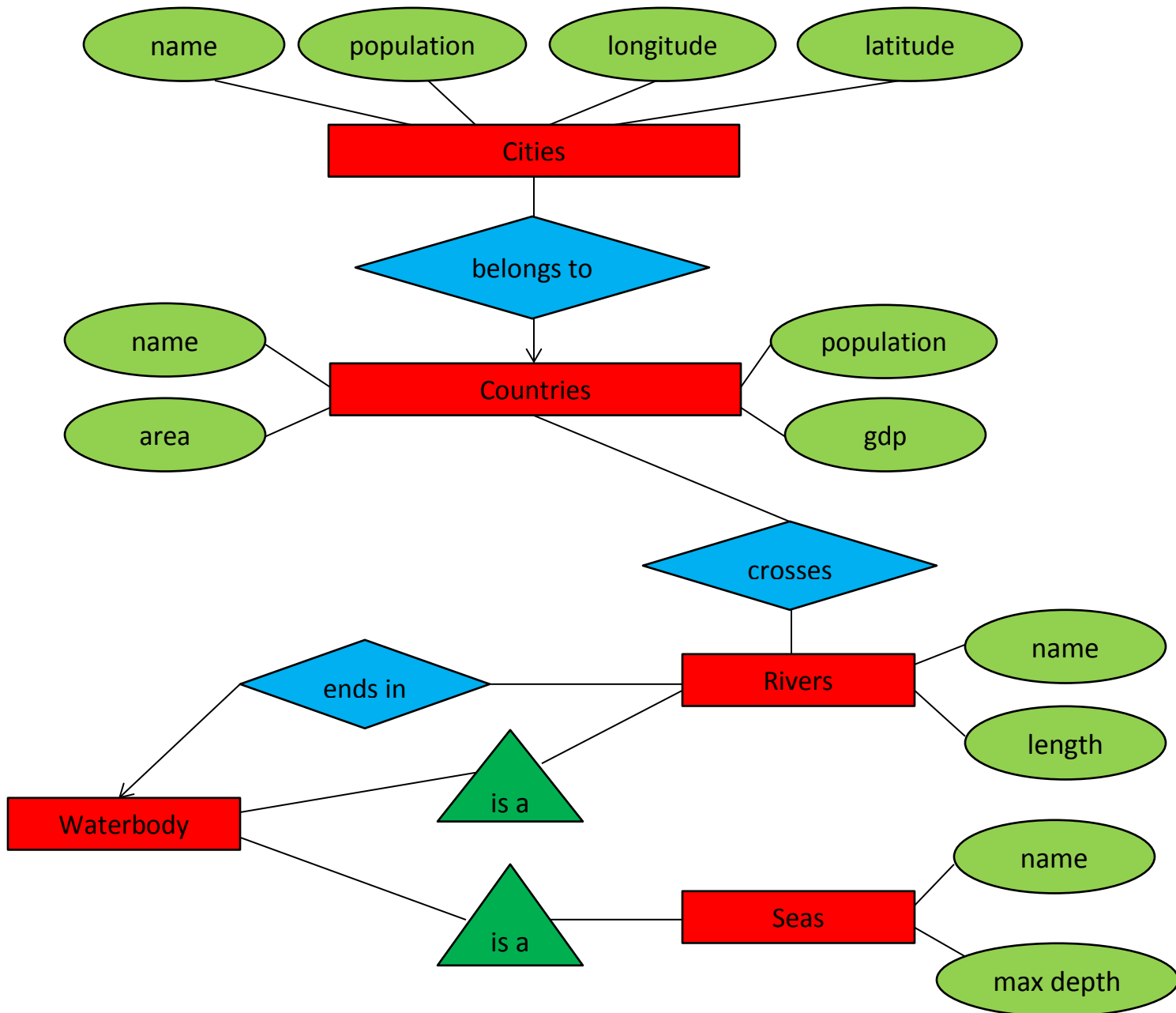


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CSE 344 Homework 6

02/27/14

1. The spec doesn't ask the key of the object, so I didn't underline any attribute. If the key is implicit asked, I think the name is a good candidate for primary key of every object.



2.

a.

```
CREATE TABLE InsuranceCo(name VARCHAR(50) PRIMARY KEY, phone VARCHAR(10));
```

```
CREATE TABLE Person(ssn VARCHAR(9) PRIMARY KEY, name VARCHAR(30));
```

```
CREATE TABLE Driver(licenceNo VARCHAR(12) PRIMARY KEY, ssn VARCHAR(9) REFERENCES Person);
```

```
CREATE TABLE NonProfessionalDriver(licenceNo VARCHAR(12) PRIMARY KEY, FOREIGN KEY (licenceNo) REFERENCES Driver);
```

```
CREATE TABLE ProfessionalDriver(licenceNo VARCHAR(12) PRIMARY KEY, medicalHistory VARCHAR(50), FOREIGN KEY (licenceNo) REFERENCES Driver);
```

```
CREATE TABLE Vehicle(licencePlate VARCHAR(10) PRIMARY KEY, year INT, maxLiability INT, maxLossDamage INT, name VARCHAR(50) REFERENCES InsuranceCo, ssn VARCHAR(9) REFERENCES Person);
```

```
CREATE TABLE Car(licencePlate VARCHAR(10) PRIMARY KEY, make VARCHAR(30), FOREIGN KEY (licencePlate) REFERENCES Vehicle);
```

```
CREATE TABLE Truck(licencePlate VARCHAR(10) PRIMARY KEY, capacity INT, licenceNo VARCHAR(12) REFERENCES ProfessionalDriver, FOREIGN KEY (licencePlate) REFERENCES Vehicle);
```

```
CREATE TABLE drives(licenceNo VARCHAR(12) REFERENCES NonProfessionalDriver, licencePlate VARCHAR(10) REFERENCES Vehicle, PRIMARY KEY (licenceNo, licencePlate));
```

b.

Vehicle(licencePlate, year, maxLiability, maxLossDamage, name, ssn)

InsuranceCo(name, phone)

In my representation, Vehicle relation represents the relationship “insure.” As the example of “N-1 Relationships to Relations” in the slides of lecture 15, we don’t need to create a separate relation; therefore, I just use Vehicle relation to represent both Vehicle and insure in the E/R diagram.

c.

The relationship “operates” is many-to-one relationship, same as “insure,” so no separate relation is created in my representation. On the other hand, the relationship “drives” is many-to-many, which we can’t represent the relationship as the way we do for many-to-one relationships; therefore, we need to use a separate relation, drives(licenceNo, licencePlate) in this case, to represent it.

3.

i.  $R(A,B,C,D,E)$ ,  $D \rightarrow B$ ,  $CE \rightarrow A$

Iteration 1:  $R$ :  $D^+ = \{D,B\}$

Dependency violations:  $D^+ \neq \{D\}$  or  $\{A,B,C,D,E\}$

Decompose into:  $R_1(D,B)$ ,  $R_2(D,A,C,E)$

Iteration 2:  $R_2$ :  $(CE)^+ = \{C,E,A\}$

Dependency violations:  $(CE)^+ \neq \{C,E\}$  or  $\{D,A,C,E\}$

Decompose into:  $R_{21}(C,E,A)$ ,  $R_{22}(C,E,D)$

Final BCNF:  $R_1(D,B)$ ,  $R_{21}(C,E,A)$ ,  $R_{22}(C,E,D)$

ii.  $S(A,B,C,D,E)$ ,  $A \rightarrow E$ ,  $BC \rightarrow A$ ,  $DE \rightarrow B$

Iteration 1:  $S$ :  $A^+ = \{A,E\}$

Dependency violations:  $A^+ \neq \{A\}$  or  $\{A,B,C,D,E\}$

Decompose into:  $S_1(A,E)$ ,  $S_2(A,B,C,D)$

Iteration 2:  $S_2$ :  $(BC)^+ = \{B,C,A\}$

Dependency violations:  $(BC)^+ \neq \{B,C\}$  or  $\{B,C,A,D\}$

Decompose into:  $S_{21}(B,C,A)$ ,  $S_{22}(B,C,D)$

Iteration 3: No dependency violations

Final BCNF:  $S_1(A,E)$ ,  $S_{21}(B,C,A)$ ,  $S_{22}(B,C,D)$

4.

a. Functional dependencies:  $A \rightarrow A, B \rightarrow B, C \rightarrow C, D \rightarrow D$

b. Functional dependencies:  $A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow A$

c. Functional dependencies:  $A \rightarrow B, B \rightarrow A, C \rightarrow ABD, D \rightarrow ABC$

5.

ii.

**name  $\rightarrow$  price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name  
AND s1.price != s2.price;
```

Result: 0

**name  $\rightarrow$  discount, price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name  
AND s1.discount != s2.discount AND s1.price != s2.price;
```

Result: 0

**name  $\rightarrow$  month, price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name  
AND s1.month != s2.month AND s1.price != s2.price;
```

Result: 0

**name  $\rightarrow$  discount, month, price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name  
AND s1.discount != s2.discount AND s1.month != s2.month AND s1.price != s2.price;
```

Result: 0

**month → discount**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.month = s2.month  
AND s1.discount != s2.discount;
```

Result: 0

**month → name, discount**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.month = s2.month  
AND s1.name != s2.name AND s1.discount != s2.discount;
```

Result: 0

**month → discount, price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.month = s2.month  
AND s1.discount != s2.discount AND s1.price != s2.price;
```

Result: 0

**month → name, discount, price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.month = s2.month  
AND s1.name != s2.name AND s1.discount != s2.discount AND s1.price != s2.price;
```

Result: 0

**name, discount → price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name AND s1.discount = s2.discount  
AND s1.price != s2.price;
```

Result: 0

**name, discount → month, price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name AND s1.discount = s2.discount  
AND s1.month != s2.month AND s1.price != s2.price;
```

Result: 0

**name, month → discount**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name AND s1.month = s2.month  
AND s1.discount != s2.discount;
```

Result: 0

**name, month → price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name AND s1.month = s2.month  
AND s1.price != s2.price;
```

Result: 0

**name, month → discount, price**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.name = s2.name AND s1.month = s2.month  
AND s1.discount != s2.discount AND s1.price != s2.price;
```

Result: 0

**month, price → discount**

```
SELECT COUNT(*)  
FROM Sales s1, Sales s2  
WHERE s1.month = s2.month AND s1.price = s2.price  
AND s1.discount != s2.discount;
```

Result: 0

**month, price → name, discount**

```
SELECT COUNT(*)
FROM Sales s1, Sales s2
WHERE s1.month = s2.month AND s1.price = s2.price
AND s1.name != s2.name AND s1.discount != s2.discount;
```

Result: 0

**name, discount, month → price**

```
SELECT COUNT(*)
FROM Sales s1, Sales s2
WHERE s1.name = s2.name AND s1.discount = s2.discount AND s1.month = s2.month
AND s1.price != s2.price;
```

Result: 0

**name, month, price → discount**

```
SELECT COUNT(*)
FROM Sales s1, Sales s2
WHERE s1.name = s2.name AND s1.month = s2.month AND s1.price = s2.price
AND s1.discount != s2.discount;
```

Result: 0

iii.

Sales(name, discount, month, price), name → price, month → discount

Iteration 1: Sales: name+ = {name, price}

Dependency violations: name+ ≠ {name} or {name, discount, month, price}

Decompose into: S1(name, price), S2(name, discount, month)

Iteration 2: S2: month+ = {month, discount}

Dependency violations: month+ ≠ {month} or {name, discount, month}

Decompose into: S21(month, discount), S22(month, name)

**Final BCNF: S1(name, price), S21(month, discount), S22(month, name)**

**SQL commands for creating the tables:**

```
CREATE TABLE S1(name VARCHAR(50) PRIMARY KEY, price INT);
```

```
CREATE TABLE S21(month VARCHAR(3) PRIMARY KEY, discount FLOAT);
```

```
CREATE TABLE S22(month VARCHAR(3) REFERENCES S21, name VARCHAR(50) REFERENCES S1);
```

iv.

```
INSERT INTO S1 SELECT DISTINCT name, price FROM Sales;
```

name	price
-----	-----
bar1	19
bar8	19
gizmo3	19
gizmo7	19
mouse1	19
gizmo6	29
gizmo4	29
mouse3	29
mouse7	29
bar4	29
bar7	29
click7	29
bar9	39
click1	39
click2	39
click3	39
click8	39
click4	49
click9	49
gizmo1	49
mouse2	49
mouse8	59
bar2	59
bar3	59
mouse9	69
mouse4	69
gizmo9	79
gizmo5	79
gizmo8	89
mouse5	89



click6 89  
bar5 89  
bar6 99  
mouse6 99  
click5 99  
gizmo2 99

INSERT INTO S21 SELECT DISTINCT month, discount FROM Sales;

month	discount
apr	15%
aug	15%
dec	33%
feb	10%
jan	33%
jul	33%
jun	10%
mar	15%
may	10%
nov	15%
oct	10%
sep	15%

INSERT INTO S22 SELECT DISTINCT month, name FROM Sales;

month	name
apr	bar1
apr	bar8
apr	gizmo3
apr	gizmo7
apr	mouse1
aug	bar1
aug	bar8
aug	gizmo3
aug	gizmo7
aug	mouse1
dec	bar1
dec	bar8
dec	gizmo3
dec	gizmo7
dec	mouse1
feb	bar1
feb	bar8

feb	gizmo3
feb	gizmo7
feb	mouse1
jan	bar1
jan	bar8
jan	gizmo3
jan	gizmo7
jul	bar1
jul	bar8
jul	gizmo3
jul	gizmo7
jul	mouse1
jun	bar1
jun	bar8
jun	gizmo3
jun	gizmo7
jun	mouse1
mar	bar1
mar	bar8
mar	gizmo3
mar	gizmo7
mar	mouse1
may	bar1
may	bar8
may	gizmo3
may	gizmo7
may	mouse1
nov	bar1
nov	bar8
nov	gizmo3
nov	gizmo7
nov	mouse1
oct	bar1
oct	bar8
oct	gizmo3
oct	gizmo7
oct	mouse1
sep	bar1
sep	bar8
sep	gizmo3
sep	gizmo7
sep	mouse1
sep	gizmo6
sep	gizmo4

sep	mouse3
sep	mouse7
oct	mouse7
sep	bar4
sep	bar7
sep	click7
oct	gizmo6
oct	mouse3
oct	gizmo4
oct	click7
oct	bar4
oct	bar7
nov	mouse7
nov	mouse3
nov	gizmo6
nov	gizmo4
nov	bar4
nov	bar7
nov	click7
may	mouse7
may	gizmo6
may	mouse3
may	gizmo4
may	click7
may	bar4
may	bar7
mar	mouse7
mar	mouse3
mar	gizmo6
mar	gizmo4
jun	mouse7
mar	bar4
mar	bar7
mar	click7
jun	gizmo6
jun	mouse3
jun	gizmo4
jun	click7
jun	bar4
jun	bar7
jul	mouse7
jul	mouse3
jul	gizmo6
jul	gizmo4

jul	bar4
jul	bar7
jul	click7
jan	mouse7
jan	mouse3
jan	gizmo4
jan	gizmo6
jan	click7
jan	bar4
jan	bar7
feb	mouse7
feb	mouse3
feb	gizmo4
feb	gizmo6
feb	click7
dec	mouse7
feb	bar7
dec	mouse3
dec	gizmo4
dec	gizmo6
dec	bar7
dec	click7
dec	bar4
aug	mouse7
aug	mouse3
aug	gizmo6
aug	gizmo4
aug	bar7
aug	click7
aug	bar4
apr	mouse7
apr	gizmo6
apr	mouse3
apr	gizmo4
apr	bar7
apr	click7
apr	bar4
apr	bar9
apr	click1
apr	click2
apr	click3
apr	click8
aug	click8
aug	bar9

aug	click2
aug	click3
dec	bar9
dec	click1
dec	click2
dec	click3
dec	click8
feb	click8
feb	bar9
feb	click1
feb	click2
feb	click3
jan	bar9
jan	click1
jan	click2
jan	click3
jan	click8
jul	bar9
jul	click1
jul	click2
jul	click8
jun	bar9
jun	click1
jun	click2
jun	click3
jun	click8
mar	click8
mar	bar9
mar	click1
mar	click2
mar	click3
may	bar9
may	click1
may	click2
may	click3
may	click8
nov	bar9
nov	click1
nov	click2
nov	click3
nov	click8
oct	bar9
oct	click1
oct	click2

oct	click3
oct	click8
sep	click8
sep	bar9
sep	click1
sep	click2
sep	click3
sep	click4
sep	click9
sep	gizmo1
oct	click9
oct	gizmo1
oct	mouse2
oct	click4
nov	click9
nov	gizmo1
nov	mouse2
sep	mouse2
nov	click4
may	mouse2
may	click9
may	gizmo1
may	click4
mar	click4
mar	click9
mar	gizmo1
mar	mouse2
jun	click9
jun	gizmo1
jun	mouse2
jun	click4
jul	click9
jul	gizmo1
jul	mouse2
jul	click4
jan	mouse2
jan	click9
jan	gizmo1
jan	click4
feb	mouse2
feb	click4
feb	click9
feb	gizmo1
dec	click9

dec	gizmo1
dec	mouse2
dec	click4
aug	mouse2
aug	click4
aug	click9
aug	gizmo1
apr	gizmo1
apr	click4
apr	mouse2
apr	mouse8
aug	bar2
aug	bar3
apr	bar2
apr	bar3
aug	mouse8
dec	bar2
dec	bar3
dec	mouse8
feb	bar2
feb	bar3
feb	mouse8
jan	bar2
jan	bar3
jan	mouse8
jul	bar2
jul	bar3
jul	mouse8
jun	bar2
jun	bar3
mar	mouse8
may	bar2
may	bar3
jun	mouse8
mar	bar2
mar	bar3
may	mouse8
nov	bar2
nov	bar3
sep	mouse8
nov	mouse8
oct	bar2
oct	bar3
oct	mouse8

sep	bar2
sep	bar3
oct	mouse9
oct	mouse4
nov	mouse9
nov	mouse4
sep	mouse9
sep	mouse4
may	mouse9
may	mouse4
jun	mouse9
mar	mouse9
mar	mouse4
jul	mouse9
jul	mouse4
jun	mouse4
jan	mouse9
jan	mouse4
feb	mouse9
feb	mouse4
dec	mouse9
dec	mouse4
aug	mouse9
aug	mouse4
apr	mouse9
apr	mouse4
apr	gizmo9
apr	gizmo5
aug	gizmo5
aug	gizmo9
dec	gizmo9
feb	gizmo5
feb	gizmo9
jan	gizmo5
jan	gizmo9
jul	gizmo9
jul	gizmo5
jun	gizmo9
jun	gizmo5
mar	gizmo9
mar	gizmo5
may	gizmo9
may	gizmo5
sep	gizmo9



sep	gizmo5
nov	gizmo9
nov	gizmo5
oct	gizmo9
oct	gizmo5
oct	gizmo8
oct	mouse5
sep	click6
sep	bar5
nov	gizmo8
nov	click6
nov	bar5
nov	mouse5
oct	click6
oct	bar5
sep	gizmo8
sep	mouse5
may	gizmo8
may	click6
may	bar5
may	mouse5
mar	gizmo8
mar	mouse5
mar	click6
mar	bar5
jun	gizmo8
jun	mouse5
jul	mouse5
jun	click6
jun	bar5
jul	gizmo8
jul	click6
jul	bar5
jan	gizmo8
jan	mouse5
jan	click6
jan	bar5
feb	click6
feb	gizmo8
feb	mouse5
feb	bar5
dec	mouse5
dec	gizmo8
dec	click6

aug	gizmo8
aug	click6
aug	mouse5
dec	bar5
apr	click6
apr	bar5
apr	gizmo8
apr	mouse5
aug	bar5
aug	bar6
apr	mouse6
apr	bar6
apr	click5
apr	gizmo2
dec	bar6
dec	click5
aug	mouse6
aug	gizmo2
aug	click5
dec	gizmo2
dec	mouse6
feb	bar6
feb	gizmo2
feb	click5
feb	mouse6
jan	bar6
jan	click5
jan	gizmo2
jan	mouse6
jul	click5
jul	bar6
jul	gizmo2
jun	bar6
jun	click5
jul	mouse6
jun	mouse6
jun	gizmo2
mar	bar6
mar	gizmo2
mar	click5
mar	mouse6
may	mouse6
nov	click5
may	bar6

may	click5
may	gizmo2
sep	mouse6
oct	bar6
oct	click5
nov	mouse6
nov	bar6
nov	gizmo2
sep	bar6
sep	gizmo2
sep	click5
oct	mouse6
oct	gizmo2