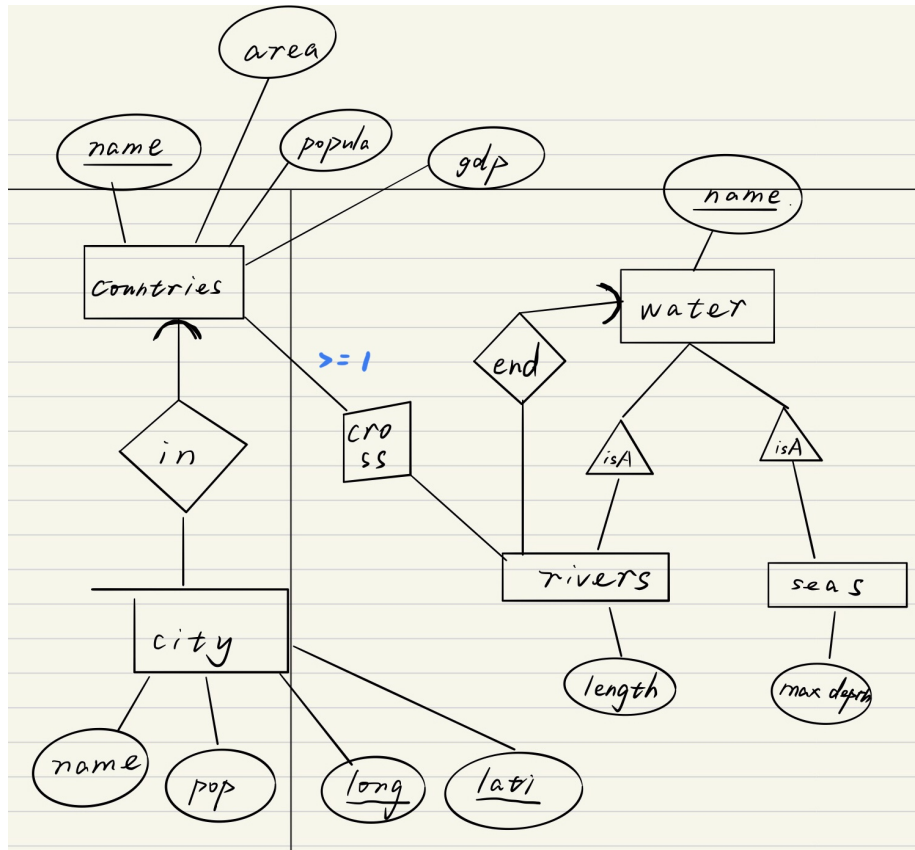# 1 Design an E/R diagram



# 2 Consider the following E/R diagram...

1.

```
1   CREATE TABLE Vehicle(
2     licensePlate varchar(7) PRIMARY KEY,
3     year int,
4     maxLiability int,
5     ins_name varchar(20) REFERENCES InsuranceCo(name),
6     per_ssn int REFERENCES Person(ssn)
7   );
8
9   CREATE TABLE Car(
10    C_licensePlate varchar(7) PRIMARY KEY REFERENCES ...
          Vehicle(licensePlate),
11    make text
12  );
```

```
13
14  CREATE TABLE Truck(
15    T_licensePlate varchar(7) PRIMARY KEY REFERENCES ...
          Vehicle(licensePlate),
16    capacity int,
17    PD_ssn int REFERENCES ProfessionalDriver(D_ssn)
18  );
19
20  CREATE TABLE NonProfessionalDriver(
21    D_ssn int PRIMARY KEY REFERENCES Driver(P_ssn)
22  );
23
24  CREATE TABLE ProfessionalDriver(
25    D_ssn int PRIMARY KEY REFERENCES Driver(P_ssn),
26    medicalHistory varchar(20)
27  );
28
29  CREATE TABLE Driver(
30    P_ssn int PRIMARY KEY REFERENCES Person(ssn),
31    driverID varchar(12)
32  );
33
34  CREATE TABLE Person(
35    ssn int PRIMARY KEY,
36    name varchar(10)
37  );
38
39  CREATE TABLE InsuranceCo(
40    name varchar(20) PRIMARY KEY,
41    phone int
42  );
43
44  CREATE TABLE Drives(
45    NPD_ssn int REFERENCES NonProfessionalDriver(D_ssn),
46    V_licensePlate varchar(7) REFERENCES Vehicle(licensePlate),
47    PRIMARY KEY (NPD_ssn, V_licensePlate)
48  );
```

2. The relationship "insures" is contained by the relation "Vehicle." Since "insures" is a many-to-1 relationship, each vehicle is guaranteed to have at most 1 insurance company. In order to reduce data redundancy, the "Vehicle" relation will include the attribute(s) "maxLiability" in relationship "insures" and a foreign key to the relation "InsuranceCo."

3. The difference is that: **relationship "Drives" is a many-to-many relationship while "Operates" is a many-to-one relationship.** In order to represent a many-to-many relationship, a new table must be created. However, there's no need to create a new table for a many-to-1 relationship. We only need to add the attribute(s) of "Operates" and the a foreign key of "ProfessionalDriver" to the table "Truck"(many).

# 3 Consider the following two relational schemas

| | |
|---|---|
| | 1. use $D \to B$: |
| R(A, B, C, D, E) | Decompose R into |
| FD: | $R_1(D, B)$, $T(D, A, C, E)$. |
| $D \to B$, | Since T violates BCNF by |
| $CE \to A$ | $CE \to A$ $\{CE\}^+ = \{A, C, E\} \neq \{D, A, C, E\}$ |
| | Need to further decompose T |
| | 2. use $CE \to A$: |
| | Decompose T into. |
| | $R_2(C, E, A)$, $R_3(C, E, D)$ |
| | Now, for every combination X |
| | in either $R_2$, $R_3$ |
| | $\{X\}^+ = X$. |
| | Thus, $R_1(B, D)$, $R_2(A, C, E)$, $R_3(C, D, E)$ |
| S(A, B, C, D, E) | 1. use $BC \to A$: |
| | decompose S into. |
| FD: | $S_1(A, B, C)$, $T_1(B, C, D, E)$. |
| $A \to E$. | for $T_1$, since $DE \to B$, need to |
| $BC \to A$. | further decompose it. |
| $DE \to B$. | 2. use $DE \to B$ |
| | $S_2(B, D, E)$, $T_2(D, E, C)$. |
| | for $T_2$, any combination X satisfy |
| | $\{X\}^+ = X$. |
| | Thus, |
| | $S_1(A, B, C)$, $S_2(B, D, E)$, |
| | $S_3(C, D, E)$. |

# 4 A set of attributes is called closed...

1.
$$A \to A$$
$$B \to B$$
$$C \to C$$
$$D \to D$$

2.
$$A \to ABCD$$
$$B \to ABCD$$
$$C \to ABCD$$
$$D \to ABCD$$

3.
$$A \to B$$
$$B \to A$$
$$C \to A$$
$$D \to B$$