DB Normalization

Submitted by Abhijith A Nair

1NF : Eliminates repeating groups and ensures single values for each attribute at a row-column intersection.

2NF : Eliminates partial dependencies. Every non-key attribute depends fully on the primary key.

3NF : Eliminates transitive dependencies. Every non-key attribute depends directly on the primary key, not on any other non-key attribute.

1.Employee Information Table:

EmployeeID	EmployeeName	Department	ManagerID	Salary	HireDate
1	John Smith	HR	101	50000	2022-01-15
2	Alice Brown	IT	102	60000	2022-02-20
3	Mark Johnson	Sales	101	55000	2022-03-10

Primary Key : EmployeeID

1NF :

- No repeating groups and no multiple values for each attribute

2NF :

- Removing partial dependency
- Here Department and ManagerID are not fully dependent on EmployeeID which is the primary key. Therefore splitting the table.

EmployeeID	EmployeeName	Department	ManagerID	Salary	HireDate
1	John Smith	HR	101	50000	2022-01-15
2	Alice Brown	IT	102	60000	2022-02-20
3	Mark Johnson	Sales	101	55000	2022-03-10

EmployeeID	EmployeeName	Salary	HireDate
1	John Smith	50000	2022-01-15
2	Alice Brown	60000	2022-02-20
3	Mark Johnson	55000	2022-03-10

EmployeeID	Department	ManagerID
1	HR	101
2	IT	102
3	Sales	101

3NF :

- No transitive dependency

Improving Efficiency :

Employee

EmployeeID	EmployeeName	Salary	HireDate
1	John Smith	50000	2022-01-15
2	Alice Brown	60000	2022-02-20

EmployeeID	EmployeeName	Salary	HireDate
3	Mark Johnson	55000	2022-03-10

Employee-Manager Mapping

EmployeeID	ManagerID
1	101
2	102
3	101

Department-Manager Mapping

DepartmentID	ManagerID
D-101	101
D-102	102
D-103	101

Department

DepartmentID	DeptName
D-101	HR
D-102	IT
D-103	Sales

2.Training Programs Table:

ProgramID	ProgramName	Trainer	Department	EmployeeID	EmployeeName	Date
1	Java Fundamentals	John Smith	IT	101	Alice Brown	2022-03-01
2	Project Management	Sarah White	HR	102	Bob Green	2022-03-10
3	Sales Techniques	Mark Johnson	Sales	103	Charlie Black	2022-03-20

Primary Key : ProgramID

1NF :

- No repeating groups and no multiple values for each attribute

2NF :

- Removing partial dependency.

ProgramID	ProgramName	Trainer	Department	EmployeeID	EmployeeName	Date
1	Java Fundamentals	John Smith	IT	101	Alice Brown	2022-03-01
2	Project Management	Sarah White	HR	102	Bob Green	2022-03-10
3	Sales Techniques	Mark Johnson	Sales	103	Charlie Black	2022-03-20

⇒

ProgramID	ProgramName	Trainer
1	Java Fundamentals	John Smith

ProgramID	ProgramName	Trainer
2	Project Management	Sarah White
3	Sales Techniques	Mark Johnson

ProgramID	Department	EmployeeID	EmployeeName	Date
1	IT	101	Alice Brown	2022-03-01
2	HR	102	Bob Green	2022-03-10
3	Sales	103	Charlie Black	2022-03-20

3NF :

- Removing transitive dependency

ProgramID	Department	EmployeeID	EmployeeName	Date
1	IT	101	Alice Brown	2022-03-01
2	HR	102	Bob Green	2022-03-10
3	Sales	103	Charlie Black	2022-03-20

⇒

ProgramID	ProgramName	Trainer
1	Java Fundamentals	John Smith
2	Project Management	Sarah White
3	Sales Techniques	Mark Johnson

ProgramID	Department	EmployeeID	Date
1	IT	101	2022-03-01
2	HR	102	2022-03-10
3	Sales	103	2022-03-20

EmployeeID	EmployeeName
101	Alice Brown
102	Bob Green
103	Charlie Black

Improving Efficiency:

Employee

EmployeeID	EmployeeName
101	Alice Brown
102	Bob Green
103	Charlie Black

Program

ProgramID	ProgramName	Trainer
1	Java Fundamentals	John Smith
2	Project Management	Sarah White
3	Sales Techniques	Mark Johnson

Program-Employee Mapping

ProgramID	DepartmentID	EmployeeID	Date
1	D-101	101	2022-03-01
2	D-102	102	2022-03-10
3	D-103	103	2022-03-20

Department

DepartmentID	DeptName
D-101	IT
D-102	HR
D-103	Sales

3.Customer Orders Table:

OrderID	CustomerName	ProductID	ProductName	Qty	UnitPrice	TotalAmount	OrderDate
1	John Doe	101	Laptop	2	800	1600	2022-01-15
2	Jane Smith	102	Smartphone	1	500	500	2022-02-20
3	John Doe	103	Printer	1	200	200	2022-03-10

Primary Key : OrderID

1NF :

- No repeating groups and no multiple values for each attribute.

2NF :

- No partial dependency.

3NF :

- Here ProductName is dependent on ProductId which is dependent on OrderId which constitute transitive dependency.

OrderID	CustomerName	ProductID	Qty	UnitPrice	TotalAmount	OrderDate
1	John Doe	101	2	800	1600	2022-01-15
2	Jane Smith	102	1	500	500	2022-02-20
3	John Doe	103	1	200	200	2022-03-10

ProductID	ProductName
101	Laptop
102	Smartphone
103	Printer

Improving Efficiency

Orders

OrderID	CustomerID	ProductID	Qty	UnitPrice	TotalAmount	OrderDate
1	C-100	101	2	800	1600	2022-01-15
2	C-101	102	1	500	500	2022-02-20
3	C-100	103	1	200	200	2022-03-10

Products

ProductID	ProductName
101	Laptop
102	Smartphone
103	Printer

Customers

CustomerID	CustomerName
C-100	John Doe
C-101	Jane Smith

4.Stress Management Table:

EmployeeID	FirstName	LastName	StressLevel	HoursOfWork	BreaksTaken	PhysicalActivity	CounselingSe
101	Sarah	White	Moderate	45	3	Yoga	2
102	Bob	Green	High	50	2	Jogging	1
103	Charlie	Black	Low	40	4	Meditation	3
104	David	Miller	High	48	1	Gym	2
105	Jane	Doe	Moderate	42	3	Walking	1

Primary Key : EmployeeID

1NF :

- No repeating groups and no multiple values for each attribute

2NF :

- Every attribute fully dependent on primary key

3NF :

- No transitive dependency

Improving Efficiency

- To improve the efficiency of the table we can split it into following tables:

Employee

EmployeeID	FirstName	LastName
101	Sarah	White
102	Bob	Green
103	Charlie	Black
104	David	Miller
105	Jane	Doe

Stress

EmployeeID	StressLevel	HoursOfWork	BreaksTaken	CounselingSessions
101	Moderate	45	3	2
102	High	50	2	1
103	Low	40	4	3

EmployeeID	StressLevel	HoursOfWork	BreaksTaken	CounselingSessions
104	High	48	1	2
105	Moderate	42	3	1

Activity-Employee Mapping

EmployeeID	PhysicalActivityID
101	PA-101
102	PA-102
103	PA-103
104	PA-104
105	PA-105

Physical Activity

PhysicalActivityID	PhysicalActivity
PA-101	Yoga
PA-102	Jogging
PA-103	Meditation
PA-104	Gym
PA-105	Walking

5.Flee Market Table:

ItemID	SellerName	ItemName	Category	Price	Quantity	Description	Condition
101	John's Treasures	Vintage Chair	Furniture	50.00	2	Beautiful vintage chair, excellent condition	Like New
102	Alice's Finds	Antique Clock	Home Decor	80.00	1	Authentic antique clock with Roman numerals	Good
103	Mark's Collectibles	Vinyl Records	Music	15.00	10	Various artists and genres, in good condition	Used
104	Emma's Treasures	Vintage Jewelry	Accessories	35.00	5	Assorted vintage jewelry pieces, unique designs	Excellent
105	Robert's Finds	Retro Camera	Electronics	60.00	1	Vintage Polaroid camera with original case	Good

Primary Key : ItemID

1NF :

- No repeating groups and no multiple values for each attribute

2NF :

- Every attribute fully dependent on primary key

3NF :

- No transitive dependency

Improving Efficiency :

To improve the efficiency we can split the table and have a seperate table for the seller. Also many item can belong to same category , therefore giving it a seperate table as well.

ItemDetails

ItemID	SellerID	ItemName	CategoryID	Price	Quantity	Description	Condition
101	S-101	Vintage Chair	C-101	50.00	2	Beautiful vintage chair, excellent condition	Like New
102	S-102	Antique Clock	C-102	80.00	1	Authentic antique clock with Roman numerals	Good
103	S-103	Vinyl Records	C-103	15.00	10	Various artists and genres, in good condition	Used
104	S-104	Vintage Jewelry	C-104	35.00	5	Assorted vintage jewelry pieces, unique designs	Excellent
105	S-105	Retro Camera	C-105	60.00	1	Vintage Polaroid camera with original case	Good

Seller

SellerID	SellerName	Location
S-101	John's Treasures	Booth 15, Section A
S-102	Alice's Finds	Stall 8, Section B
S-103	Mark's Collectibles	Booth 20, Section C
S-104	Emma's Treasures	Stall 12, Section D
S-105	Robert's Finds	Booth 5, Section A

Category

CategoryID	Category
C-101	Furniture
C-102	Home Decor
C-103	Music
C-104	Accessories
C-105	Electronics

6.Learning Management System Table:

CourseID	CourseName	Instructor	Department	Credits	Enrolled Students	StartDate	EndDate
101	Introduction to Biology	Prof. Smith	Science	3	25	2022-01-15	2022-05-10
102	Programming in Python	Prof. Brown	Computer Science	4	30	2022-02-20	2022-06-15

CourseID	CourseName	Instructor	Department	Credits	Enrolled Students	StartDate	EndDate
103	Financial Accounting	Prof. Green	Finance	3	20	2022-03-10	2022-07-05
104	English Literature	Prof. White	Humanities	3	22	2022-04-05	2022-08-20
105	Web Development Fundamentals	Prof. Black	IT	4	28	2022-05-15	2022-09-25

Primary Key : CourseID

1NF :

- No repeating groups and no multiple values for each attribute

2NF :

- Every attribute fully dependent on primary key

3NF :

- The Availability is dependent on Location which is dependent on CourseID thus constituting transitive dependency.

CourseID	CourseName	Instructor	Department	Credits	Enrolled Students	StartDate	EndDate
101	Introduction to Biology	Prof. Smith	Science	3	25	2022-01-15	2022-05-10
102	Programming in Python	Prof. Brown	Computer Science	4	30	2022-02-20	2022-06-15
103	Financial Accounting	Prof. Green	Finance	3	20	2022-03-10	2022-07-05
104	English Literature	Prof. White	Humanities	3	22	2022-04-05	2022-08-20
105	Web Development Fundamentals	Prof. Black	IT	4	28	2022-05-15	2022-09-25

LocationID	LocationName	Availability
L-101	Room 101	Open
L-102	Lab 3, Building B	Closed
L-103	Room 201	Open
L-104	Room 301	Open
L-105	Lab 2, Building A	Closed

Improving Efficiency :

To improve the efficiency we can split the table for Instructor and Departments.

Courses

CourseID	CourseName	InstructorID	DepartmentID	Credits	Enrolled Students	StartDate	EndDate
101	Introduction to Biology	I-101	D-101	3	25	2022-01-15	2022-05-10
102	Programming in Python	I-102	D-102	4	30	2022-02-20	2022-06-15

103	Financial Accounting	I-103	D-103	3	20	2022-03-10	2022-07-05
104	English Literature	I-104	D-104	3	22	2022-04-05	2022-08-20
105	Web Development Fundamentals	I-105	D-105	4	28	2022-05-15	2022-09-25

Instructor

InstructorID	InstructorName
I-101	Prof. Smith
I-102	Prof. Brown
I-103	Prof. Green
I-104	Prof. White
I-105	Prof. Black

Department

DepartmentID	DeptName
D-101	Science
D-102	Computer Science
D-103	Finance
D-104	Humanities
D-105	IT

Location

LocationID	LocationName	Availability
L-101	Room 101	Open
L-102	Lab 3, Building B	Closed
L-103	Room 201	Open
L-104	Room 301	Open
L-105	Lab 2, Building A	Closed