Database Fundamentals

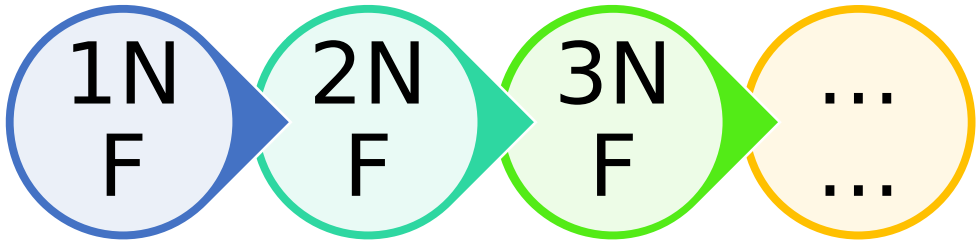
Mrihan Mohamed Ahmed

Teacher Assistant – ITI

mrihan.m.ahmed@gmail.com

Normalization

- The process of decomposing unsatisfactory "bad" relations by breaking up their attributes into smaller relations.
- Normalization Avoids:
  - Update anomalies.
  - Deletion anomalies.
  - Insert anomalies.
  - Duplication of Data.
  - Frequent Null Values.



- Normalization is a method to remove all these anomalies and bring the database to a consistent state.

Functional Dependency

- Functional dependency is represented by an arrow sign (→) that is, X→Y, where X functionally determines Y. It is read as: X determines Y OR Y depends on X.
- Examples:
  - Social security number determines employee name

    SSN -> ENAME
  - Project number determines project name and location.

    PNUMBER -> {PNAME, PLOCATION}
  - Employee ssn and project number determines the hours per week that the employee works on the project.

    {SSN, PNUMBER} -> HOURS

Normalization Forms

- First Normal Form (1NF).
- Second Normal Form (2NF).
- Third Normal Form (3NF).
- Fourth Normal Form (4NF).
- Boyce Codd Normal Form (BCNF).
- Fifth Normal Form (5NF).
- Domain Key Normal Form (DK/NF).

Better Database Design as we go down

First Normal Form

- First Normal Form is defined in the definition of relations (tables) itself.
- This rule defines that all the attributes in a relation must have atomic domains. The values in an atomic domain are indivisible units.
- contains no multi-valued attributes

No.	course	content
CS001	Programming	C#, oop
CS002	Design	HTML, CSS

No.	course
CS001	Programming
CS002	Design

CNo.	content
CS001	C#
CS001	oop
CS002	HTML
CS00	CSS

Second Normal Form

- **Prime attribute**: An attribute, which is a part of the candidate-key, is known as a prime attribute.
- **Non-prime attribute**: An attribute, which is not a part of the prime-key, is said to be a non-prime attribute.
- Every non-prime attribute should be fully functionally dependent on Table Key.

EId	PId	WorkHours	EName
E1	P1	12	Ali
E2	P1	10	Ramy

EId	EName
E1	Ali
E2	Ramy

EId	PId	WorkHours
E1	P1	12
E2	P1	10

Third Normal Form

- A relation is in **third normal form** if it is in 2NF, AND no transitive dependencies exist.

Eld	Name	City	Zip
E1	Ali	Minia	16111
E2	Ramy	Minia	16111

City	Zip
Minia	16111

Eld	Name	City
E1	Ali	Minia
E2	Ramy	Minia

Joins

- **Join** is a combination of a Cartesian product followed by a selection process. A Join operation pairs two tuples from different relations, if and only if a given join condition is satisfied.

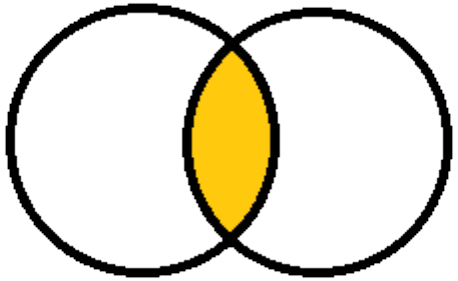
No.	course
CS001	Programming
CS002	Design

CNo.	content
CS001	C#
CS001	oop
CS002	HTML

Cartesian product

No.	Course	CNo.	Content
CS001	programming	CS001	C#
CS001	programming	CS001	oop
CS001	programming	CS002	HTML
CS002	Design	CS001	C#
CS002	Design	CS001	oop

Joins (Inner Join)



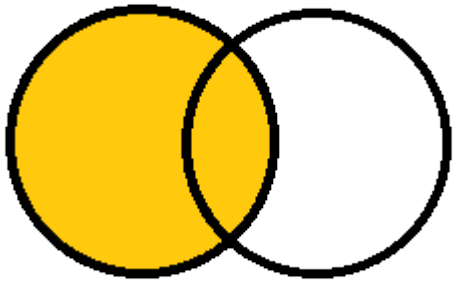
No.	course
CS001	Programming
CS002	Design

CNo.	content
CS001	C#
CS001	oop
NULL	HTML

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop
CS001	Prog.	NULL	HTML
CS002	Design	CS001	C#
CS002	Design	CS001	oop
CS002	Design	NULL	HTML

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop

Joins (Left Join)



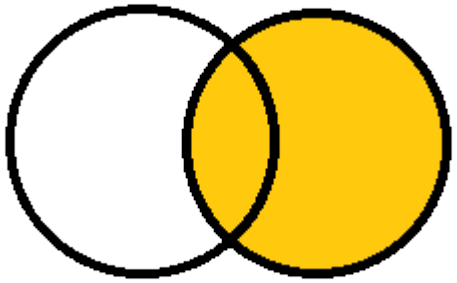
No.	course
CS001	Programming
CS002	Design

CNo.	content
CS001	C#
CS001	oop
NULL	HTML

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop
CS001	Prog.	NULL	HTML
CS002	Design	CS001	C#
CS002	Design	CS001	oop
CS002	Design	NULL	HTML

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop
CS002	Design	NULL	NULL

Joins (Right Join)



No.	course
CS001	Programming
CS002	Design

CNo.	content
CS001	C#
CS001	oop
NULL	HTML

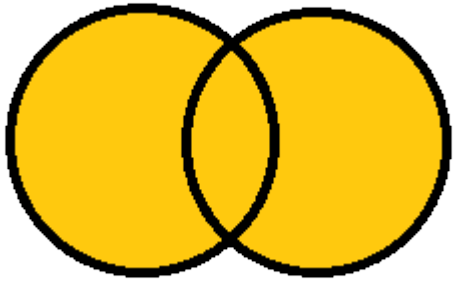
→

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop
CS001	Prog.	NULL	HTML
CS002	Design	CS001	C#
CS002	Design	CS001	oop
CS002	Design	NULL	HTML

→

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop
NULL	NULL	NULL	HTML

Joins (Full Join)



No.	course
CS001	Programming
CS002	Design

CNo.	content
CS001	C#
CS001	oop
NULL	HTML

→

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop
CS001	Prog.	NULL	HTML
CS002	Design	CS001	C#
CS002	Design	CS001	oop
CS002	Design	NULL	HTML

→

No.	Course	CNo.	Content
CS001	Prog.	CS001	C#
CS001	Prog.	CS001	oop
NULL	NULL	NULL	HTML
CS002	Design	NULL	NULL

Thanks