Normal forms
(Exercises)

Find (candidate) key & check for normal forms [Example]

▶ Suppose you are given a relation R with four attributes ABCD. For each of the following sets of FDs, do the following: **F = (B → C, D → A)**

➥ Identify the candidate key(s) for R.

➥ Identify the best normal form that R satisfies (1NF, 2NF, 3NF or BCNF).

Candidate Key is BD

Relation R is in 1NF but not 2NF. In above FDs, there is a partial dependency

(As per FD B → C, C depends only on B but Key is BD so C is partial depends on key (BD))

(As per FD D → A, A depends only on D but Key is BD so A is partial depends on key (BD))

Find (candidate) key & check for normal forms [Example]

▶ Suppose you are given a relation R with four attributes ABCD. For each of the following sets of FDs, do the following: **F = (C → D, C → A, B → C)**

- ➡ Identify the candidate key(s) for R.

- ➡ Identify the best normal form that R satisfies (1NF, 2NF, 3NF or BCNF).

Candidate Key is B

Relation R is in 2NF but not 3NF. In above FDs, there is a transitive dependency

(As per FDs B → C & **C → D** then **B → D** so D is transitive depends on key (B))

(As per FDs B → C & C → A then B → A so **A is transitive depends on key (B)**)

Find (candidate) key & check for normal forms [Example]

▶ Suppose you are given a relation R with four attributes ABCD. For each of the following sets of FDs, do the following: **F = (A → B, BC → D, A → C)**

➡ Identify the candidate key(s) for R.

➡ Identify the best normal form that R satisfies (1NF, 2NF, 3NF or BCNF).

Candidate Key is A

Relation R is in 2NF but not 3NF. In above FDs, there is a transitive dependency

(As per FDs A → B & **A → C** then **A → BC** using union rule) and

(As per FDs A → BC & BC → D then A → D so **D is transitive depends on key (A)**)

Find (candidate) key & check for normal forms [Example]

▶ Suppose you are given a relation R with four attributes ABCD. For each of the following sets of FDs, do the following: **F = (ABC → D, D → A)**

↪ Identify the candidate key(s) for R.

↪ Identify the best normal form that R satisfies (1NF, 2NF, 3NF or BCNF).

Candidate Key are ABC & BCD

Relation R is in 3NF but not BCNF.

In the above FDs, both FDs have prime attribute **(D and A)** in dependent (right) side.

Normal Form [Exercise]

Q.) R (A, B, C, D, E), **F = (AB → CE, E → AB, C → D,** Identify the highest normal form.

Q.) R (X, Y, Z, W), **F = (X → W, W → X, XY → Z,** Identify the highest normal form.

Normal forms
4NF (Forth Normal Form)

Multivalued dependency (MVD)

- For a dependency X → Y, if **for a single value of X, multiple values of Y exists**, then the **table may have multi-valued dependency**.

Student		
RNO	**Subject**	**Faculty**
101	DS	Patel
101	DBMS	Patel
101	DS	Shah
101	DBMS	Shah

- Multivalued dependency (MVD) is denoted by →→
- Multivalued dependency (MVD) is represented as X →→ Y

4NF (Forth Normal Form)

- Conditions for 4NF
- A relation R is in fourth normal form (4NF)
  - if and only if it is in **BCNF** and
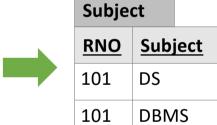 - **has no multivalued dependencies**

Student

RNO	Subject	Faculty
101	DS	Patel
101	DBMS	Patel
101	DS	Shah
101	DBMS	Shah

Subject

RNO	Subject
101	DS
101	DBMS

Faculty

RNO	Faculty
101	Patel
101	Shah

- Above student table **has multivalued dependency**. So student table is **not in 4NF**.

Functional dependency & Multivalued dependency

- A table can have both functional dependency as well as multi-valued dependency together.
    - RNO → Address
    - RNO →→ Subject
    - RNO →→ Faculty

Student

RNO	Address	Subject	Faculty
101	C. G. Road, Rajkot	DS	Patel
101	C. G. Road, Rajkot	DBMS	Patel
101	C. G. Road, Rajkot	DS	Shah
101	C. G. Road, Rajkot	DBMS	Shah

Subject

RNO	Subject
101	DS
101	DBMS

Faculty

RNO	Faculty
101	Patel
101	Shah

Address

RNO	Address
101	C. G. Road, Rajkot

Normal forms
5NF (Fifth Normal Form)

5NF (Fifth Normal Form)

- Conditions for 5NF

- A relation R is in fifth normal form (5NF)
  - if and only if it is in **4NF** and
  - it **should not have a lossless decomposition in to any number of smaller tables** (relations).

Student_Result

RID	RNO	Name	Subject	Result
1	101	Raj	DBMS	Pass
2	101	Raj	DS	Pass
3	101	Raj	DF	Pass
4	102	Meet	DBMS	Pass
5	102	Meet	DS	Fail
6	102	Meet	DF	Pass
7	103	Suresh	DBMS	Fail
8	103	Suresh	DS	Pass

Student_Result relation is **further decomposed** into sub-relations.