price_per_night
room_type
bed_type
CHECKIN
PK FK room_no
PK checkin_date
FK bill_id
FK receptionist_id
FK individual_id
checkout_date
lounge_access
key_type
time
LICENSED_EMP
PK FK emp_id
FK event_staff_id
licensed_emp_type
LICENSES_OBTAINED
PK FK emp_id
PK license_obtained
RECEPTION
PK FK emp_id
LANGUAGES
PK FK emp_id
PK language
MANAGEMENT
PK FK emp_id
FK event_staff_id
title
EVENT_STAFF
PK event_staff_id
on-call_no
SERVES
PK FK event_staff_id
PK FK event_id
EVENT
PK event_id
FK event_staff_id
FK manager_id
time
date
PHONE_NO
PK FK client_id
PK phone_no
MEMBERSHIP_NO
PK FK client_id
PK membership_no
INDIVIDUAL
PK FK client_id
d_o_b
sex
name
DINING
PK FK emp_id
shift_type
LOUNGE/BAR
PK FK emp_id
FINE_DINING
PK FK emp_id
BUFFET
PK FK emp_id
CATERING
PK FK emp_id
FK event_staff_id
BILL
PK bill_id
bill_amount
date_issued
PREPARES
PK FK bill_id
FK accountant_id
FK event_id
PAYMENT
PK FK bill_id
PK payment_id
FK client_id
date
time
amount
type
CLIENT
PK client_id
ORGANIZATION
PK FK client_id
HOLDS
PK FK event_id
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deposit
ACCOUNT
PK FK client_id
PK account_no
account_type
CONTAINS
PK FK client_id
PK FK account_no
PK FK bill_id