Database Management System

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Slide 1

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File Management Systems

- File based systems
  - Data is stored in files
  - Each file has a specific format
  - Programs that use these files depend on knowledge about that format
- Problems:
  - No standards
  - Data duplication
  - Data dependence
  - No way to generate ad hoc queries
  - No provision for security, recovery, concurrency, etc.

File Processing Vs DBMS

File Systems :

- Store data over long periods of time
- Store large amount of data

However :

- No guarantee that data is not lost if not backed up
- No support to query languages
- No efficient access to data items unless the location is known
- Application depends on the data definitions (structures)
- Change to data definition will affect the application programs
  - Single view of the data
  - Separate files for each application
  - Limited control to multiple accesses
  - Data viewed as physically stored

Basic Definitions

Data : Known facts that can be recorded and have an implicit meaning.

Database : A collection of related data.

A collection of data arranged for ease and speed of search and retrieval" -Dictionary.com

Database Administrator : Responsible for authorizing access to the database, coordinating, monitoring its use, acquiring hardware, software needed.

Database Designers : Responsible for identifying the data to be stored, storage structure to represent and store data. This is done by a team of professionals in consultation with users, and applications needed.

Basic Definitions

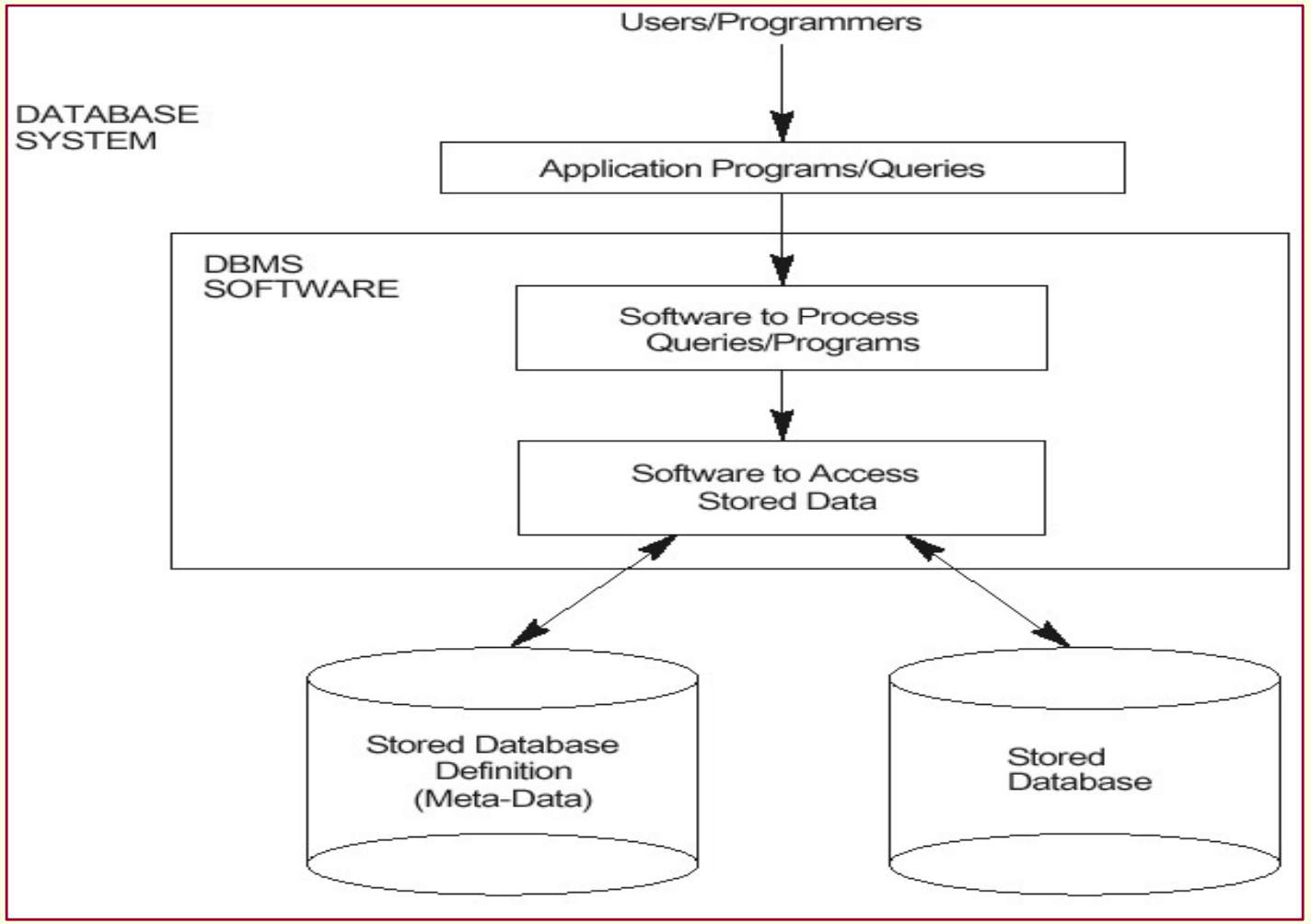
Database Management System (DBMS): A software package/ system to facilitate the creation and maintenance of a computerized database.

- It defines (data types, structures, constraints)
- construct (storing data on some storage medium controlled by DBMS)
- manipulate (querying, update, report generation) databases for various applications.

- Examples:
  - Oracle, DB2 (IBM), MS SQL Server, MS Access,Ingres, PostgreSQL, MySQL

Database System: The DBMS software together with the data itself. Sometimes, the applications are also included.

Database System



Database System

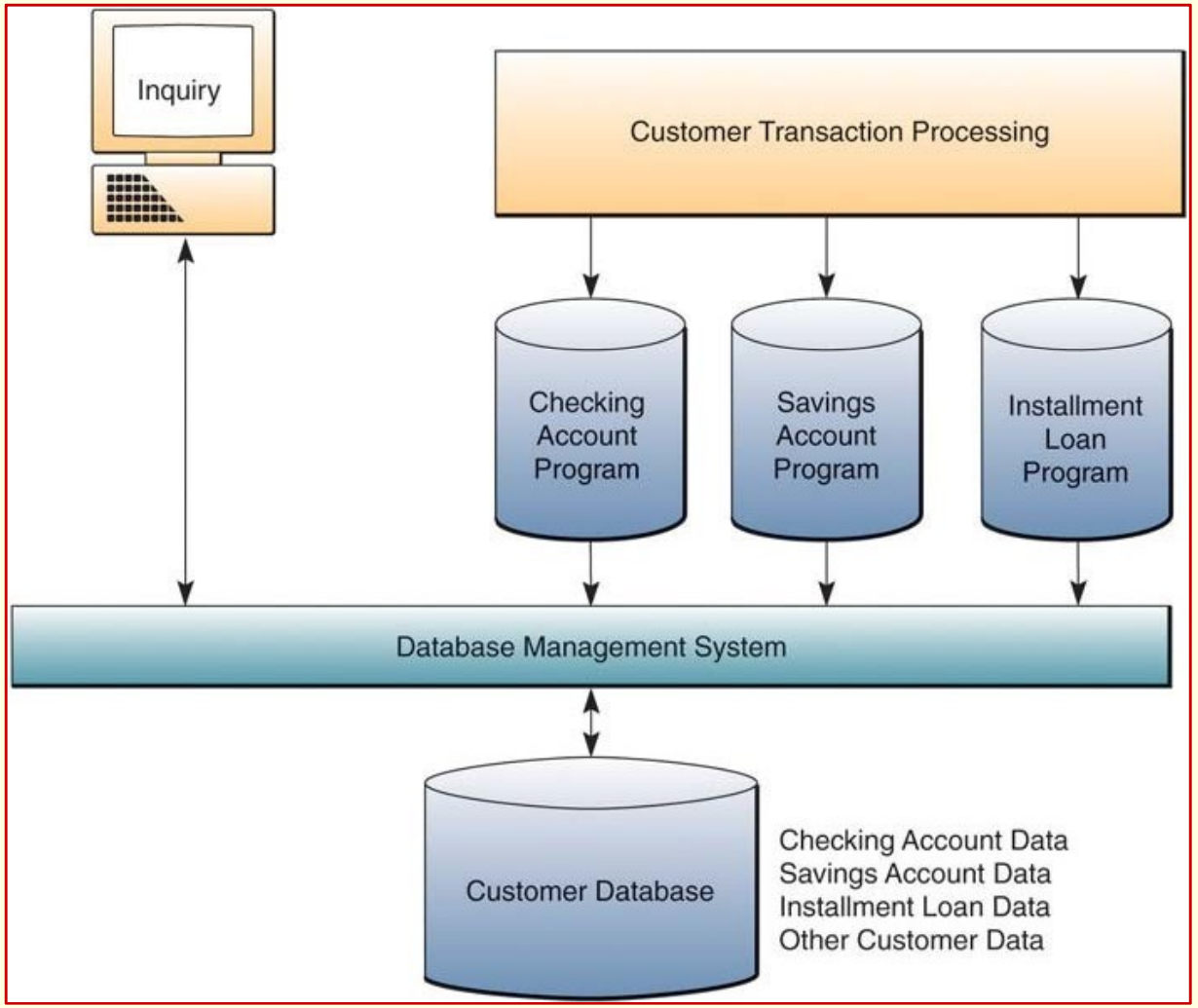
- A database system consists of
  - Data (the database)
  - Software
  - Hardware
  - Users (*End users, Database Administrator (DBA), Application developers, Database systems programmer*)
- We focus mainly on the software

- Database systems allow users to
  - Store
  - Update
  - Retrieve
  - Organise
  - Protect

  their data.

Example:

Consolidates data records into one CENTRAL database that can be accessed by many **different application programs.**



An example of a database that stores student records and their grades.

STUDENT	Name	StudentNumber	Class	Major
	Smith	17	1	CS
	Brown	8	2	CS

COURSE	CourseName	CourseNumber	CreditHours	Department
	Intro to Computer Science	CS1310	4	CS
	Data Structures	CS3320	4	CS
	Discrete Mathematics	MATH2410	3	MATH
	Database	CS3380	3	CS

SECTION	SectionIdentifier	CourseNumber	Semester	Year	Instructor
	85	MATH2410	Fall	98	King
	92	CS1310	Fall	98	Anderson
	102	CS3320	Spring	99	Knuth
	112	MATH2410	Fall	99	Chang
	119	CS1310	Fall	99	Anderson
	135	CS3380	Fall	99	Stone

GRADE_REPORT	StudentNumber	SectionIdentifier	Grade
	17	112	B
	17	119	C
	8	85	A
	8	92	A
	8	102	B
	8	135	A

PREREQUISITE	CourseNumber	PrerequisiteNumber
	CS3380	CS3320
	CS3380	MATH2410
	CS3320	CS1310

What the DBMS does

- Provides users with
  - Data definition language (DDL)
  - Data manipulation language (DML)
  - Data control language (DCL)
- Often these are all the same language

- DBMS provides
  - Persistence
  - Concurrency
  - Integrity
  - Security
  - Data independence
- Data Dictionary
  - Describes the database itself

ACID Properties

ACID Properties are used for maintaining the integrity of database during transaction processing. ACID in DBMS stands for **A**tomicity, **C**onsistency, **I**solation, and **D**urability.

•**Atomicity:** A transaction is a single unit of operation. You either execute it entirely or do not execute it at all. There cannot be partial execution.

•**Consistency:** Once the transaction is executed, it should move from one consistent state to another.

•**Isolation:** Transaction should be executed in isolation from other transactions (no Locks). During concurrent transaction execution, intermediate transaction results from simultaneously executed transactions should not be made available to each other. (Level 0,1,2,3)

•**Durability:** · After successful completion of a transaction, the changes in the database should persist. Even in the case of system failures.

Database

Foundation

Foundation Data Concepts

Abstract Concepts

- **Entity** – person, place, object or event

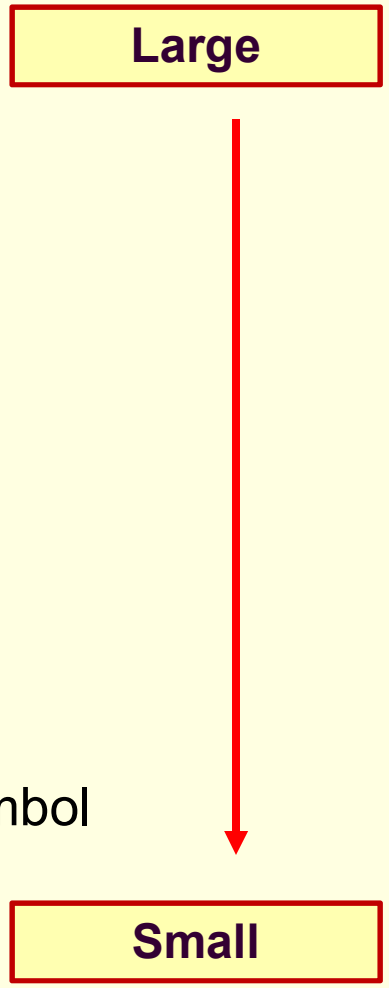
  – stored as a record or a **table row**

- **Attribute** – characteristic of an entity

  – stored as field or **table column**

Data Concepts

- **Database** – a collection of related tables
- **Tables** – a collection of related records
  – collection of related entities
- **Record** – collection of fields (**table row**)
  –represents an entity
- **Field** – collection of characters (**table column**)
  – represents an attribute
- **Character** – single alphabetic, numeric or other symbol



Fields

- Characters “Last Name” form a field

Last Name
Sadu

- A field is an attribute of an entity

Records

- A bunch of fields form a record

First Name	Last Name	Sex	Age
Hari	Sadu	M	45

- A record is an entity

Tables

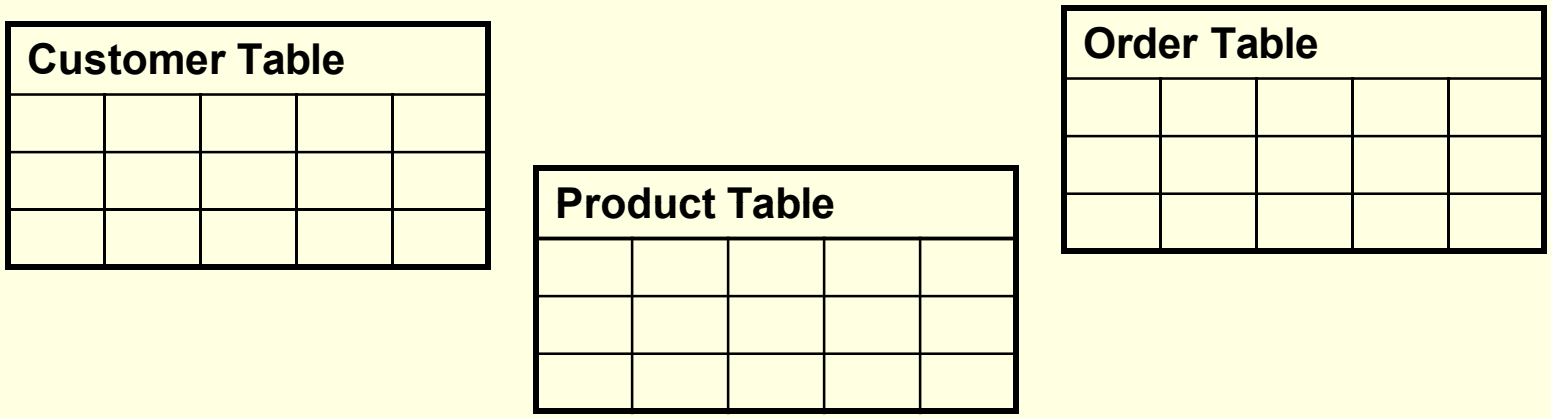
- A bunch of records forms a table

First Name	Last Name	Sex	Age
Hari	Sadu	M	45
Abhimanyu	Singh	M	25
Shanaya	Singhaniya	F	23
Rohan	Nanda	M	24

- A table is a group of related entities

Databases

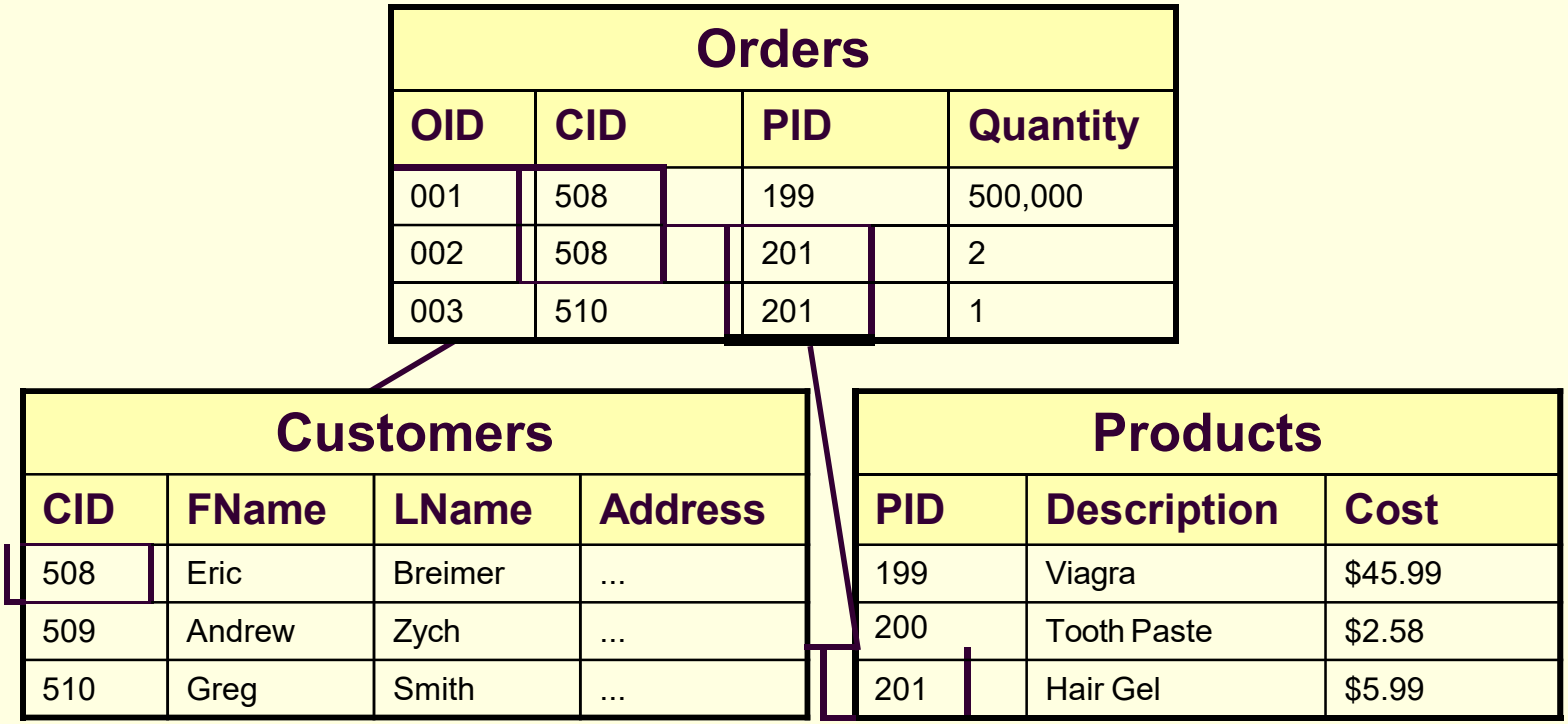
- A bunch of tables form a database



- A database can represent a single business or an entire system

Database

- But, database is not just a bunch of tables



Orders

OID	CID	PID	Quantity
001	508	199	500,000
002	508	201	2
003	510	201	1

Customers

CID	FName	LName	Address
508	Eric	Breimer	...
509	Andrew	Zych	...
510	Greg	Smith	...

Products

PID	Description	Cost
199	Viagra	$45.99
200	Tooth Paste	$2.58
201	Hair Gel	$5.99

- A database also includes relationships between the different tables

Database

Relationships

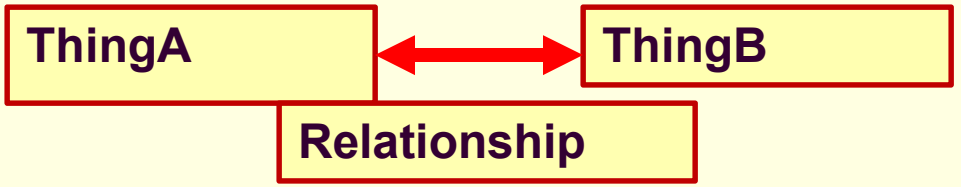
Relational Theory

- In order to work with DBMS it is necessary to understand the basics of relational theory. i.e how and why data is stored and managed in a relational database.

- The guiding principle behind a relational database is to store data once and only once.

Types of Relationships

One to One

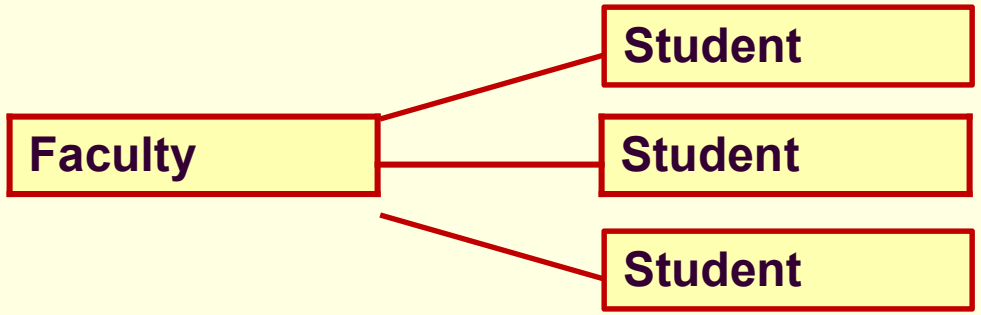


- Examples?

- Analysis Technique
  - Consider ThingA and ThingB
  - Can ThingA be related to more than one ThingB?
  - Can ThingB be related to more than one ThingA?
  - If the two answers are NO, then it is a **one to one** relationship.

Types of Relationships

One to Many

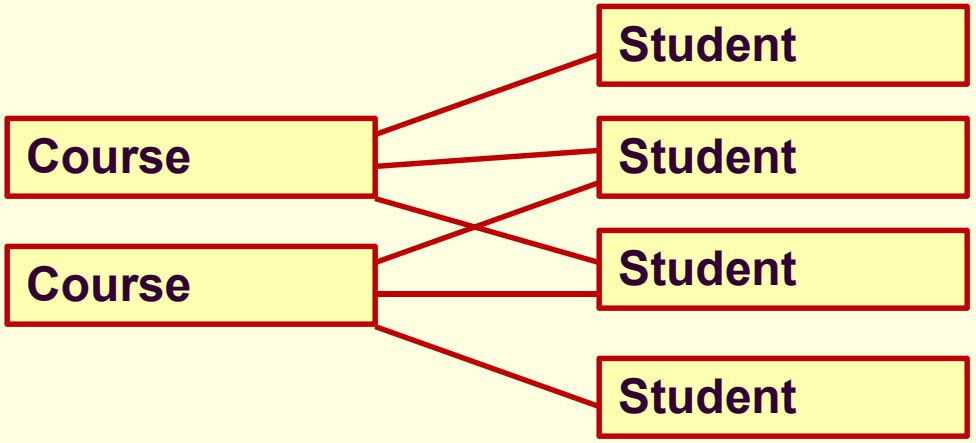


- Examples?

- Analysis Technique
  - Consider ThingA and ThingB
  - Can ThingA be related to more than one ThingB?
  - Can ThingB be related to more than one ThingA?
  - If only one answer is yes, then you have a one to many relationship

Types of Relationships

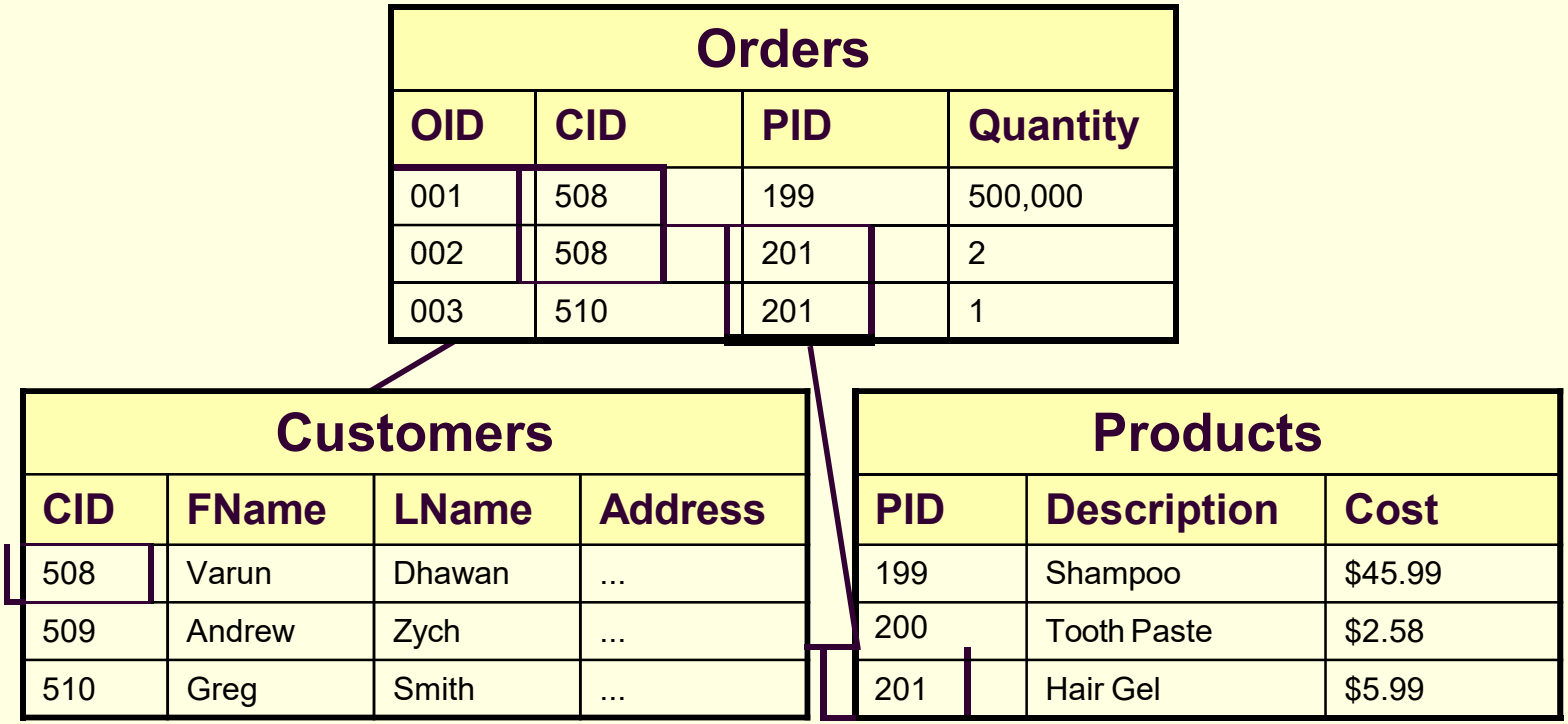
Many to Many



- Examples?

- Analysis Technique
  - Consider ThingA and ThingB
  - Can ThingA be related to more than one ThingB?
  - Can ThingB be related to more than one ThingA?
  - If the answers are yes and yes, then the relationship is **many to many**.

Model Relationships Example



Orders

OID	CID	PID	Quantity
001	508	199	500,000
002	508	201	2
003	510	201	1

Customers

CID	FName	LName	Address
508	Varun	Dhawan	...
509	Andrew	Zych	...
510	Greg	Smith	...

Products

PID	Description	Cost
199	Shampoo	$45.99
200	Tooth Paste	$2.58
201	Hair Gel	$5.99

Database vs Relational Database

Relational Database	Database
A relational database can store and arrange the data in the tabular form like rows and columns.	It is used to store the data as files.
In a relational database, the values are stored as tables that require a primary keys to possess the data in a database.	Generally, it stores the data in the hierarchical or navigational form.
It is designed to handle a huge collection of data and multiple users.	It is designed to handle the small collection of data files that requires a single user.
Stored data can be accessed from the relational database because there is a relationship between the tables and their attributes.	There is no relationship between data value or tables stored in files.
The data normalization feature is available in the relational database.	It does not have a normalization.
A relational database uses integrity constraints rules that are defined in ACID properties.	It does not follow any integrity constraints rule nor utilize any security to protect the data from manipulation.

Reassembling data

- Data was broken down into tables to preserve integrity
- How can we put it together to derive information?
- Use Structured Query Language (SQL) to JOIN tables using a common attribute

Join

orders

OrderID	CustomerID	OrderDate
10308	2	1996-09-18
10309	37	1996-09-19
10310	77	1996-09-20

customers

CustomerID	CustomerName	ContactName	Country
1	Alfreds Futterkiste	Maria Anders	Germany
2	Ana Trujillo Emparedados y helados	Ana Trujillo	Mexico
3	Antonio Moreno Taquería	Antonio Moreno	Mexico

```
SELECT Orders.OrderID, Customers.CustomerName, Orders.OrderDate
FROM Orders
INNER JOIN Customers ON Orders.CustomerID=Customers.CustomerID;
```

OrderID	CustomerName	OrderDate
10308	Ana Trujillo Emparedados y helados	9/18/1996

Primary Key (Unique and not NULL)

- Identifies the row of a table without duplicates.
- Tells you what the row contains
- Eg. If **tree_id** is the primary key then the row has information about that tree

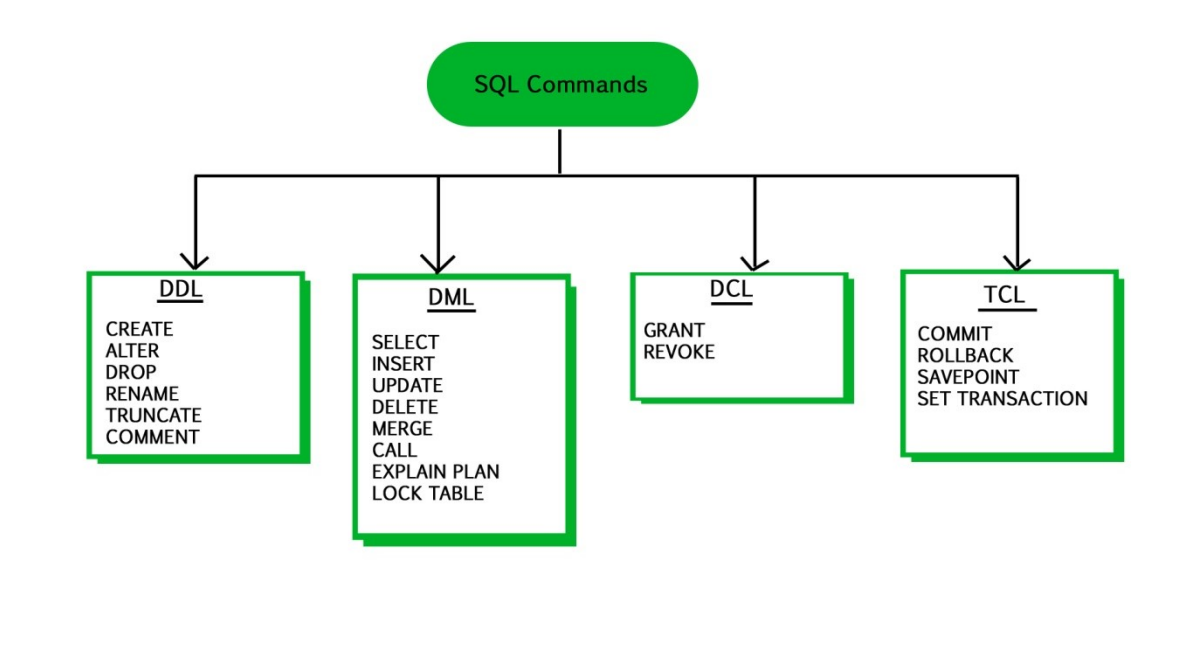
Foreign Key

- A foreign key is a column in a table that matches the primary key column of another table. Its function is to link the basic data of two entities on demand, i.e. when two tables are joined using the common key.

Database

Languages

Database Languages



DDL (Data Definition Language)
DML (Data Manipulation Language)
DCL (Data Control Language)
TCL (Transaction Control Language)

DBMS Languages

•**Data Definition Language** (**DDL**): Using the DDL statements, you can create the skeleton of the database.

•**Create:** It is used to create objects in the database.
•**Alter:** It is used to alter the structure of the database.
•**Drop:** It is used to delete objects from the database.
•**Truncate:** It is used to remove all records from a table.
•**Rename:** It is used to rename an object.
•**Comment:** It is used to comment on the data dictionary.

Contd.

Data Manipulation Language (**DML**): Used to specify database retrievals and updates.

- Alternatively, *stand-alone* DML commands can be applied directly (**query language**).

- **Select:** It is used to retrieve data from a database.
- **Insert:** It is used to insert data into a table.
- **Update:** It is used to update existing data within a table.
- **Delete:** It is used to delete all records from a table.

Assess Yourself:

1. DML is provided for

a) Description of the logical structure of database
b) The addition of new structure in database
c) Manipulation and processing of the database
d) Definition of a physical structure of the database system

Contd.

2. Related fields in a database are grouped to form

a) Data file
b) Data record
c) Menu
d) bank

3. DBMS is software.

a) True
b) False

THANK YOU!