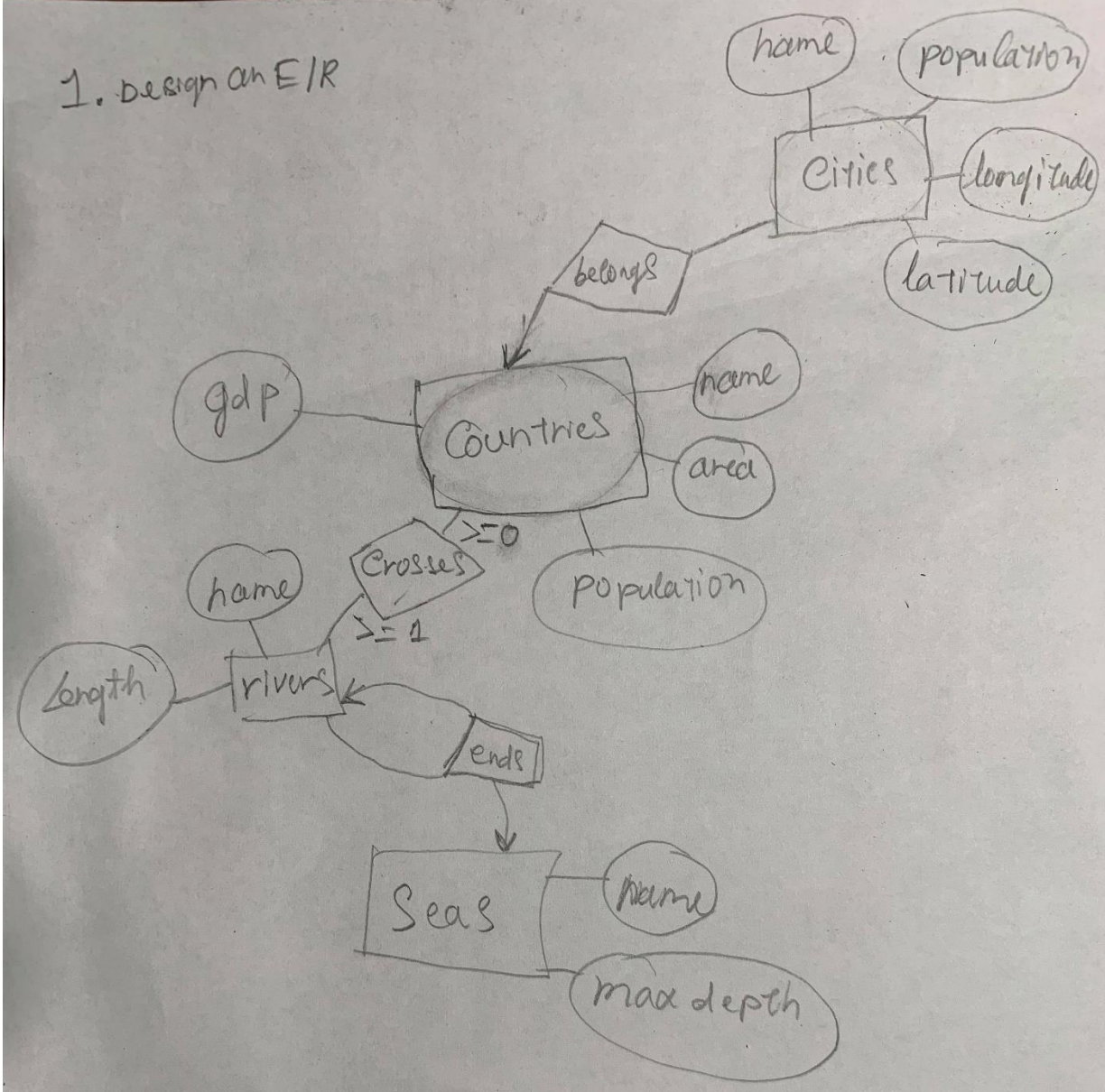
1. Design an E/R



2.

CREATE TABLE InsuranceCo(name VARCHAR(60) PRIMARY KEY, phone INT);

CREATE TABLE Person(ssn INT PRIMARY KEY, name VARCHAR(60));

CREATE TABLE Driver(driverID INT PRIMARY KEY, ssn INT, FOREIGN KEY (ssn) REFERENCES Person(ssn));

CREATE TABLE NonprofessionalDriver(driverID INT PRIMARY KEY, FOREIGN KEY (driverID) REFERENCES Driver(driverID));

CREATE TABLE ProfessionalDriver(driverID INT PRIMARY KEY, medicalHistory VARCHAR(60), FOREIGN KEY (driverID) REFERENCES Driver(driverID));

CREATE TABLE Vehicle(licensePlate VARCHAR(60) PRIMARY KEY, year INT, maxLiability REAL, name VARCHAR(60) REFERENCES InsuranceCo(name), ssn INT REFERENCES Person(ssn));

CREATE TABLE Truck(licensePlate VARCHAR(60) PRIMARY KEY, capacity VARCHAR(60), driverID INT REFERENCES ProfessionalDriver(driverID), FOREIGN KEY (licensePlate) REFERENCES Vehicle(licensePlate));

CREATE TABLE Car(licensePlate VARCHAR(20) PRIMARY KEY, make VARCHAR(60), FOREIGN KEY (licensePlate) REFERENCES Vehicle(licensePlate));

CREATE TABLE Drives(driverID INT REFERENCES NonProfessionalDriver(driverID), licensePlate VARCHAR(60) REFERENCES CAR(licensePlate), PRIMARY KEY(driverID, licensePlate));

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

Vehicle(licensePlate, year, maxLiability, name, ssn);
InsuranceCo(name, phone);

There is a reference between Vehicle and InsuranceCo because Vehicle needs insurance, and they need information each other such that Vehicle reference the primary key of InsuranceCo.

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

We have the relationship Truck's "operates", and we can reference Truck to Professional Driver.

Moreover, in Car's "drives" relationship in which we can't show that a single car can be driven by multiple Non-Professional Drivers. Therefore, we need to separate table which can show the relationship of many to many by making distinct car to non-professional-driver key table such that we can identify a car refers to one or drivers.

3. Consider the following two relational schemas and sets of functional dependencies:

R(A,B,C,D,E) with functional dependencies D → B, CE → A.

S(A,B,C,D,E) with functional dependencies A → E, BC → A, DE → B.

We know that X+ = {X} or X+ = {entire set} is not satisfy BCNF.

a. We have R(A,B,C,D,E), D+ = {D,B} is not satify BCNF neither {D} nor {A,B,C,D,E}. we set I = D+ - D = B and J = (A,B,C,D,E) - (D,B) = (A,C,E). R1(D U I) = R1(B,D) and R2(D U J) = R2(A,C,D,E). So R(A,B,C,D,E) is come from R1 and R2.
b. We know R1(B,D), B+ = {B} and D+ = {B,D}. Both B+ and D+ can be itself or whole set which satisfy a BCNF. So, R1(BD) can be a key.
c. We know R2(A,C,D,E), (CE)+ = {A,C,E} is not satisfy BCNF., then I = CE+ - CE = A and J = (A,C,D,E) - (A,C,E) = D. R3(CE U I) = R3(A,C,E) and R4(CE U J) = R4(C,D,E). R2 is come from R3 and R4.
d. We know R3(A,C,E), A+ = {A}, C+ = {C}, E+ = {E} and (CE)+ = {A,C,E}which is satisfy BCNF.
e. We know R4(C,D,E), C+ = {C}, D+ = {D}, E+ = {E} which satisfy BCNF.

Therefore, we have: R1(B,D), R3(A,C,E), R4(C,D,E)

4. A set of attributes X is called closed (with respect to a given set of functional dependencies) if X+=X. Consider a relation with schema R(A,B,C,D) and an unknown set of functional dependencies. For each closed attribute set below, give a set of functional dependencies that is consistent with it.

Therefore, we have:

We know all sets of attributes are closed:

A -> A

B -> B

C -> C

D -> D

We know the only closed sets are {} and {A,B,C,D}:

A -> B

B -> C

C -> D

D -> A

We know the only closed sets are {}, {A,B}, and {A,B,C,D}:

A -> B

B -> A

C -> A,B,D

D -> A,B,C