



# Database Management Systems

Introduction

By

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# What is Database and what is DBMS?

- Database: A collection of (related) data
- DataBase Management System: A piece of software that can facilitate the creation and maintenance of a computerized database.
- Examples: MySQL, SQLite, PostgreSQL, MS Access, Oracle DB, IBM DB2 , MongoDB, Google Bigtable, Cassandra etc.

# Database Vs DBMS

- Database System: The DBMS software together with the data itself.
- But many a times, people refer to DBMS simply as a Database

# Essential Components of a DBMS

1. Storage Management software (Data Definition)
2. Query Processing software (Data Management)



Is this a database system?

# Expectations from a DBMS

- **Transaction guarantees** - Roll back payments/  
ATM withdrawals
- **Safety** - Shouldn't lose data on unexpected crashes
- **Scale** - Should be able to store and work at scale
- **Concurrency** - Multiple user access to data

# Expectations from a DBMS

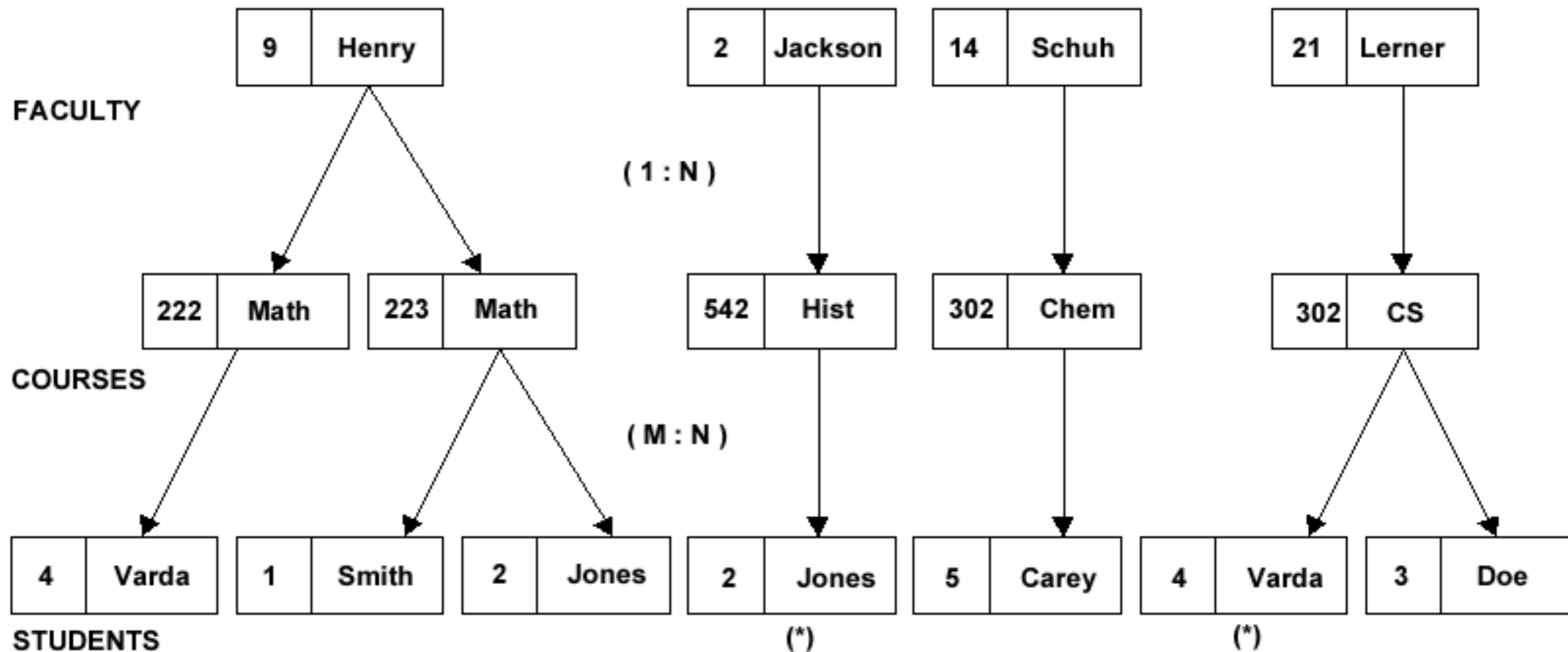
- Support for Complex relationships between data (e.g. primary keys, relational structure)
- Support for Complex Queries
- Rich text and objects like images, videos etc.

# Conceptual Data Modeling

- A data model is used to hide storage details and present the users with a conceptual view of the database
- Customer (Customer ID, Tax ID, Name, Address, City, State, Zip, Phone, Email)
- Order (Order No, Customer ID, Invoice No, Date Placed, Date Promised, Terms, Status)



# Hierarchical Data Model



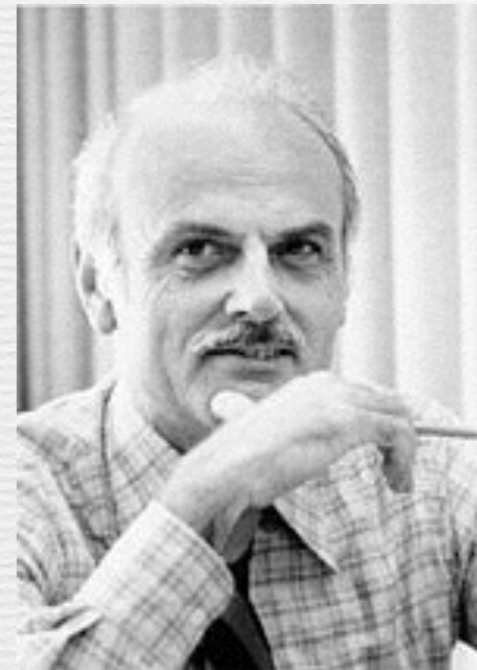
## Notes:

(1) Some fields of the records in the database have been left out to simplify the diagram.

(2) The (\*)'s indicate duplicate records. We will talk about alternatives to duplication in class.

# Relational Model

- The previous model had several limitations
- Proposed by Edgar F. Codd in 1970
- Won Turing award for his works



# Relational Model

- It is a mathematical model in terms of sets and first order predicate logic (We'll study in detail)
- Data is represented in terms of tuples, grouped into relations.
- A database organized in terms of the relational model is called a relational database.

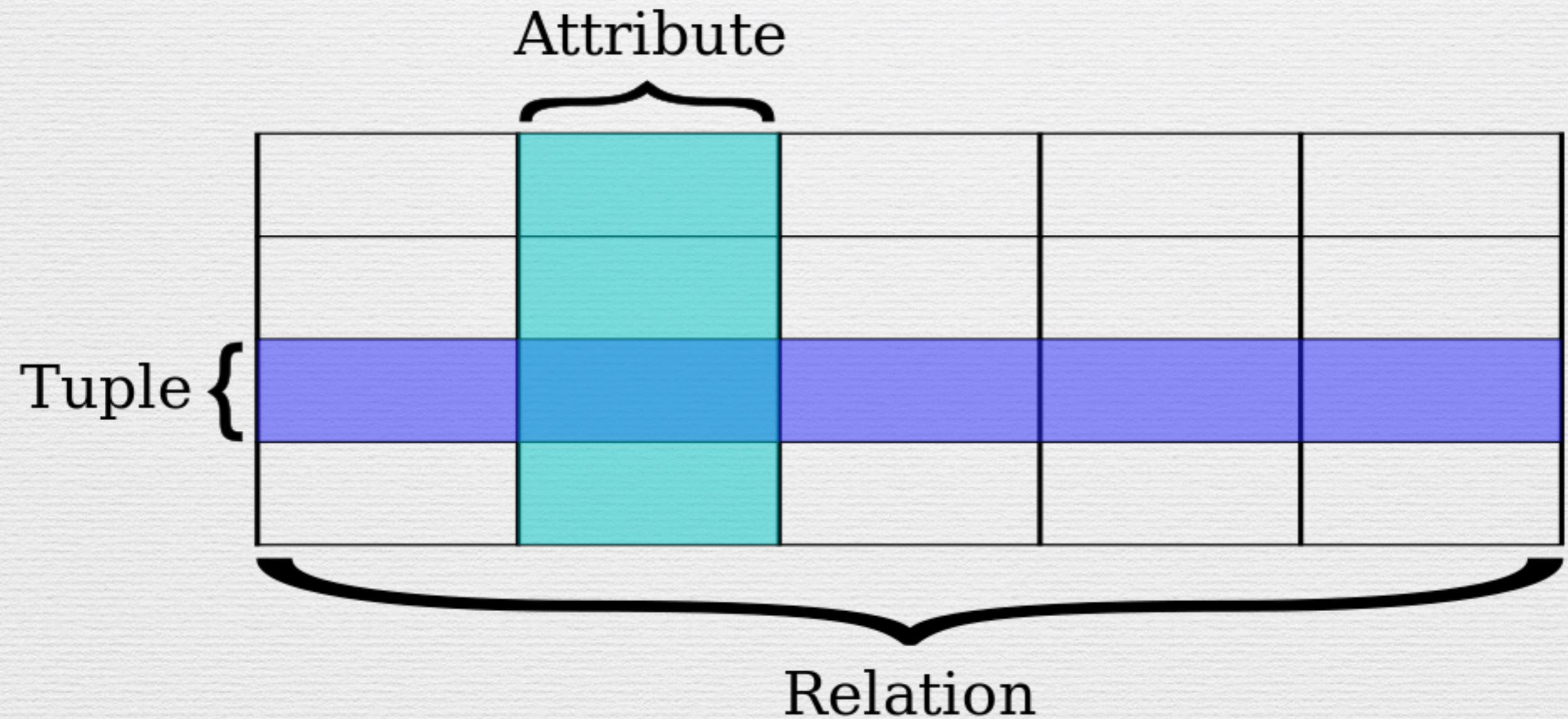
# Relational Database & RDBMS

- Database whose organization is based on the relational model of data
- Software systems used to maintain relational databases are known as a relational database management system (RDBMS)
- Eg:- MySQL

# Relational Model (Contd.)

- Organises data into one or more tables (or "relations")
- A unique key identifies each row. Rows are also called records or tuples
- Generally, each table/relation represents one "entity type" (such as customer or product)
- The columns are called attributes. (e.g. address, price, Name, ID etc.)

# Relational Model (Contd.)



# Schema

- Design blueprint of the structure of the database
- Eg: The schema of a table can be thought of as the set of attributes as well as the specification of the key (unique identifier) of each row)
- More about schemas later...

# Structured Query Language (SQL)

- A special-purpose programming language designed for managing data held in a relational database management system (RDBMS)
- ANSI/ISO standard
- Follows the relational model with some exceptions
- Support data insert, query, update and delete, schema creation and modification, and data access control.



# SQL - Create Table

- `CREATE TABLE Persons (PersonID int, LastName varchar(255), FirstName varchar(255), Address varchar(255), City varchar(255));`
- Oracle V2 is the first commercial implementation of SQL
- Almost none of the RDBMS comply entirely with the SQL standard. (MySQL, SQLite, PostgreSQL)

# NoSQL databases

- Non SQL databases or Not only SQL
- Relational databases may fail to scale to millions of requests at a time.
- Sacrifice consistency for scalability (eventual consistency)
- Eg: MongoDB, HBase(Facebook messaging platf), Google Appengine datastore, Cassandra etc.

# Distributed Databases and Cloud Storage

- Distributed infrastructure: Different set of concerns - We will not cover in this course
- Dropbox, iCloud, Google cloud storage
- Cloud computing allows companies to avoid infrastructure costs, and focus on their businesses
- Cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance