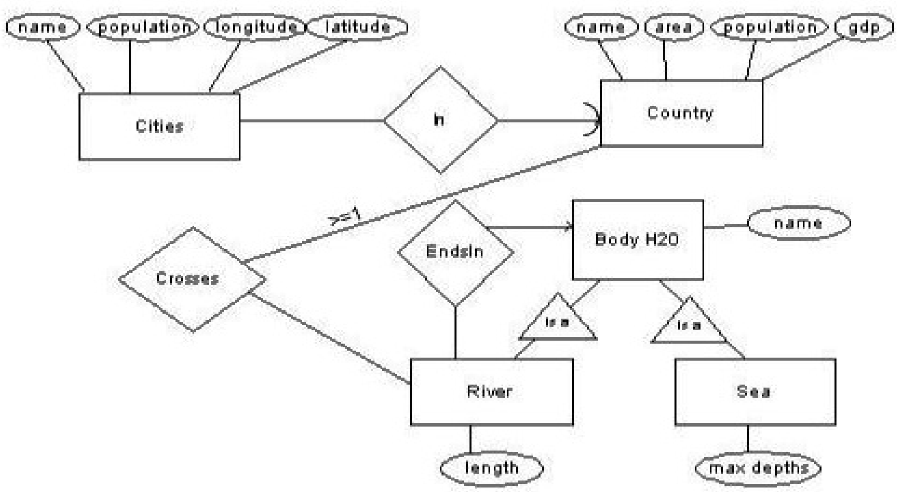
CSE 344 - Problem Set 2 Sample Solution

Problem 1:



Problem 2:

a. The relational schema is listed below. Key constraints, as usual, are specified by underlining. For foreign key constraints, we have used the convention that a field named B.key in table A is a foreign key referencing B. We have not included the "create table" statements; they can be easily obtained from the relational schema.

   `InsuranceCo(`<u>`name`</u>`, phone)`

   `Vehicle(`<u>`licencePlate`</u>`, year, InsuranceCo.name, maxLiability, maxLossDamage, Person.ssn)`

   `Car(`<u>`Vehicle.licencePlate`</u>`, make)`

   `Truck(`<u>`Vehicle.licencePlate`</u>`, capacity, ProfessionalDriver.Driver.licenceNo)`

   `Person(`<u>`ssn`</u>`, name)`

   `Driver(`<u>`licenceNo`</u>`, Person.ssn)`

   `ProfessionalDriver(`<u>`Driver.licenceNo`</u>`, medicalHistory)`

   `NonProfessionalDriver(`<u>`Driver.licenceNo`</u>`)`

   `Drives(`<u>`Car.Vehicle.licencePlate, NonProfessionalDriver.Driver.licenceNo`</u>`)`

b. The "insures" relationship is many-one and this allows it to be included in the Vehicle relation. If a vehicle entity does not have insurance, these attributes will be NULL for it.

c. Drives is many-many and Operates is many-one. Drives requires an additional relation, while operates can be inlined into the Truck relation.

Problem 3:

i. There is a unique key (C,D,E).
   Both dependencies violate BCNF.
   Fixing D → B gives us (ACDE), (DB).
   Fixing CE → A gives us (CDE), (CEA), (DB) which is the final decomposition.

ii. The keys for the relation are (A,C,D), (B,C,D) and (C,D,E).
   All given dependencies violate BCNF.
   Fixing BC → A gives us (BCDE), (BCA). The dependency A → E is also gone, so this is not a dependency-preserving decomposition.

Fixing DE → B gives us (CDE), (DEB), (BCA) which is the final decomposition.

An alternative approach: fixing A → E gives us (AE), (ABCD). The dependency DE → B is also gone.
Fixing BC → A gives (ABC), (BCD), (AE) which is the final decomposition.

Another alternative approach: fixing DE → B gives us (BDE), (ACDE). The dependency BC → A is also gone.
Fixing A → E gives (BDE), (AE), (ACD) which is the final decomposition.

Problem 4:

a. Only trivial dependencies can exist. {} is one such set.
b. `A->B`, `B->C`, `C->D`, `D->A`
c. `A->B`, `B->A`, `C->{ABD}` and `D->{ABC}`

Problem 5:

ii. We assume that, as suggested in the instructions, you have loaded the data into a table called "hw1_data". The queries to help determine which functional dependencies exist are listed below.

```
select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.name=H2.name and H1.discount !=H2.discount;
--Returns a count of 36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.name=H2.name and H1.month !=H2.month;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.name=H2.name and H1.price !=H2.price;
--0-->YES, is FD

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.name!=H2.name and H1.discount =H2.discount;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.discount =H2.discount and H1.month !=H2.month;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.discount=H2.discount and H1.price !=H2.price;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.name!=H2.name and H1.month =H2.month;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.discount!=H2.discount and H1.month =H2.month;
--0-->YES, is FD

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.month =H2.month and H1.price !=H2.price;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.name!=H2.name and H1.price =H2.price;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.discount!=H2.discount and H1.price =H2.price;
--36

select count(DISTINCT H1.name)
```

```
from hw1_data H1, hw1_data H2
where H1.month!=H2.month and H1.price =H2.price;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.month=H2.month and H1.price =H2.price and H1.name!=H2.name;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.month!=H2.month and H1.discount=H2.discount and H1.name=H2.name;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.month!=H2.month and H1.discount=H2.discount and H1.price=H2.price;
--36

select count(DISTINCT H1.name)
from hw1_data H1, hw1_data H2
where H1.name!=H2.name and H1.discount=H2.discount and H1.price=H2.price;
--36
```

The dependencies are **`name->price`** and **`month->discount`**.

iii. The BCNF decomposition is:
R1 (name, price)
R2 (name, month)
R3 (month, discount)

The "create table" statements are listed below:

```
create table NamePrice ( -- R1
  name varchar(20) primary key,
  price real
);

create table MonthDiscount ( -- R3
  month varchar(20) primary key,
  discount varchar(10)
);

create table NameMonth ( -- R2
  name varchar(20) references NamePrice(name),
  month varchar(20) references MonthDiscount(month)
);
```

iv. Here is the code to populate the tables:

```
insert into NamePrice
  select distinct name, cast(price as real) as the_price
  from hw1_data;

insert into MonthDiscount
  select distinct month, discount
  from hw1_data;

insert into NameMonth
  select name, month
  from hw1_data;
```

Note that (name,month) is the key for hw1_data, so the "distinct" modifier is not needed for NameMonth.