

**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

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

##### 2.1.3 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

#### 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

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)

##### 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

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