

Basic Database Concepts

- * Database Fundamentals
- * Normal Form
- * Relational Design Basics
- * Relationships
- * Northwind Database

Database Fundamentals

- What is a Database?

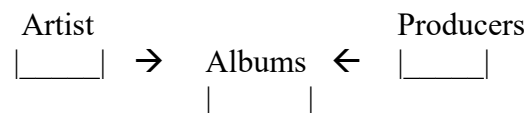
"Repository"

- What is a Table, an Index, a Query?

"Records Container", "Pointer", "Question"

Relational Design Basics

Relational vs. Flat file



*Entities

Instructors – Students – Class Rooms

Customers – Products – Orders

University DB Mind-Juice

Database

A Database is a collection of data about objects of the real world according to a set of rules, usually represented in tables, and it contains information about entities & relationships between entities.

Database Management System (DBMS)

A DBMS is a collection of inter-related data and set of programs used to access the data described in one particular object

Data Abstraction

- | | | |
|-------------------|----------------|-----------------|
| 1. Physical Level | Machine [DBMS] | (Lowest Level) |
| 2. Logical Level | Administrator | |
| 3. View Level | User | (Highest Level) |

Database Scheme

Tables or Views are DB schemes

Instance

The collection of information stored in the DB at a particular moment.

Database Independence

The ability to modify a schema definition in one level of the data abstraction without affecting the schema definition in the next higher level

Entity-Relationship Model (ERM)

Entity: is an object (thing) in the real world which is distinguishable from other object (Person, Account, Faculty... etc)

The Entity is described by a set of attributes

Example: Account: 1. Account Number
2. Balance
3.

Entity Set	Set of all entities of the same type
Relationship	An association among several Entity-Sets
Relationship Set	Set of all relationships of the same type

Domain

It is set of permitted values which can be stored in one attribute

Types of Relationships

1. One to One
2. One to Many, or Many to One
3. Many to Many

Example of a **One to One** relationship:

Customer-----1-----<Borrowed>-----1-----Loan	
-- SSN	-- Loan ID
-- Name	-- Amount
-- Address	

*each Customer has only 1 loan
&
each Loan has only 1 Customer*

Example of a **One to Many** relationship:

Mother-----1-----<Has>-----m-----Child	
-- SSN	-- SSN
-- Name	-- Name
-- Age	-- Age

*each Mother has many Children
&
each Child has only 1 Mother*

Example of a **Many to Many** relationship:

Climbers-----m-----<Climbed>-----m-----Mountains	
-- Age	-- MID
-- CID	-- Height
--Name	
--First Name	
--Mid Name	
--Last Name	

*each climber climbed many mountains
&
each mountain was climbed by many climbers*

Primary Key & Foreign Key

Primary Key is a unique key chosen by the designer that uniquely identifies every entity in the ES (e.g. SSN or Loan-ID).

We connect ESs (tables) together by adding the PK of the Strong ES into the Weak-ES as a Foreign Key.

NOTE: FK + Discriminator = PK (of the Weak-ES)

Tables Rules

1. It is not permitted to have two tables with the same name in the same DB.
2. It is not permitted to have two columns with the same name in the same table.

Example of a database relationship represented in tables:

This is a 1-to-Many relationship.

DEPARTMENT			EMPLOYEE			
DID	DeptName	Location	DID	EID	EmpName	Salary
001	HR	2 nd floor	001	AAA	Bob	\$15,000
002	IT	1 st floor	002	AAB	John	\$18,500
003	Marketing	3 rd floor	001	AAC	Mike	\$16,000

This is a 1-to-Many relationship.

Transaction

It is a set of operation that forms a single logical unit, which must be performed as All or None.

Database Administrator (DBA)

The person who has central control over the system

S/He has the following functions:

1. Schema Definition
2. Storage Structure & Access Definition
3. Generating of authorization rights
4. Integrity Constraints

Database Users

DB users can be categorized into the following classes:

- a. Application Programmer
- b. Sophisticated User
- c. Specialized User
- d. Naïve User

SQL

Structured Query Language, sometimes pronounced as "Sequel".

It is a relational language created by IBM – 1970. The statements of SQL can be divided into the next categories:

1. DML Data Manipulation Language
2. DDL Data Definition Language

3. DCL Data Definition Language

4. TL Transaction Language

For a detailed course on SQL basics, please click [here](#)

Trigger

It is a program that the system executes automatically as a side effect of a modification to the database.

A trigger must satisfy two requirements:

1. Specify when it is to be executed.
2. Specify the action to be taken.

Assertion

An assertion is a term, a predicate, expressing a condition on the DB.

Domain-type is a form of assertion. The total amount of all loans must be less than total amount of balances

Functional Dependencies

1. Transitivity $A \rightarrow B \text{ holds} \mid ______ A \rightarrow C \text{ holds}$
 $B \rightarrow C \text{ holds} \mid$
2. Reflexivity $B \subset A \quad \rightarrow \quad A \rightarrow B$
3. Augmentation $A \rightarrow B \text{ holds} \quad \rightarrow \quad AC \rightarrow BC \text{ holds}$
4. Self-Determination $A \rightarrow A \text{ holds}$
5. Union $A \rightarrow B \text{ holds} \mid ______ A \rightarrow BC \text{ holds}$
 $A \rightarrow C \text{ holds} \mid$
6. Decomposition $A \rightarrow BC \text{ holds} \quad \rightarrow \quad A \rightarrow B \text{ and } A \rightarrow C$
7. Composition $A \rightarrow B \text{ holds} \mid ______ A \rightarrow B \text{ and } A \rightarrow C$
 $C \rightarrow D \text{ holds} \mid$
8. Pseudo Transitivity $A \rightarrow B \text{ holds} \mid ______ AC \rightarrow C \text{ holds}$
 $CB \rightarrow D \text{ holds} \mid$

Normal Forms

Normalization is the process which makes all attributes in the relation dependent of the candidate key.

First Normal Form

1. No data duplication
2. Each row must have a unique identifier.

Incorrect:

Room#	Student1	Student2	Student3
8	Bob	Jane	Bob
8	Sue	John	Paul

Room#	Student
8	Bob
8	Jane
8	Bob
11	Sue

Correct:

Room#	Student ID
8	234
8	345
11	456

Room# + Student ID = Unique Identifier

Or

Create an ID column as an unique identifier

Second Normal Form

1. The relationship must be in the First Normal Form
2. No data duplication
3. Place duplicated data in a separate table and create a relationship to the data via foreign key

Incorrect:

Order#	Date	Shipper	Address
218	1/101	ABC Shipping	123 Main St.
321	1/101	ABC Shipping	123 Main St.

Correct:

Shipper#	Name	Address
1	ABC Shipping	123 Main St.
2	Blue Shipping	Orange St.

PK | _____
|
V

Order#	Date	Shipper#
218	1/1/01	1
321	1/1/01	1

Third Normal Form

1. The relationship must be in the Second Normal Form
2. Data must be completely dependent on the primary key

Incorrect:

Class#	Male Students	Female Students	Total
21	6	8	14
32	12	4	16

Correct:

Class#	Male Students	Female Students
21	6	8
32	12	4

The "Total" column was just an addition operation