Study group exercises

In attendance: KEY

1. Suppose you have a relation P (A, B, C, D, E, F), with functional dependencies (FDs)

A → B , BCD → E , E → F

Suppose there are at most 2 different possible values for each of attributes A, C, and D. What is the maximum number of different values for attribute F? **8**

(At most 2 values for A) AND (A→B) means **(At most 2 values for B)**

(**At most 2 values for B**) AND (At most 2 values for C) AND (At most 2 values for D) means **(At most 8 combinations of B,C,D composite values)**

(At most 8 combinations of B,C,D composite values) AND (BCD→E) means **(At most 8 values for E)**

(At most 8 values for E) AND (E→F) means **(At most 8 values for F)**

2. Suppose that you have a relation Q (A , B, C, D, E) with only one FD AB → CDE . Decompose Q into a set of relations, EACH of which is in BCNF, or state that Q is already in BCNF (and in either case, explain your answer, and in doing so, identify the key for each relation).

AB must be part of any key for Q, since A and B do not appear on right-hand side Of any FD.

KEY for Q is AB, since all attributes (ABCDE) determined by AB alone

ALL FDs asserted of Q have a left-hand side that is a key of Q; Q is already in BCNF

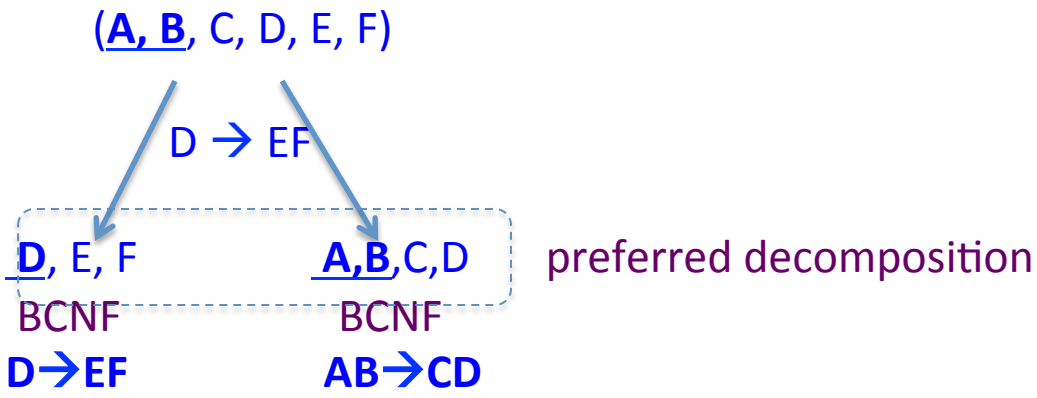
3. Suppose that you have a relation R (A, B, C, D, E, F) with FDs AB → CD and D → EF. Decompose R into a set of relations, EACH of which is in BCNF, or state that R is already in BCNF (and in either case, explain your answer, and in doing so, identify the key for each relation).

AB must be part of any key for R, since A and B do not appear on right-hand side of any FD.

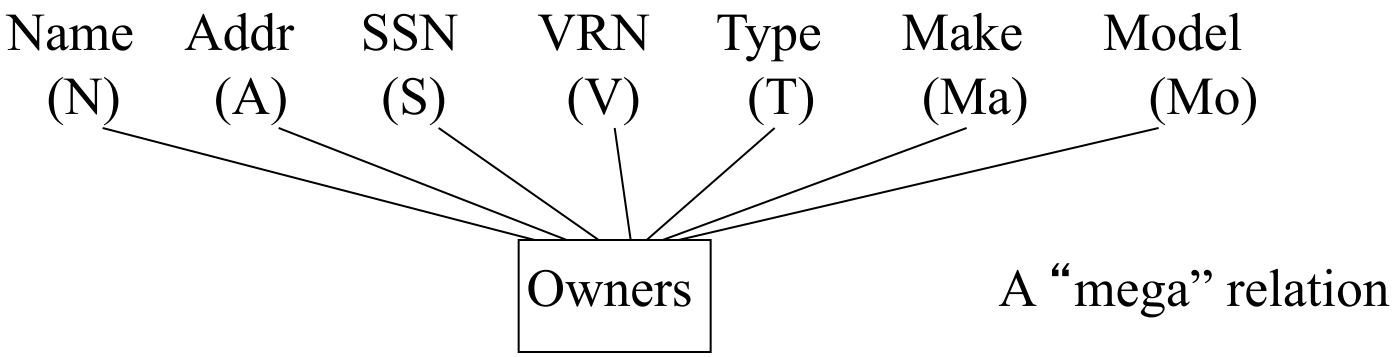
KEY for R is AB, since all attributes (ABCDEF) determined by AB alone

R is NOT in BCNF since D→EF violates BCNF constraint (left-hand side of D→EF is Not a key of R)

Decompose R using an offending FD



Assume the following relational schema covering vehicle ownership data (forgive lack of key, or assume that all attributes form the key for now).



Assume the DB designer asserts that the the following FDs should hold

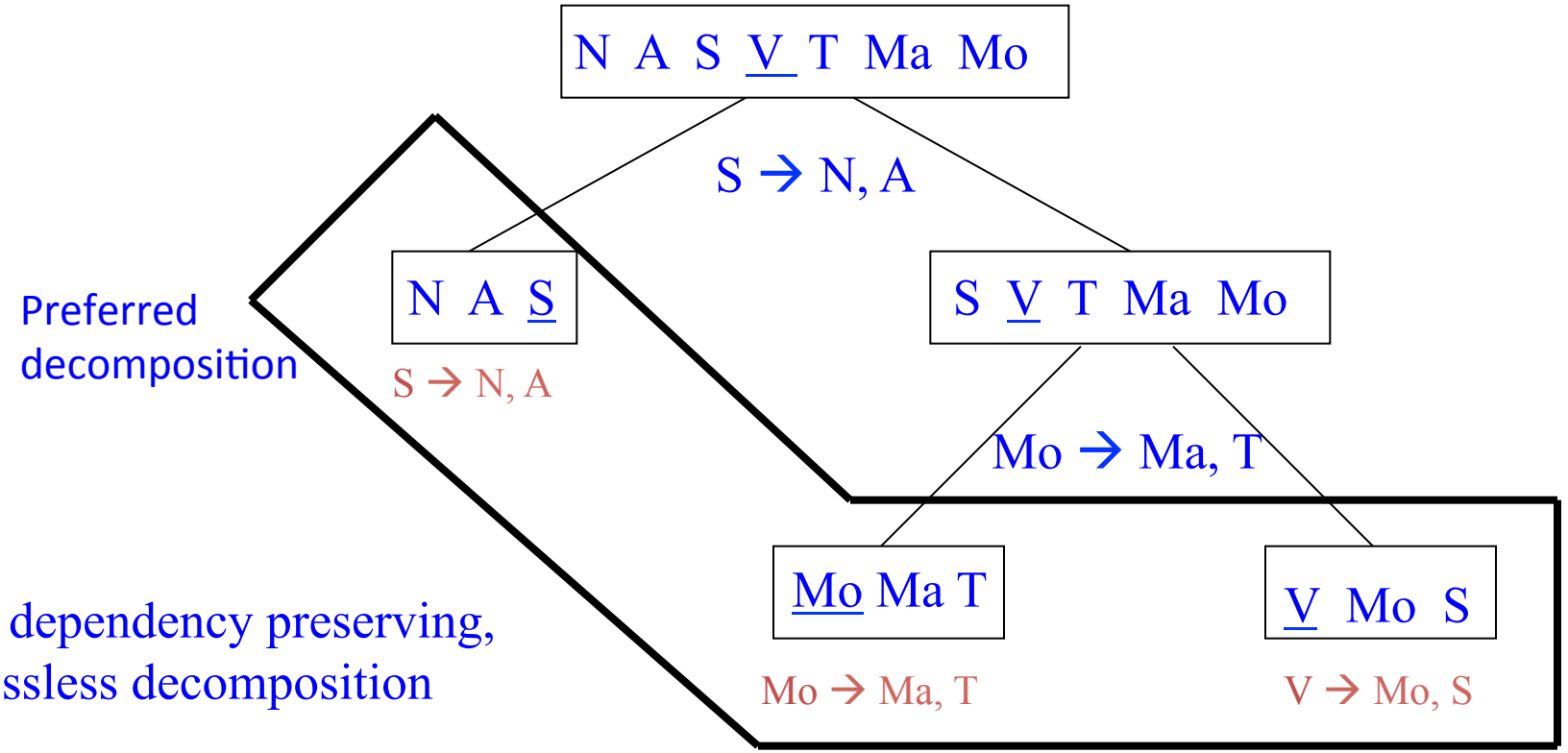
S → N, S → A, ~~V → T,~~ ~~V → Ma~~, V → Mo, Mo → Ma, Mo → T, V → S

4. Show a decomposition of the mega relation into BCNF tables using these FDs (first ask whether the FDs above constitute a minimal set, that is whether all of them must be considered explicitly, or some are informationally redundant given the transitivity properties of FDs) ***V does not appear on RHS of any FD so V must be part of any key; in fact, V determines all other attributes;*** Show your decomposition on the next page. ***V is the only key***

Answer to 4 here

Importance of lossless decomposition: obvious, don't want to lose information

Importance of dependency preservation: each FD constraint can be checked by looking within a single table/relation (i.e., efficiency)



5. Consider the relation

Kwatts, Dorm, Floor#, Date, Time, Temp, Humidity, Occupancy, Weekday?, SensorID

and FDs that are asserted as true of the relation

1) Dorm, Floor# → Occupancy **2)** Date, Time → Temp, Humidity **3)** Date → Weekday?
4) SensorID, Date, Time, ~~Temp~~ → Kwatts ~~**5)** Dorm, Floor#, Date, Time, Temp → Kwatts~~
6) SensorId → Dorm, Floor# **7)** Dorm, Floor# → SensorId

a) Give a minimal FD set (remove any FDs that need not be explicitly stated, but that are implied by the remaining FDs). If there is more than one such set, just give one of them.

Can eliminate 4 or 5, but not both; can eliminate Temp from 4 (or 5), because of 2

b) Give all keys for the relation

Date, Time must be part of any key (they are not on RHS of any FD; but attribute closure of Date,Time = {Date,Time,Temp, Humidity,Weekday?} so Date and Time alone not a key

Date,Time, SensorID is a key
Date,Time,Dorm, Floor is a key

c) Give a decomposition of the relation into BCNF tables. If the relation is already in BCNF then state so. If there is no dependency-preserving decomposition into BCNF tables then state so.

1) Do, F → O
~~4') S, Da, Ti → K~~
6) S → Do, F

2) Da, Ti → Te, Hu
5') Do, Fl, Da, Ti → K
7) Do, F → S

3) Da → W

Keys: SensorId, Date, Time (S, Da, Ti)
Dorm, Floor#, Date, Time (Do, F, Da, Ti)

All FDs from this minimal set, except 5' (and 4', if it were in the min set), violate BCNF

Kwatts, Dorm, Floor#, Date, Time, Temp, Humidity, Occupancy, Weekday?, SensorID
K Do F Da Ti Te H O W S

Do, F → O, S

Do, F, O, S

why doesn't FD 6 violate BCNF?

Because this table covers S→DoF too, and S is a key of the table too. In an SQL CREATE TABLE statement, we might declare Do,F as PRIMARY KEY and S as UNIQUE, or vice versa

K, Do, F, Da, Ti, Te, H, W (FDs 2, 3 violate BCNF)

Da, Ti → Te, Hu

Da, Ti, Te, Hu

K, Do, F, Da, Ti, W (FD 3 violates BCNF)

Da → W

Da, W

K, Do, F, Da, Ti

Other answers possible

7. For the Book table, repeated on the next page, give (a) all the FDs that you believe are enforced by the table definition, (b) any FDs that you think should be enforced, but aren't currently, and (c) at least one multi-value dependency that you think might be reasonably true of the data stored in this table (and that you might want to enforce)

Of course, FDs with ISBN as LHS

Also,
AmazonPrice , SavingsInPrice → ListPrice
ListPrice, SavingsInPrice → AmazonPrice
AmazonPrice , ListPrice → SavingsInPrice

Title, Format, PublicationDate, PublisherName → ISBN (????)

MVDs

I only saw trivial MVDs, corresponding to FDs, in study group answers , and I will continue To think of possible nontrivial MVDs

```
CREATE TABLE Book (
   Isbn                INTEGER,
   Title               CHAR[120] NOT NULL,
   Synopsis            CHAR[500],
   ListPrice           CURRENCY NOT NULL,
   AmazonPrice         CURRENCY NOT NULL,
   SavingsInPrice      CURRENCY NOT NULL,   /* redundant
   AveShipLag          INTEGER,
   AveCustRating       REAL,
   SalesRank           INTEGER,
   CoverArt            FILE,
   Format              CHAR[4] NOT NULL,
   CopiesInStock       INTEGER,
   PublisherName       CHAR[120] NOT NULL,  //Remove NOT NULL if you want 0 or 1
   PublicationDate     DATE NOT NULL,
   PublisherComment    CHAR[500],
   PublicationCommentDate DATE,
   PRIMARY KEY (Isbn)
   FOREIGN KEY (PublisherName) REFERENCES Publisher,
        ON DELETE NO ACTION,  ON UPDATE CASCADE,
   CHECK (Format = 'hard' OR Format = 'soft' OR Format = 'audi'
                                  OR Format = 'cd' OR Format = 'digital')
         // alternatively, CHECK (Format IN ('hard', 'soft', 'audi', 'cd', 'digital'))
   CHECK (AmazonPrice + SavingsInPrice = ListPrice)   )
```