RELATIONAL DATABASE

Storing and manipulating records

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DATABASE

- May be defined as a collection of interrelated data stored together to serve multiple application
- It is computer based record keeping system.
- It not only allows to store but also allows us modification of data as per requirements.

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DBMS

- A DBMS refers to Database Management System
- It is a software that is responsible for storing, manipulating, maintaining and utilizing database.
- A database along with the a DBMS is referred to as a database system.
- There are various DBMS software available in the market like :-
- Oracle, MS SQL Server, MySQL, Sybase, PostgreSQL, SQLite

PURPOSE OF DBMS

- **Databases reduces Redundancy**

  It removes duplication of data because data are kept at one place and all the application refers to the centrally maintained database.

- **Database controls Inconsistency**

- When two copies of the same data do not agree to each other, then it is called Inconsistency. By controlling redundancy, the inconsistency is also controlled.

- **Database facilitate Sharing of Data**

- Data stored in the database can be shared among several users.

- **Database ensures Security**

- Data are protected against accidental or intentional disclosure to unauthorized person or unauthorized modification.

- **Database maintains Integrity**

- It enforces certain integrity rules to insure the validity or correctness of data. For ex. A date cant be like 25/25/2000.

- **Database enforces Standard**

- Database is maintained in a standard format which help to data interchange or migration of data between two systems.

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RELATIONAL DATABASE MODEL

o In relational database model data is organized into table (i.e. rows and columns).

o These tables are also known as relations.

o A row in a table represent relationship among a set of values.

o A column represent the field/attributes related to relation under which information will be stored.

o For example if we want to store details of students then : Roll, Name, Class, Section, etc. will be the column/attributes and the collection of all the column information will become a Row/Record

SAMPLE TABLES

EMPLOYEE

EMPNO	ENAME	GENDER	DEPTNO	SALARY	COMM
1	ANKITA	F	10	20000	1200
2	SUJEET	M	20	24000	
3	VIJAYA	F	10	28000	2000
4	NITIN	M	30	18000	3000
5	VIKRAM	M	30	22000	1700

DEPARTMENT

DEPTNO	DNAME	LOCATION
10	HR	NEW YORK
20	ACCOUNTS	BRAZIL
30	SALES	CANADA
40	IT	INDIA

COMPONENT OF A TABLE

- Byte : group of 8 bits and is used to store a character.

- Data Item : smallest unit of named data. It represent one type of information and often referred to as a field or column information

- Record : collection of data items which represent a complete unit of information

- Table : collection of all Rows and Columns.

Table

Fields

DEPTNO	DNAME	LOCATION
10	HR	NEW YORK
20	ACCOUNTS	BRAZIL
30	SALES	CANADA
40	IT	INDIA

Data Items (requires 5 bytes)

Records

COMMON RDBMS

- Oracle, MS SQL Server, MySQL, IBM DB2, IBM Informix, SAP Sybase, Adaptive Server Enterprise, SAP Sybase IQ, Teradata, PostgreSQL, SQLite, etc.

- Out of these MySQL, PostgreSQL and SQLite are Open source implementation.

COMMON RDBMS

- ## MySQL
  - Runs on virtually all platforms including Linux, Unix and Windows. Popular for web based application and online publishing. It is a part of LAMP (Linux, Apache, MySQL, PHP) stack

- ## SQLite
  - Relational DBMS but it is not client-server database engine rather, it is embedded into end program. Arguably the most widely deployed database engine as it is used by several browsers, OS and embedded systems(Mobiles).

- ## PostgreSQL
  - General purpose object-relational DBMS. It is the most advanced open source database system. It is free and open source i.e. source code is available under PostgreSQL license, a liberal open source license.

COMMON DBMS TOOLS FOR MOBILE DEVICES

- SQL Anywhere, DB2 Everywhere, IBM Mobile Database, SQL Server Compact, SQL Server Express, Oracle DatabaseLite, SQLite, SQLBase etc.

- Out of these **SQLite** is public domain open source implementation

Various Terms used in the Relational Model

Relational Model was developed by E.F.codd of the IBM and used widely in the most of the DBMS.

Relation (Table)

A Relation or Table is Matrix like structure arranged in Rows or Columns. It has the following properties-

❖ All items in a column are homogeneous i.e. same data type.
❖ Each column assigned a unique name and must have atomic (indivisible) value.
❖ All rows of a relation are distinct i.e. no two identical rows (record) are present in the Relation.
❖ Ordering or Rows (Records) or Columns (fields) are immaterial.

Domain

It is collection of values from which the value is derived for a column.

Tuple / Entity / Record

Rows of a table is called Tuple or Record.

Attribute/ Field

Column of a table is called Attribute or Field.

Degree

Number of columns (attributes) in a table.

Cardinality

Number of Records in a table.

JUST A MINUTE…

BOOKCODE	BOOKNAME	PUB	PRICE
B001	LET US C	BPB	400
B002	VISUAL BASIC	EEE	350
B003	JAVA	PHI	550
B004	VC++	BPB	750

Identify the following in the above table

1) Degree of Table
2) Cardinality of Table
3) Attributes of Table
4) Tuple
5) Data types of Book Code and Price (as studied in Python)

CONCEPT OF KEYS

EMPNO	ENAME	GENDER	DEPTNO	SALARY	COMM
1	ANKITA	F	10	20000	1200
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In relation each record must be unique i.e. no two identical records are allowed in the Database. A key attribute identifies the record and must have unique values. There are various types of Keys:

Primary Key, Candidate Key, Alternate Key and Foreign Key.

KEYS

- Primary Key
  - A set of one or more attribute that can identify a record uniquely in the relation is called Primary Key.
  - There can be only 1 primary key in a table
  - Allows only distinct (no duplicate) values and also forces mandatory entry (NOT NULL) i.e. we cannot left it blank.
- Candidate Key
  - In a table there can be more than one attribute which contains unique values. These columns are known as candidate key as they are the candidate for primary key.
  - Among these database analyst select one as a primary key based on requirement like must contain unique value, compulsory entry and where maximum searching is done etc.

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KEYS

- Alternate Key
  - In case of multiple candidate keys, one of them will be selected as Primary Key and rest of the column will serve as Alternate Key
  - A Candidate Key which is not a primary key is an Alternate Key.
- Foreign key
  - Used to create relationship between two tables.
  - It is a non-key attribute whose value is derived from the Primary key of another table.
  - Foreign key column will for the value in Primary key of another table, if present then entry will be allowed otherwise data will be rejected.
  - Primary Key column table from where values will be derived is known as Primary Table or Master Table or Parent Table and Foreign key column table will be Foreign Table or Detail Table or Child table

EMPLOYEE

EMPNO	ENAME	GENDER	DEPTNO	SALARY	COMM
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4	NITIN	M	30	18000	3000
5	VIKRAM	M	30	22000	1700

Child Table

DEPARTMENT

DEPTNO	DNAME	LOCATION
10	HR	NEW YORK
20	ACCOUNTS	BRAZIL
30	SALES	CANADA
40	IT	INDIA

Parent Table

From the Above table definition we can observe that the **DEPTNO** column of EMPLOYEE table is deriving its value from **DEPTNO** of table DEPARTMENT. So we can say that the **DEPTNO** of EMPLOYEE table is a foreign key whose value is dependent upon the Primary key column **DEPTNO** of table DEPARTMENT.

REFERENTIAL INTEGRITY

- Used to ensure relationship between records in related tables are valid and user don't accidentally delete or change the related data.
- Referential integrity can be applied when:
  - The master table's column is a Primary Key or has a unique index
  - The related fields have the same data type
  - Both tables must belong to same database.

REFERENTIAL INTEGRITY

- When referential integrity is enforced using Foreign Key you must observe the following rules:
  - You cannot enter a value in Child Table which is not available in Master Table's Primary key column. However you can enter NULL values in foreign key
  - You cannot delete a record from Master Table if matching record exists in related table
  - You cannot modify or change the Primary Key value in Master table if its matching record is present in related table.

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BRIEF HISTORY OF MYSQL

- MySQL is freely available open source RDBMS
- Can be downloaded from www.mysql.org
- In MySQL information is stored in Tables.
- Provides features that support secure environment for storing, maintaining and accessing data.
- It is fast, reliable, scalable alternative to many of the commercial RDBMS today.
- Create and supported by MySQL AB, a company based in Sweden. This company is now subsidiary of *Sun Microsystems*. On April 2009 Oracle Corp. acquires *Sun Microsystems*.
- The chief inventor of MySQL was Michael Widenius(a.k.a Monty). MySQL has been named after Monty's daughter *My*. The logo of MySQL is dolphin and name of that dolphin is '*Sakila*'

MySQL Database System

- MySQL database system refers to the combination of a MySQL server instance and MySQL database.

- It operates using Client/Server architecture in which the server runs on the machine containing the database and client connects to server over a network

- MySQL is a multiuser database system, meaning several users can access the database simultaneously

MySQL Database System

- The Server
  - Listens for client requests coming in over the network and access the database as per the requirements and provide the requested information to the Client

- The Client
  - Are the programs that connect to MySQL server and sends requests to the server and receives the response of Server. Client may be the MySQL prompt or it may be Front-end programming which connect to server programmatically like connecting to MySQL using Python Language or Java or any other language

FEATURES OF MySQL

- Speed
  - MySQL runs very fast.
- Ease of Use
  - Can be managed from command line or GUI
- Cost
  - Is available free of cost. It is Open Source
- Query language Support
  - Supports SQL
- Portability
  - Can be run on any platform and supported by various compilers
- Data Types
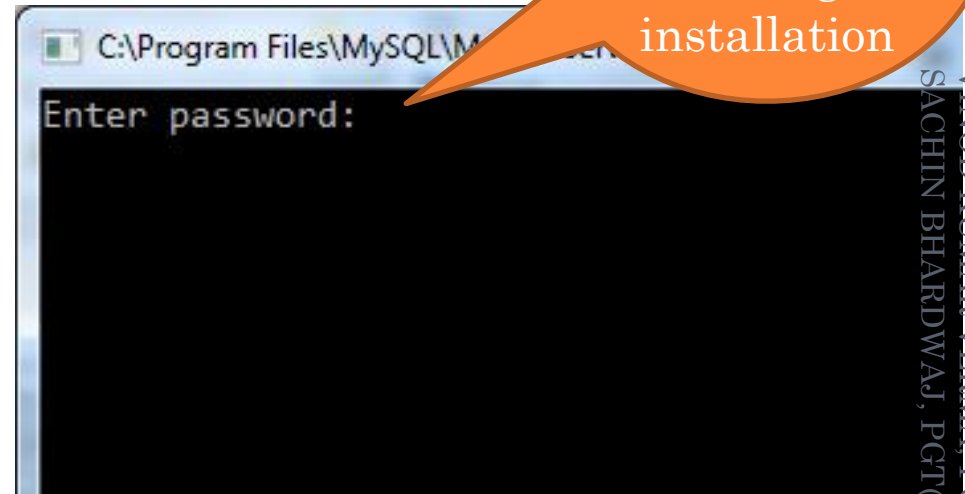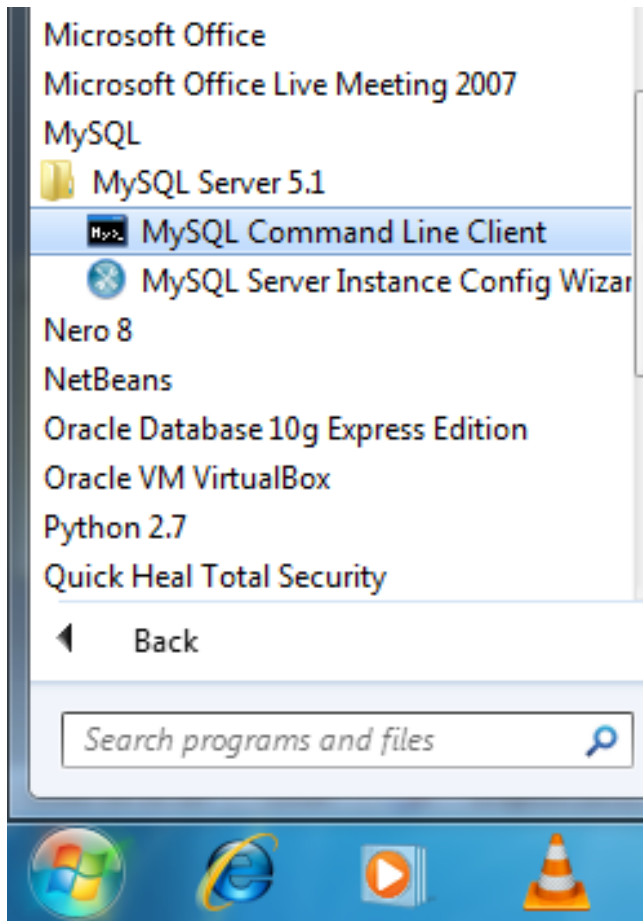 - Supports various data types like Numbers, Char etc.
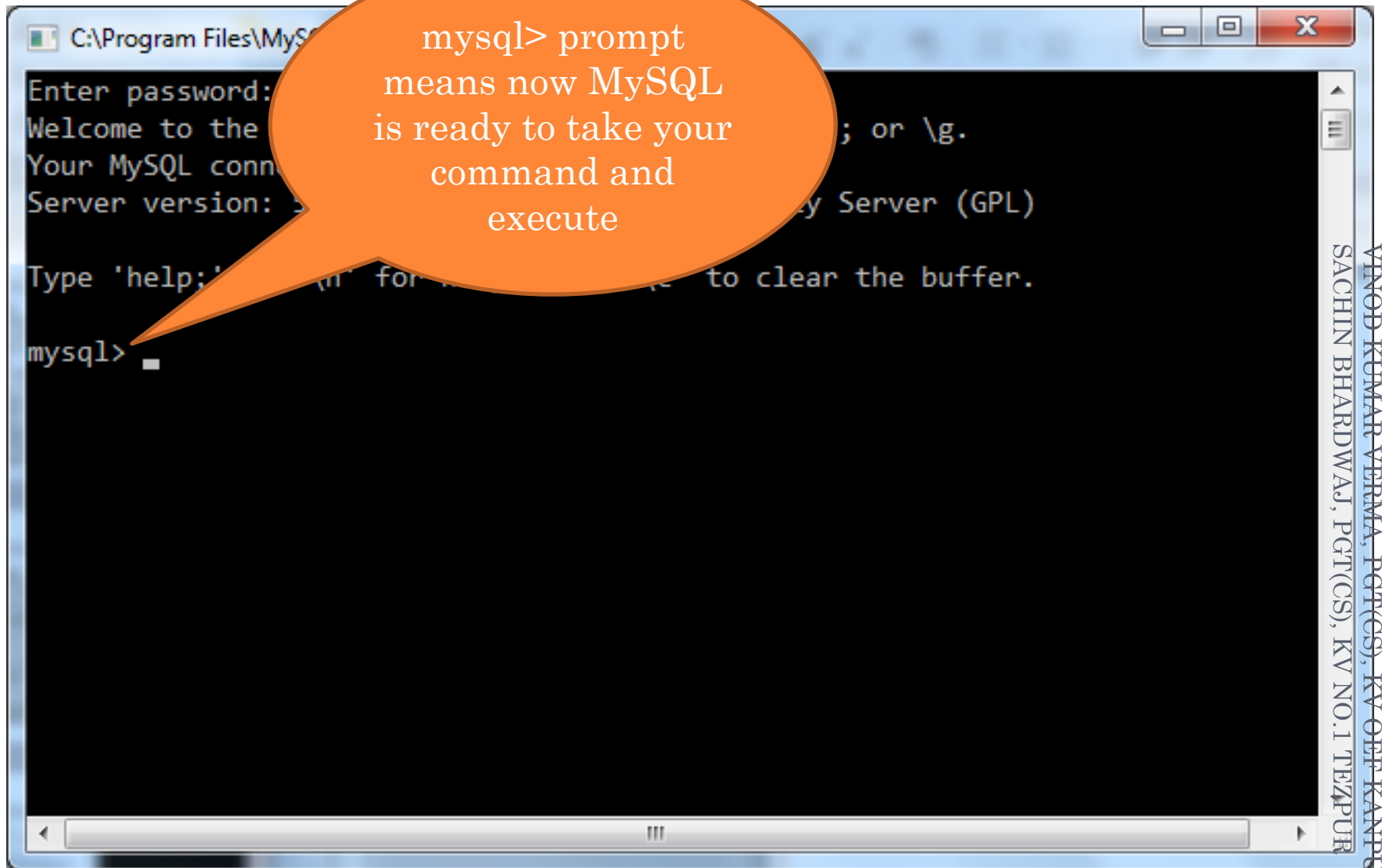
FEATURES OF MySQL

- Security
  - Offers privileges and password systems that is very flexible and secure.
- Scalability and Limits
  - Can handle large databases. Some of real life MySQL databases contains millions of records.
- Connectivity
  - Clients can connect to MySQL using drivers
- Localization
  - The server can provide error message to client in many language
- Client and Tools
  - Provides several client and utility programs. Like *mysqldump* and *mysqladmin*. GUI tools like MySQL Administration and Query Browser

STARTING MYSQL

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Click on **Start** → All Programs → MySQL →
MySQL Server → **MySQL Command Line Client**

To exit from MySQL type **exit or quit** in front

of **mysql** prompt

SQL AND MYSQL

- SQL stands for Structured Query Language.
- Is a language that enables you to create and operate on relational databases.
- MySQL uses SQL in order to access databases.
- It is the standard language used by almost all the database s/w vendors.
- Pronounced as SEQUEL
- Original version was developed by IBM's **Almanden Research Center**
- Latest ISO standard of SQL was released in 2008 and named as SQL:2008

Processing Capabilities of SQL

➢ *DDL (Data Definition Language)*

➢ *DML (Data Manipulation Language)*

➢ *Embedded DML*

➢ *View*

➢ *Authorization*

➢ *Integrity*

➢ *Transaction Control*

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DATA DEFINITION LANGUAGE

➢ It allows to create database objects like creating a table, view or any other database objects.

➢ The information about created objects are stored in special file called DATA DICTIONARY

➢ DATA DICTIONARY contains metadata i.e. data about data.

➢ While creating a table DDL allows to specify – name of table, attributes, data types of each attribute, may define range of values that attributes can store, etc

➢ Major commands of DDL are – **CREATE, ALTER, DROP**

DATA MANIPULATION LANGUAGE

➢ It allows to perform following operation on table
  ✓ Retrieval of information stored in table
  ✓ Insertion of new data in table
  ✓ Modification of existing data in table
  ✓ Deletion of existing data from table

➢ DML is of 2 type
  ✓ **Procedural DML** (in this we specify what data is needed and how to get it)
  ✓ **Non-Procedural DML** (in this we specify what data is needed without specifying how to get it)

➢ Main DML commands are – **SELECT, INSERT, UPDATE AND DELETE**

TCL COMMANDS

- Stands for Transaction Control Language
- **MySQL transaction** allows you to execute a set of **MySQL** operations to ensure that the database never contains the result of partial operations. In a set of operations, if one of them fails, the rollback occurs to restore the database to its original state. For example Transfer of money from one account to another etc.
- It follows ACID property (Atomicity, Consistency, Isolation and Durability)
- Commands used for managing the Transaction are: **COMMIT, ROLLBACK, SAVEPOINT and SET TRANSACTION**

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TCL COMMANDS

- Commit
  - To save the current transaction
- RollBack
  - To undo/cancel the current transaction activity
- Savepoint
  - To insert a Flag/Bookmark in various stages of Transaction, so that later on we can rollback from any given savepoint
- Set Transaction
  - To specify the properties of current Transaction
- Start Transaction
  - To start transaction acitivity

TCL COMMANDS

- By default, MySQL automatically commits the changes permanently to the database. To force MySQL not to commit changes automatically, you use the following statement:

    Set autocommit = 0   Or

    Set autocommit = OFF

To start again

    Set autocommit = 1   Or

    Set autocommit = ON

JUST A MINUTE...

- What is Database? What are the advantages of Database System?
- What is DDL and DML? Give examples of command belonging to each category

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