

Database Normalization

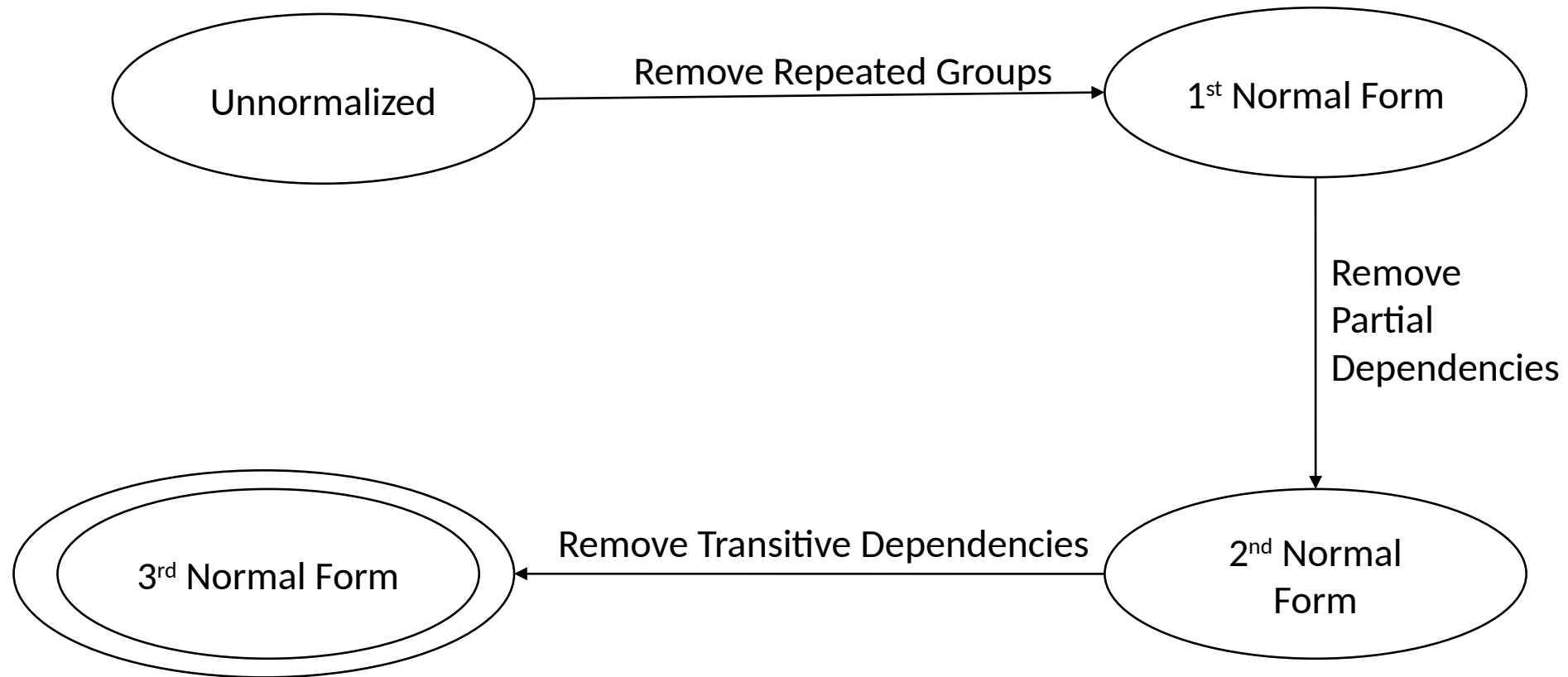
Purpose of Normalization

- It is used to remove the duplicate data and database anomalies from relational tables.
- Normalization helps to reduce redundancy and complexity by examining new data types used in the table.
- It is helpful to divide the large database table into smaller tables and link them using relationship.
- It avoids duplicate data and repeating groups in a table.
- It reduces the chances for anomalies to occur in a database.

Different Normal Forms

- Unnormalized
- 1st Normal Form
- 2nd Normal Form
- 3rd Normal Form
- Higher Normal Forms (BCNF, Fourth, Fifth, ...)

Convert from Unnormalized to 3NF



Unnormalized

HospitalRecords

<u>RecordID</u>	PatientID	PatientName	PatientAddress	Doctors		VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	Doctor ID	Doctor Name	February 14, 2021	2355.87
				3454	Jackson Grant		
				3444	Rebecca Mixon		
				2356	Stephanie Martin		
111221	435220	Jessica Landy	343 House Circle	3454, 2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, Doctors(DoctorID, DoctorName), VisitDate, Charges)

Unnormalized

HospitalRecords

<u>RecordID</u>	PatientID	PatientName	PatientAddress	Doctors		VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	Doctor ID	Doctor Name	February 14, 2021	2355.87
				3454	Jackson Grant		
				3444	Rebecca Mixon		
				2356	Stephanie Martin		
111221	435220	Jessica Landy	343 House Circle	3454, 2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, Doctors(DoctorID, DoctorName), VisitDate, Charges)

First Normal Form (1NF)

- A relation is in first normal form if every attribute in that relation is singled valued attribute.
- Attribute/column domain(data type) doesn't change
- Each attribute/column has a unique name
- Order makes no difference

Convert from unnormalized to 1NF by flattening

HospitalRecords

RECORDID	PatientID	PatientName	PatientAddress	DoctorID	DoctorName	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	3454	Jackson Grant	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	3444	Rebecca Mixon	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	2356	Stephanie Martin	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	3454		November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, DoctorID, DoctorName, VisitDate, Charges)

Convert from unnormalized to 1NF by flattening – Identify suitable PK

HospitalRecords

RECORDID	PatientID	PatientName	PatientAddress	DoctorID	DoctorName	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	3454	Jackson Grant	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	3444	Rebecca Mixon	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	2356	Stephanie Martin	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	3454		November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, DoctorID, DoctorName, VisitDate, Charges)

Convert from unnormalized to 1NF by flattening – Identify suitable PK

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	<u>DoctorID</u>	DoctorName	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	3454	Jackson Grant	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	3444	Rebecca Mixon	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	2356	Stephanie Martin	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	3454		November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, DoctorID, DoctorName, VisitDate, Charges)

Second Normal Form (2NF)

- Table should be in 1NF
- No partial Dependencies

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	<u>DoctorID</u>	DoctorName	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	3454	Jackson Grant	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	3444	Rebecca Mixon	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	2356	Stephanie Martin	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	3454		November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, DoctorID, DoctorName, VisitDate, Charges)

Converting to 2NF from 1NF

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	<u>DoctorID</u>	DoctorName	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	3454	Jackson Grant	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	3444	Rebecca Mixon	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	2356	Stephanie Martin	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	3454		November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, DoctorID, DoctorName, VisitDate, Charges)

Converting to 2NF from 1NF

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	<u>DoctorID</u>	DoctorName	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	3454	Jackson Grant	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	3444	Rebecca Mixon	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	2356	Stephanie Martin	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	3454		November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, DoctorID, DoctorName, VisitDate, Charges)

Converting to 2NF from 1NF

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	<u>DoctorID</u>	DoctorName	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	3454	Jackson Grant	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	3444	Rebecca Mixon	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	2356	Stephanie Martin	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	3454		November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	2333		November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	2356		January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, DoctorID, DoctorName, VisitDate, Charges)

Converting to 2NF from 1NF

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, VisitDate, Charges)

Doctors(DoctorID, DoctorName)

Doctors

<u>DOCTORID</u>	DoctorName
3454	Jackson Grant
3444	Rebecca Mixon
2356	Stephanie Martin
2333	

Converting to 2NF from 1NF

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, VisitDate, Charges)

Doctors(DoctorID, DoctorName)

RecordDoctors(RecordID, DoctorId)

RecordDoctors

<u>RecordID</u>	<u>DoctorID</u>
100101	3454
100101	3444
100101	2356
111221	3454
111221	2333
122108	2356

Doctors

<u>DOCTORID</u>	DoctorName
3454	Jackson Grant
3444	Rebecca Mixon
2356	Stephanie Martin
2333	

2NF Set of Tables

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, VisitDate, Charges)

Doctors(DoctorID, DoctorName)

RecordDoctors(RecordID, DoctorId)

RecordDoctors

<u>RecordID</u>	<u>DoctorID</u>
100101	3454
100101	3444
100101	2356
111221	3454
111221	2333
122108	2356

Doctors

<u>DOCTORID</u>	DoctorName
3454	Jackson Grant
3444	Rebecca Mixon
2356	Stephanie Martin
2333	

Third Normal Form (3NF)

- Be in 2NF
- No transitive dependencies

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, VisitDate, Charges)

Convert to 3NF from 2NF

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, VisitDate, Charges)

Convert to 3NF from 2NF

HospitalRecords

<u>RECORDID</u>	PatientID	PatientName	PatientAddress	VisitDate	Charges
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
100101	321001	John Doe	101 Road Ave.	February 14, 2021	2355.87
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
111221	435220	Jessica Landy	343 House Circle	November 11, 2021	34543.92
122108	435220	Jessica Landy	343 House Circle	January 3, 2022	344.33

HospitalRecords(RecordID, PatientID, PatientName, PatientAddress, VisitDate, Charges)

Convert to 3NF from 2NF by removing transitive dependencies

HospitalRecords

<u>RecordID</u>	PatientID	VisitDate	Charges
100101	321001	02/14/2021	2355.87
111221	435220	11/11/21	34543.92
122108	435220	01/03/22	344.33

Patients

<u>PATIENTID</u>	PatientName	PatientAddress
321001	John Doe	101 Road Ave.
435220	Jessica Landy	343 House Circle

HospitalRecords(RecordID, PatientID, VisitDate, Charges)

Patients(PatientID, PatientName, PatientAddress)

Convert to 3NF from 2NF by removing transitive dependencies

HospitalRecords

<u>RecordID</u>	PatientID	VisitDate	Charges
100101	321001	02/14/2021	2355.87
111221	435220	11/11/21	34543.92
122108	435220	01/03/22	344.33

RecordDoctors

<u>RecordID</u>	<u>DoctorID</u>
100101	3454
100101	3444
100101	2356
111221	3454
111221	2333
122108	2356

Doctors

<u>DOCTORID</u>	DoctorName
3454	Jackson Grant
3444	Rebecca Mixon
2356	Stephanie Martin
2333	

Patients

<u>PATIENTID</u>	PatientName	PatientAddress
321001	John Doe	101 Road Ave.
435220	Jessica Landy	343 House Circle

HospitalRecords(RecordID, PatientID, VisitDate, Charges)

RecordDoctors(RecordID, DoctorID)

Doctors(DoctorID, DoctorName)

Patients(PatientID, PatientName, PatientAddress)