

Database Normalization Masterclass

A Step-by-Step Transition to 3NF with Corrected Keys

Unnormalized Form (UNF)

Problem: Multi-valued non-atomic properties. Sarah's course cell contains multiple comma-separated values, preventing proper indexing.

StudentID	StudentName	Courses	Instructor	InstructorOffice
101	Sarah	Math, Physics	Dr. Smith / Dr. Jones	Room 302 / Room 405
102	Alex	Math	Dr. Smith	Room 302

1st Normal Form (1NF): Flattening & Composite Keys

Solution: Rows are split so that each intersection contains exactly one atomic item. Because StudentID repeats, the true identifier must be a **Composite Primary Key (StudentID + Course)**.

StudentID (PK Part 1)	Course (PK Part 2)	StudentName	Instructor	InstructorOffice
101	Math	Sarah	Dr. Smith	Room 302
101	Physics	Sarah	Dr. Jones	Room 405
102	Math	Alex	Dr. Smith	Room 302

2nd Normal Form (2NF): Eliminating Partial Dependencies

Problem: StudentName only depends on StudentID (a *partial part* of the key), not the Course. We extract it to prevent anomalies.

Table A: Students

StudentID (PK)	StudentName
101	Sarah
102	Alex

Table B: Course Enrollments (Still violates 3NF due to Transitive Chains)

StudentID (Composite PK)	Course (Composite PK)	Instructor	InstructorOffice
101	Math	Dr. Smith	Room 302
101	Physics	Dr. Jones	Room 405
102	Math	Dr. Smith	Room 302

3rd Normal Form (3NF): Eliminating Transitive Dependencies

The Chain Flaw Resolved: InstructorOffice was transitively dependent on the composite primary key via Instructor. We isolate Instructor to its own master schema where it never duplicates.

Table B (Updated): Clean Course Enrollments

StudentID (Composite PK)	Course (Composite PK)	InstructorID (FK)
101	Math	INST_01
101	Physics	INST_02
102	Math	INST_01

Table C: Instructors Master Table

InstructorID (PK)	InstructorName	InstructorOffice
INST_01	Dr. Smith	Room 302
INST_02	Dr. Jones	Room 405