Database Management System (DBMS)
(Course code: 22CS2110RA)

CO# 1 ,Session# 3:
Session Topic: Data Independence

Session Objective

Students should be able to understand

- The three-levels of database abstraction
- The data Independence

Poll Question-01

Q: Which is the lowest level of abstraction that describes how the data are actually stored?

A) Physical

B) Abstract

C) View

D) User

Answer: A

Explanation: The physical level of abstraction that describes how the data are actually stored.

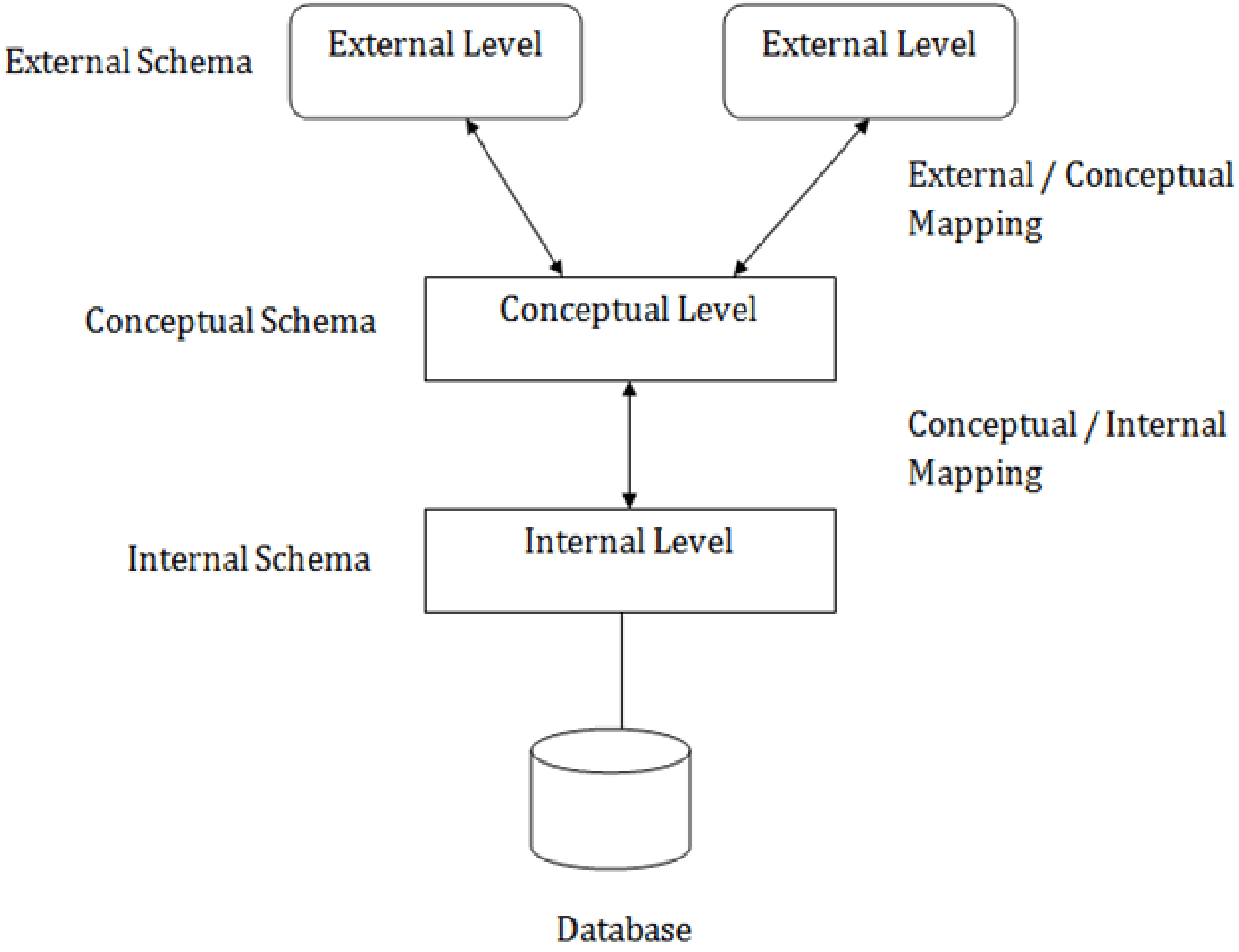
Key Concepts

- DBMS Three-Level Architecture
- Data Independence
- Database Languages

DBMS – Three Level Architecture

- A database management system that provides three level of data is said to follow three-level architecture .
  - External level (i.e. External Schema)
  - Conceptual level (i.e. Conceptual Schema)
  - Internal level (i.e. Internal Schema)

DBMS – Three Level Architecture



External level :

- The external level is at the highest level of database abstraction . At this level, there will be **many views define for different users requirement**. A view will describe only a subset of the database. Any number of user views may exist for a given global or sub schema.
- for example , each student has different view of the time table. the view of a student of BTech (CSE) is different from the view of the student of BTech(ECE). **Thus this level of abstraction is concerned with different categories of users.**
- Each external view is described by means of a schema called sub schema or external schema.

Conceptual level :

- At this level of database abstraction **all the database entities and the relationships among them** are included . **One conceptual view represents the entire database** . This conceptual view is defined by the conceptual schema.
- The conceptual schema **hides the details of physical storage structures** and concentrates on describing entities, data types, relationships, user operations and constraints.
- It describes all the records and relationships included in the conceptual view . There is only one conceptual schema per database . It includes feature that specify the checks to relation data consistency and integrity.

Internal level :

- It is the lowest level of abstraction **closest to the physical storage method** used . It **indicates how the data will be stored and describes the data structures and access methods** to be used by the database . The internal view is expressed by internal schema.
- The following aspects are considered at this level:
  - Storage allocation e.g: B-tree, hashing
  - Access paths eg. specification of primary and secondary keys, indexes etc
  - Miscellaneous eg. Data compression and encryption techniques, optimization of the internal structures.

Data Independence

- Data independence is the ability to modify the schema without affecting the programs and the application to be rewritten.
- Data is separated from the programs, so that the changes made to the data will not affect the program execution and the application.

- **The main purpose of the three levels of data abstraction is to achieve data independence.** If the database changes and expands over time, it is very important that the changes in one level should not affect the data at other levels of the database. This would save time and cost required when changing the database.

- There are two levels of data independence based on three levels of abstraction. These are as follows –
  - ✓Physical Data Independence
  - ✓Logical Data Independence

Physical data independence

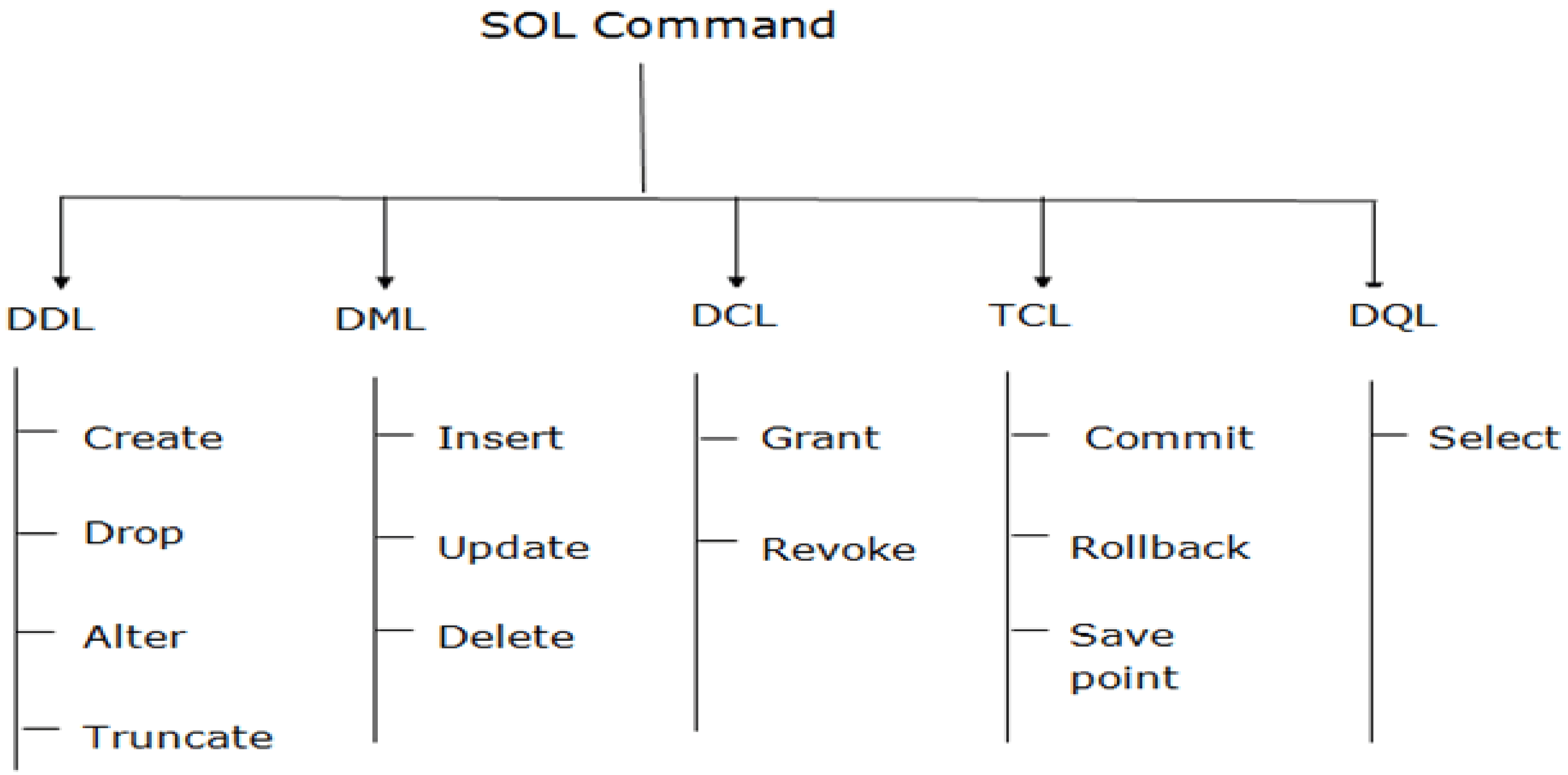
- Physical data independence is the ability to modify the physical scheme without making it necessary to rewrite application programs. Such modifications include changing from unblocked to blocked record storage, or from sequential to random access files.

Logical data independence

- Logical data independence is the ability to modify the conceptual scheme without making it necessary to rewrite application programs. Such a modification might be adding a field to a record; an application program’s view hides this change from the program.

DBMS Languages

- Data Definition Language (DDL)
- Data Manipulation Language (DML)
  - High-Level or Non-procedural Languages: These include the relational language SQL
  - Low Level or Procedural Languages:



SOL Command

- DDL
  - Create
  - Drop
  - Alter
  - Truncate
- DML
  - Insert
  - Update
  - Delete
- DCL
  - Grant
  - Revoke
- TCL
  - Commit
  - Rollback
  - Save point
- DQL
  - Select

Tools:

- **Data dictionary / repository**:
  - Used to store schema descriptions and other information such as design decisions, application program descriptions, user information, usage standards, etc.
  - *Active* data dictionary is accessed by DBMS software and users/DBA.
  - *Passive* data dictionary is accessed by users/DBA only.
- **Application Development Environments and CASE (computer-aided software engineering) tools:**
  - Examples – Power builder (Sybase), Builder (Borland)

Types of DBMS:

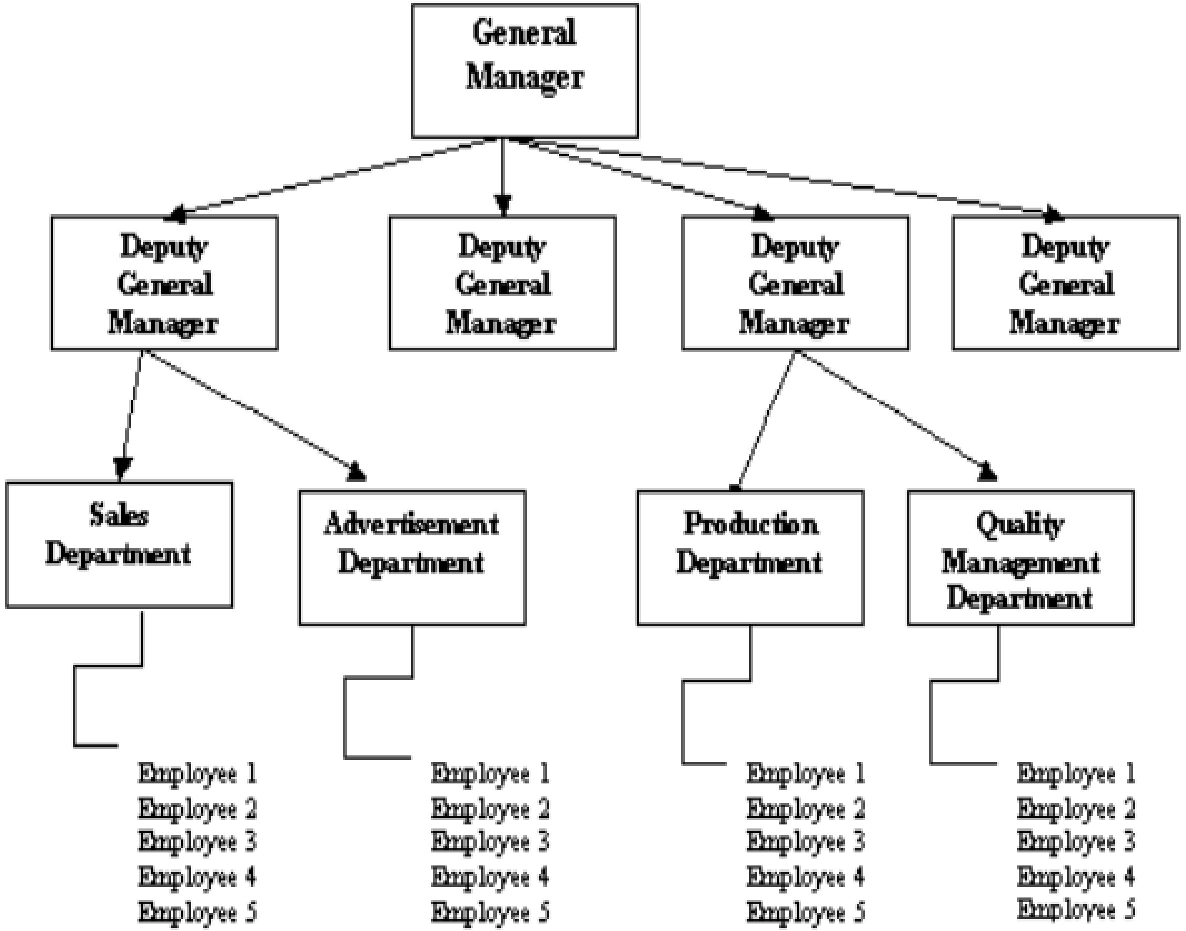
- Object Based Databases
- Hierarchical Databases
- Network Databases
- Relational Databases

Object based Databases and Hierarchical Databases

- **Object based databases** use concepts such as entities, attributes, and relationships.

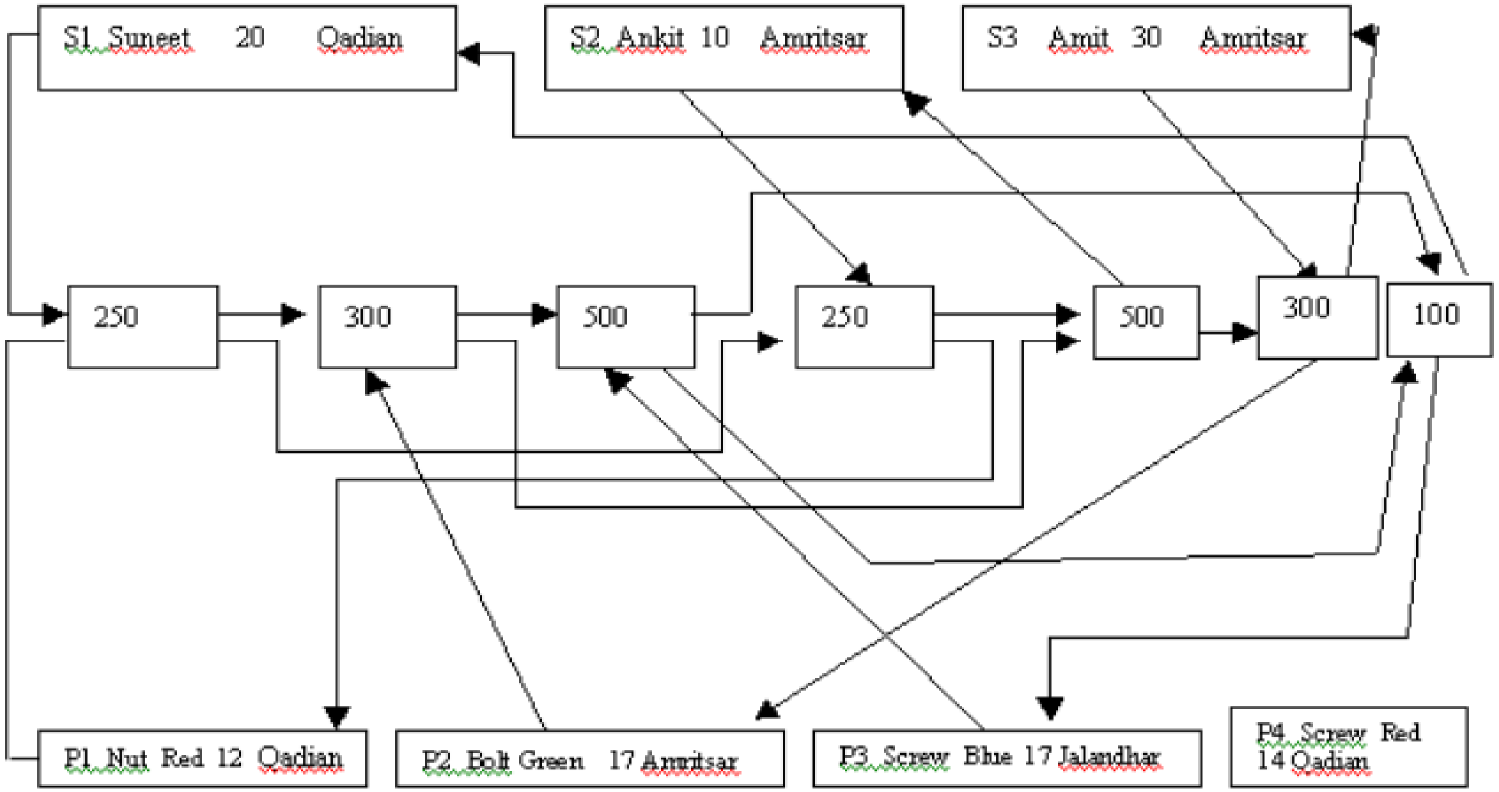
- **Hierarchical Databases:** Hierarchical Database model is one of the oldest database models. Information Management System (IMS) is based on this model

Example:


General Manager
Deputy General Manager
Deputy General Manager
Deputy General Manager
Deputy General Manager
Sales Department
Advertisement Department
Production Department
Quality Management Department
Employee 1
Employee 2
Employee 3
Employee 4
Employee 5
Employee 1
Employee 2
Employee 3
Employee 4
Employee 5
Employee 1
Employee 2
Employee 3
Employee 4
Employee 5
Employee 1
Employee 2
Employee 3
Employee 4
Employee 5

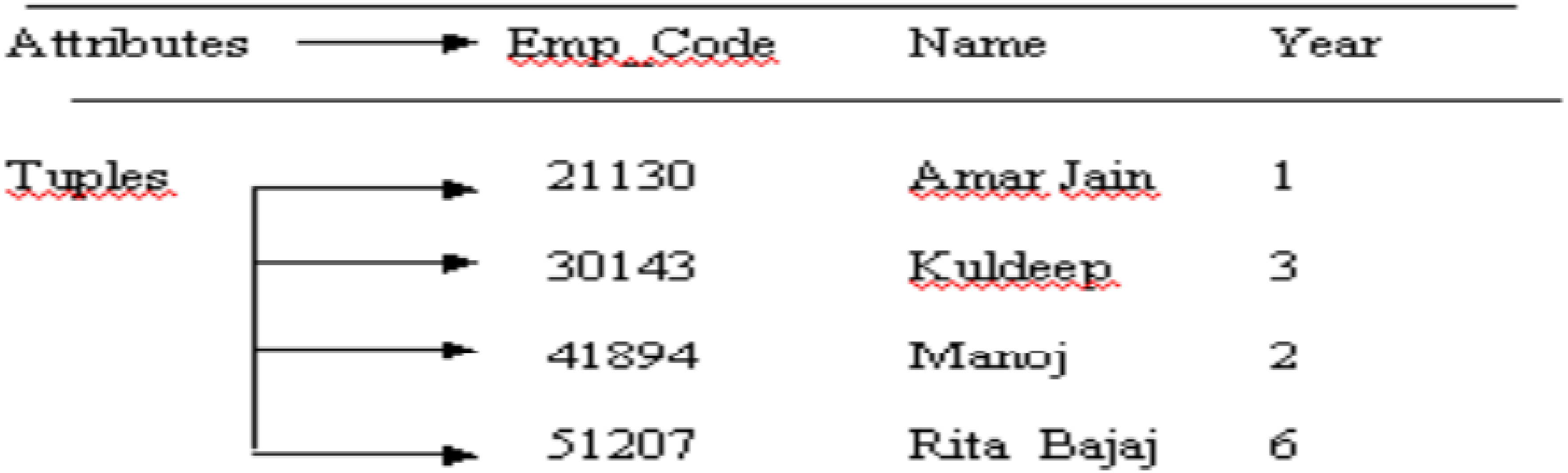
Network Databases:

- The Network Databases represents data with a graph. The main difference of the network model from the hierarchical model, is its ability to handle many to many (N:N) relations



Relational Databases:

- Relational Databases stores data in the form of tables. This concept purposed by Dr. E.F. Codd, a researcher of IBM in the year 1960 s



Attributes	Emp_Code	Name	Year
Tuples	21130	Amar Jain	1
	30143	Kuldeep	3
	41894	Manoj	2
	51207	Rita Bajaj	6

References

1. Database System Concepts, Sixth Edition, Abraham Silberschatz, Yale University Henry, F. Korth Lehigh University, S. Sudarshan Indian Institute of Technology, Bombay.
2. Fundamentals of Database Systems, 7th Edition, RamezElmasri, University of Texas at Arlington, Shamkant B. Navathe, University of Texas at Arlington.