

**Databasetheory 2dv513**

Assignment 2

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### Task 1. Relational algebra

1. R ∪ S: the tuples maximum is N+M and the minimum number of tuples is either N or M depending on which of the two are the largest.
2. R ⋈ S: the maximum tuples is N\*M and the minimum is 0.
3. σC (R) × S: the maximum tuples are N\*M and the minimum of tuples is 0.
4. πL (R) ∖ (S) (set difference): maximum is N tuples and minimum is 0.

### Task 2. Normalization

#### 2.1 R(A, B, C, D, E) AB → C, DE → C, B → D

##### 2.1.1 BCNF violations

A+ = A  
B+ = BD  
C+ = C  
D+ = D  
E+ = E  
  
AB+ = ABCD  
DE+ = DEC

None of the cases above is a super key candidate because none give all the attributes, therefore all of them violates BCNF.

##### 2.1.2 Decompose BCNF

Have candidate key ABE

First we see if it is final minimal cover of FD (it already is)

AB → C, DE → C, B→ D

Then we check if it is in BCNF and starts with AB → C and checks. It violates BCNF since the left side is not a super key. So, we split the table into two and get

R1(A,B,C,D) and R2(A,B,E)

Then we check if R1 is in the BCNF

The FD B→ D and checks. It violates BCNF since the left side is not a superkey. So we split the table into two and get

R11(B,D) and R12(A,B,C)

Then we check if R11 is in the BCNF. It is!

Then we check if R12 is in the BCNF. It is!

Then we check if R2 is in the BCNF. It is!

So, we get:

R11(B,D), R12(A,B,C), R2(A,B,E)

##### 2.1.3 3NF violations

AB → C, DE → C, B→ D

ABE is the candidate key

##### 2.1.4 Decompose 3NF

Start looking for the key and we find ABE

AB → C, DE → C, B → D

Check is AB a super Key? No, then we need to decompose the relation.

AB+ = ABCD

So R1(A B C D) and R2(DEC)

R1(A B C D) key is AB

R2(D E C) key is DE

Or... --------------------------------------------------------------------------------------------------

Start looking for the key and we find ABE

AB → C, DE → C, B → D

Check is AB a super Key? No, then we need to decompose.

AB+ = ABCD

So R1(A B C D) and R2(DEC)

Then Checking R1 the Key is AB but B is not a super key

B+ = BD

R11(B D) R12(A B C) R2(DEC)

R11(B D) Key is B

R12(A B C) Key is AB

R2(D E C) Key is DE

#### 2.2 R(A, B, C, D, E) AB → C, C → D, D → B, D → E

##### 2.2.1 BCNF violations

A+ = A  
B+ = B  
C+ = CDBE  
D+ = DBE  
E+ = E

AB+ = ABCDE

AB is the only option for a super key since it does not violate the BCNF.

##### 2.2.2 Decompose BCNF

Have candidate key AB, AC and AD

First, we see if it is final minimal cover of FD it is

A,B → C; C → D; D → B,E

AB is super key

Then we check if it is in BCNF and C → D and checks. It violates BCNF since the left side is not a super key. So, we split the table into two and get

R1(C,D,B,E) and R2(A,C)

Then we Check R1 if it is in BCNF? Its not

D → B,E violates since left side is not a superkey. So we split it again and get

R11(D,B,E) and R12(C,D)

Then we check if R11 is in the BCNF. It is!

Then we check if R12 is in the BCNF. It is!

Then we check if R2 is in the BCNF. It is!

So the given is R11(D,B,E), R12(C,D), R2(A,C)

##### 2.2.3 3NF violations

AB: AB -> C, C -> D, D -> B, D -> E; AB is the super key since it's a given FD

AC: C -> D, D -> B, D -> E AC is not a super key

AD: D -> B, D -> E, AB -> C AD is not a super key

AB, AC, AD is candidate keys

##### 2.2.4 Decompose 3NF

Is AB a key for R? Yes, so no violation.

C → D

Is C a key for R? No, so we create 2 relations:

R1 = (BCDE), key = C

R2 = (ABC), key = AB

Is C a key for R1? Yes, continue with next FD

D → B

Is D a key for R1? No, create 2 new relations

R11 = (CD), key = C

R12 = (BDE), key = D

R2 = (ABC), key = AB

Is C a key for R11? Yes.

Is D a key for R12? Yes.

Is AB a key for R2? Yes.

So, our conclusion is the relations: R11(CD), R12(BDE) and R2(ABC)