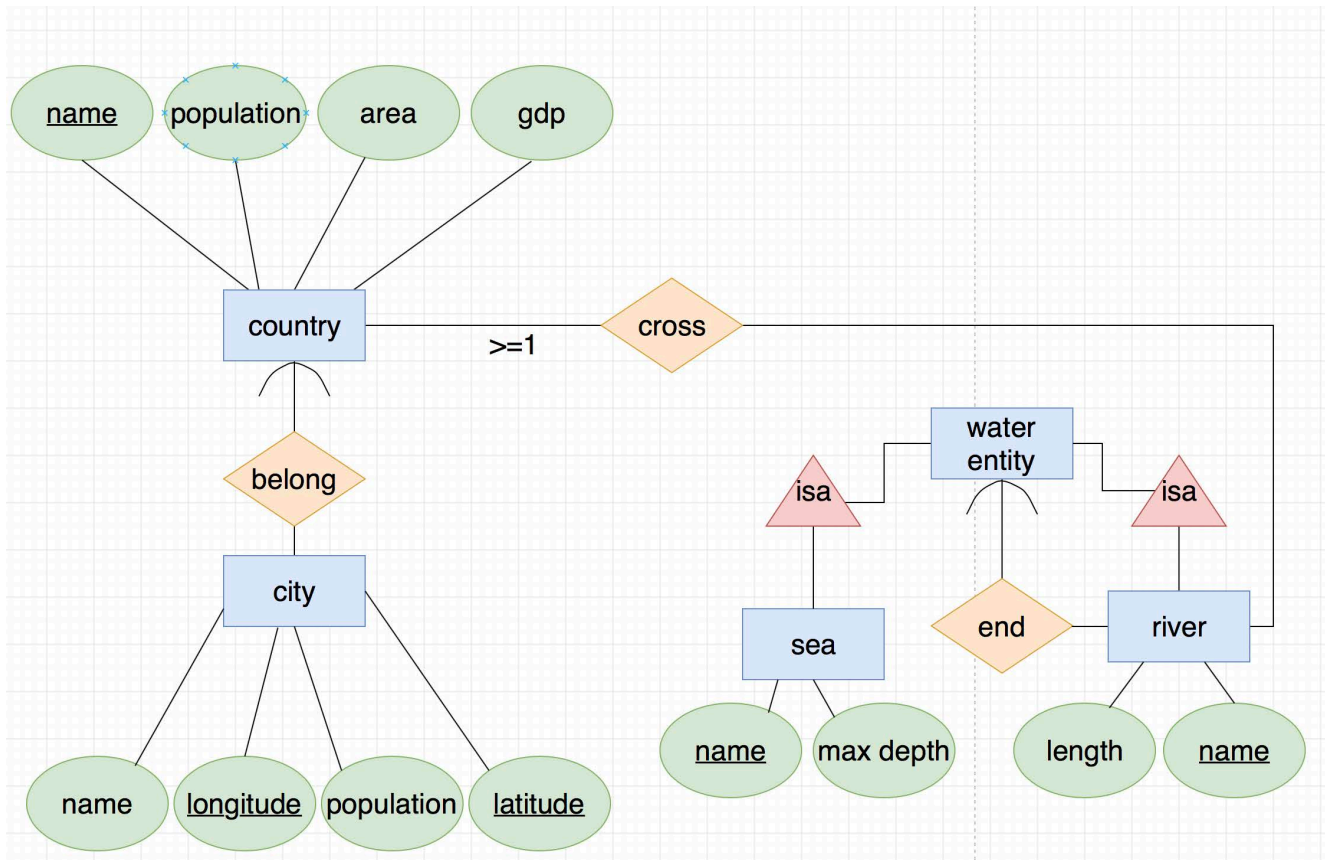


Q1



Q2-1

.table

PRAGMA foreign_keys=ON;

```
DROP TABLE IF EXISTS NonProfessionalDriver;
DROP TABLE IF EXISTS Truck;
DROP TABLE IF EXISTS ProfessionalDriver;
DROP TABLE IF EXISTS Drives;
DROP TABLE IF EXISTS Car;
DROP TABLE IF EXISTS Vehicle;
DROP TABLE IF EXISTS Driver;
DROP TABLE IF EXISTS InsuranceCo;
DROP TABLE IF EXISTS Person;
```

.table

```
create table Person(
    ssn int primary key,
    name varchar(100)
);
```

```
create table InsuranceCo(
    name varchar(100) primary key,
    phone int
);
```

```
create table Driver(
    driverID int,
    ssn int primary key,
    foreign key (ssn) references Person(ssn)
);
```

```
create table Vehicle(
    licensePlate varchar(100) primary key,
    year int,
    maxLiability real,
    name varchar(100) references InsuranceCo(name),
    ssn int references Person(ssn)
);
```

```
create table Car(
    make varchar(100),
    licensePlate varchar(100) primary key,
    foreign key (licensePlate) references Vehicle(licensePlate)
);
```

```
create table Drives(
    licensePlate varchar(100),
    ssn int,
    primary key (licensePlate, ssn),
    foreign key (licensePlate) references Vehicle(licensePlate),
    foreign key (ssn) references Person(ssn)
);
```

```
create table ProfessionalDriver(
    medicalHistory varchar(100),
```

```
    ssn int primary key,  
    foreign key (ssn) references Person(ssn)  
);
```

```
create table Truck(  
    capacity int,  
    ssn int references Person(ssn),  
    licensePlate varchar(100) primary key,  
    foreign key (licensePlate) references Vehicle(licensePlate)  
);
```

```
create table NonProfessionalDriver(  
    ssn int primary key,  
    foreign key (ssn) references Person(ssn)  
);
```

.table

Q2-2

Which relation in your relational schema represents the relationship "insures" in the E/R diagram and why is that your representation?

I didn't create a table to represent "insures", but a reference. In our E/R diagram, "insures" is a many-one relationship, no separate relations for many-one relationship, so we don't have a relational schema to represent it.

Specifically, I create a table for InsuranceCo and a table for Vehicle. From the graph, we can see that Vehicle-InsuranceCo has a many-one relationship, which means that each vehicle can be insured by at most one insurance company, there are many vehicles. Vehicle table has an attribute "name" references the attribute "name" of InsuranceCo table, this reference is a representation of "insures".

Q2-3

Compare the representation of the relationships "drives" and "operates" in your schema, and explain why they are different.

In our E/R diagram, "drives" is a many-many relationship, I need to create a table to map the associations between two tables to represent "drives". Specifically, I create a table for Car and a table for NonProfessionalDriver, Car table has a primary key "licensePlate", NonProfessionalDriver table has a primary key "ssn", the intermediate table "drives" takes these two primary keys as primary composite key.

"operates" is a many-one relationship, no separate relations for many-one relationship, so I didn't create a table to represent "operates". Specifically, I create a table for Truck and a table for ProfessionalDriver. From the graph, we can that Truck-ProfessionalDriver has a many-one relationship. Truck table has an attribute "ssn" references the attribute "ssn" of Person, ProfessionalDriver table has an attribute "ssn" references the attribute "ssn" of Person, the intersection of reference is a representation of "operates", the person with the common "ssn" in both Truck and ProfessionalDriver tables is the ProfessionalDriver "operates" the Truck.

3.

① $R(ABCDE)$ $D \rightarrow B^V$ $CE \rightarrow A^V$

$$D^+ = DB \neq ABCDE$$

 $R_1(\underline{D}, B)$ $R_2(\underline{D}, A, C, E)$

$$CE^+ = CEA \neq CEDA$$

 $R_{21}(\underline{C}, E, A)$ $R_{22}(\underline{C}, E, D)$

final decomposition into BCNF: $R_1(\underline{D}, B)$, $R_{21}(\underline{C}, E, A)$, $R_{22}(\underline{C}, E, D)$

② $S(ABCDE)$ $A \rightarrow E^V$ $BC \rightarrow A^V$ $DE \rightarrow B$

$$A^+ = AE \neq ABCDE$$

 $R_1(\underline{A}, E)$ $R_2(\underline{A}, B, C, D)$

$$BC^+ = BCA \neq ABCD$$

 $R_{21}(\underline{B}, C, A)$ $R_{22}(\underline{B}, C, D)$

final decomposition into BCNF: $R_1(\underline{A}, E)$, $R_{21}(\underline{B}, C, A)$, $R_{22}(\underline{B}, C, D)$

4.

① all sets of attr. closed $x^+ = x$
 $A \rightarrow A \quad B \rightarrow B \quad C \rightarrow C \quad D \rightarrow D$

② only closed sets are $\{\}$, $\{ABCD\}$
 $A \rightarrow B \quad B \rightarrow C \quad C \rightarrow D \quad D \rightarrow A$

③ only closed sets are $\{\}$, $\{AB\}$, $\{ABCD\}$
 $A \rightarrow B \quad B \rightarrow A \quad C \rightarrow BCD \quad D \rightarrow BCD$