Database Management Systems

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First Normal Form (1NF)

The term first normal form (1NF) describes the tabular format in which:

- All the key attributes are defined.
- There are no repeating groups in the table.
- All attributes are dependent on the primary key.

Second Normal Form (2 NF)

All attributes dependent on full primary key, partial dependencies and transitive dependencies.

- Conversion to Second Normal Form
  - Starting with the 1NF format, the database can be converted into the 2NF format by
    - Writing each key component on a separate line, and then writing the original key on the last line and
    - Writing the dependent attributes after each new key.

Third Normal Form (3 NF)

- **Conversion to Third Normal Form**
  - All columns can be determined only by the key in the table and no other column.
  - Create a separate table with attributes in a transitive functional dependence relationship.

Normalization: Overview

- 1NF (all attributes are atomic)
- 2NF (no partial dependencies)
- 3NF (no transitive dependencies)

First Normal Form (1NF)

1NF: all attributes are atomic ("no repeating groups")

Last Name	First Name
Smith	Peter Mary John
Rumpelstiltskin	Anne Michael

Not in 1NF

First Normal Form (1NF)

Last Name	First Name
Smith	Peter
Smith	Mary
Smith	John
Rumpelstiltskin	Anne
Rumpelstiltskin	Michael

Normalized to 1NF

First Normal Form (1NF)

Name	Weight
Michael	187 lb
Raphael	192 lb
Gabriel	201 lb
Uriel	165 lb
Metatron	195 kg

Not in 1NF

First Normal Form (1NF)

Name	Weight	Unit
Michael	187	lb
Raphael	192	lb
Gabriel	201	lb
Uriel	165	lb
Metatron	195	kg

Normalized to 1NF

First Normal Form (1NF)

Supplier	Part
S1	P1, P3, P4
S2	P3
S3	P2, P3

Not in 1NF

First Normal Form (1NF)

Supplier	Part1	Part2	Part3
S1	P1	P3	P4
S2	P3	null	null
S3	P2	P3	null

Is this relation in 1NF?

Formally yes, but in essence, NO!

First Normal Form (1NF)

Supplier	Part
S1	P1
S1	P3
S1	P4
S2	P3
S3	P2
S3	P3

Normalized to 1NF

Second Normal Form (2NF)

- **2NF:**
  - **1NF and**
  - **All non-key attributes are fully dependent on the PK ("no partial dependencies")**

Student	Course_ID	Grade	Address
Erik	CIS331	A	80 Ericsson Av.
Sven	CIS331	B	12 Olafson St.
Inge	CIS331	C	192 Odin Blvd.
Hildur	CIS362	A	212 Reykjavik St.

Not in 2NF

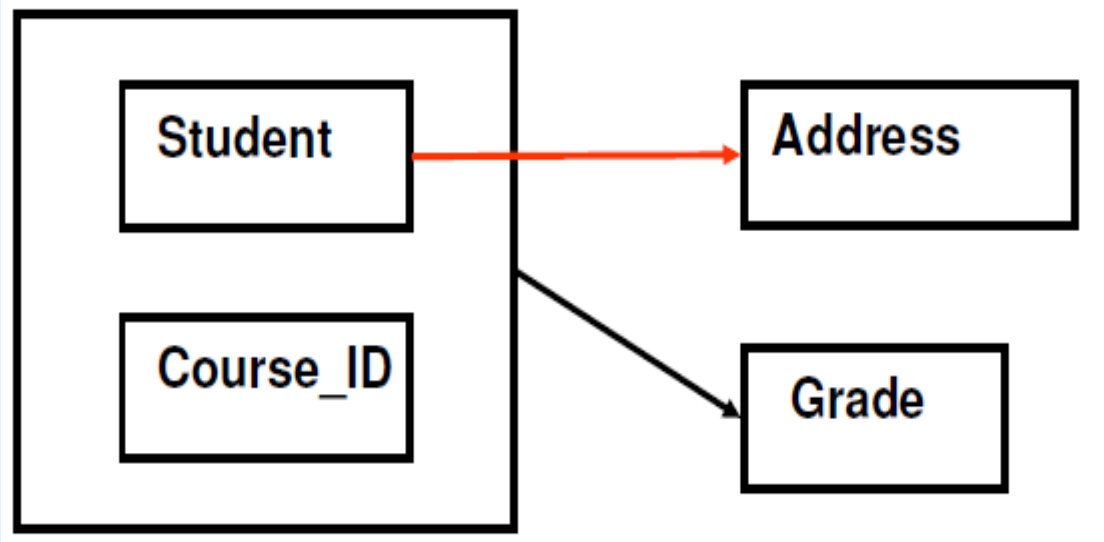
Second Normal Form (2NF)

Student	Address
Erik	80 Ericsson Av.
Sven	12 Olafson St.
Inge	192 Freya Blvd.
Hildur	212 Reykjavik St.

Student	Course_ID	Grade
Erik	CIS331	A
Sven	CIS331	B
Inge	CIS331	C
Hildur	CIS362	A

Normalized to 2NF

Second Normal Form (2NF)



Third Normal Form (3NF)

- **3NF:**
  - **2NF and**
  - **no transitive dependencies**

Student	Course_ID	Grade	Grade_value
Erik	CIS331	A	4.00
Sven	CIS331	B	3.00
Inge	CIS331	C	2.00
Hildur	CIS362	A	4.00

Not in 3NF

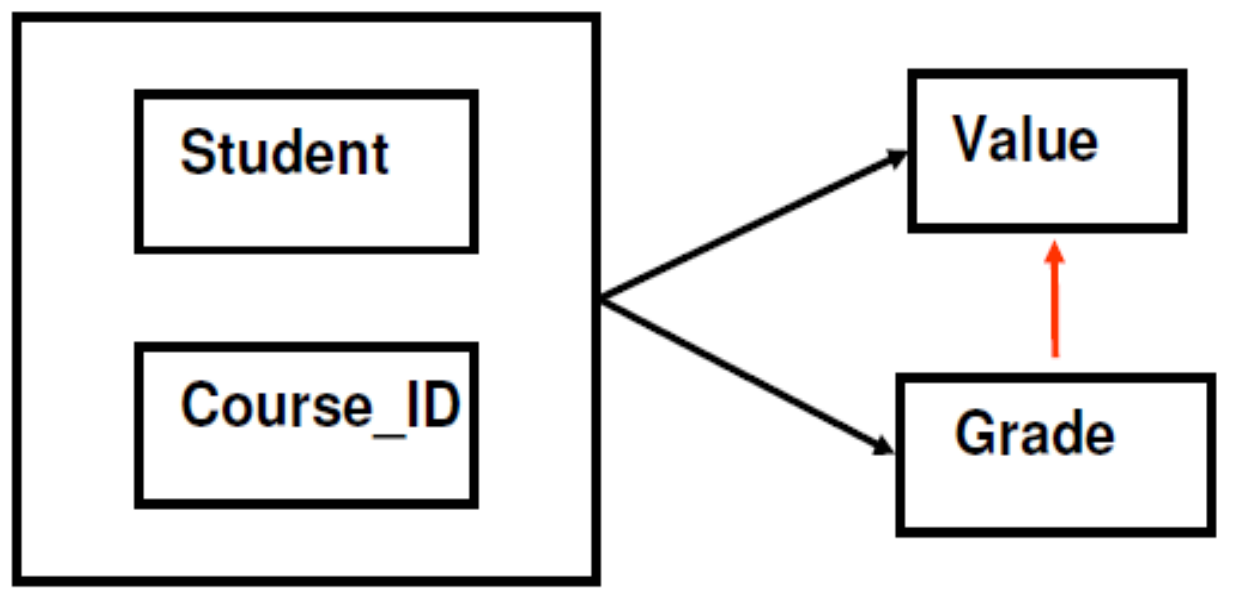
Third Normal Form (3NF)

Student	Course_ID	Grade
Erik	CIS331	A
Sven	CIS331	B
Inge	CIS331	C
Hildur	CIS362	A

Grade	Grade_value
A	4.00
B	3.00
C	2.00

Normalized to 3NF

Third Normal Form (3NF)



1st Normal Form Example

Un-normalized Students table:

Student#	AdvID	AdvName	AdvRoom	Class1	Class2
123	123A	James	555	102-8	104-9
124	123B	Smith	467	209-0	102-8

Normalized Students table:

Student#	AdvID	AdvName	AdvRoom	Class#
123	123A	James	555	102-8
123	123A	James	555	104-9
124	123B	Smith	467	209-0
124	123B	Smith	467	102-8

2nd Normal Form Example

Students table

Student#	AdvID	AdvName	AdvRoom
123	123A	James	555
124	123B	Smith	467

Registration table

Student#	Class#
123	102-8
123	104-9
124	209-0
124	102-8

3rd Normal Form Example

Students table:

Student#	AdvID	AdvName	AdvRoom
123	123A	James	555
124	123B	Smith	467

Student table:

Student#	AdvID
123	123A
124	123B

Advisor table:

AdvID	AdvName	AdvRoom
123A	James	555
123B	Smith	467

3rd Normal Form Example Cont.

Students table:

Student#	AdvID
123	123A
124	123B

Registration table:

Student#	Class#
123	102-8
123	104-9
124	209-0
124	102-8

Advisor table:

AdvID	AdvName	AdvRoom
123A	James	555
123B	Smith	467

1st Normal Form

Un-normalized Contacts table:

Contacts						
Name	Company	Address	Phone1	Phone2	Phone3	ZipCode
Joe	ABC	123	5532	2234	3211	12345
Jane	XYZ	456	3421			14454
Chris	PDQ	789	2341	6655		14423

The Zero Form

No rules have been applied

First Normal Form

1. Eliminate repeating groups in individual tables.
2. Create a separate table for each set of related data.
3. Identify each set of related data with a primary key.

1st Normal Form

Normalized Contacts table:

Contacts					
Id	Name	Company	Address	Phone	ZipCode
1	Joe	ABC	123	5532	12345
1	Joe	ABC	123	2234	12345
1	Joe	ABC	123	3211	12345
2	Jane	XYZ	456	3421	14454
3	Chris	PDQ	789	2341	14423
3	Chris	PDQ	789	6655	14423

First Normal Form

Second Normal Form

People table:

People				
Id	Name	Company	Address	Zip
1	Joe	ABC	123	12345
2	Jane	XYZ	456	14454
3	Chris	PDQ	789	14423

PhoneNumbers table:

PhoneNumbers		
PhoneID	Id	Phone
1	1	5532
2	1	2234
3	1	3211
4	2	3421
5	3	2341
6	3	6655

Second Normal Form

Third Normal Form

People		
Id	Name	AddressID
1	Joe	1
2	Jane	2
3	Chris	3

Address			
AddressID	Company	Address	Zip
1	ABC	123	12345
2	XYZ	456	14454
3	PDQ	789	14423

PhoneNumbers		
PhoneID	Id	Phone
1	1	5532
2	1	2234
3	1	3211
4	2	3421
5	3	2341
6	3	6655

Eliminate fields that do not depend on the primary key

Our **Company Name** , **Address** and **Zip** have nothing to do with the PeopleId, so they should have their own AddressId:

Thank you