Introduction to DBMS

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ToC

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Basic Terminology

- **Data** – Raw information,
  A value representing an quality or quantity
  A recorded fact.
- **Information** – Processed data
- **Record** – A collection of related data/information.

- **Data Dictionary** – Data dictionary is a detailed description of data objects exists in a system.
- **Data Warehouse** – Centralized repository of data from one or more sources and used for reporting and data analysis.

- **Type of Data – Structured, Semi-Structured, Unstructured**

Database & DBMS

Database – A database is an organized collection of data, that can be easily accessed, managed and manipulated.

OR

A database is a collection of interrelated data stored together without harmful or unnecessary redundancy.

DBMS

A database management system(DBMS) is a software package used to store and manage data.

Problems in Manual/File System Database

- No Sharing
- Data isolation
- Diffused responsibilities
- Poor coordination
- Data redundancy
- No/Weak Security
- Cumbersome Retrieval Process
- Cumbersome/No Update Possible
- Weak (data) integrity

Functions/Characteristics of DBMS

- Data Representation
- Data Manipulation Management
- Performance
- Transaction Management
- Data Access Management

Features & Advantages of DBMS

- Data Representation
- Data Manipulation Management
- Transaction Management
- Data Access Management
- Storage and Data Redundancy Management
- Increased Security
- Faster Retrieval
- Analysis Summary Reports
- Centralized Management and Control
- Data Sharing

Applications of DBMS

- Banking
- Railway
- Airlines
- Educational Organizations / University
- Data Warehouses
- And many more…

- Enterprise Business
  - Manufacturing
  - Sales
  - Human Resource
  - Payroll
  - And many more…

Find at least 3 more applications of DBMS

DBMS Examples

Find names of at least 5 additional popular DBMS

- Oracle
- Microsoft SQL Server
- IBM DB2
- Microsoft Access
- PostgreSQL (Open Source)
- MySQL (Open Source)
- MariaDB (Open Source)
- SQLite
- Teradata

- NoSQL Databases
  - MongoDB
  - Apache CouchDB
  - Apache Cassandra
  - Apache Hbase
  - Neo4J
  - Oracle NoSQL

Find more about these listed databases – Type, License, Uses, Latest Versions, Underlying Data Modals, Owner Companies etc.

Database System Architecture

Database System Architecture can be defined on three levels

- **External Level (View Level)** – The way data will be represented to the end user. High Level Architecture
- **Conceptual Level (Logical Level)** – Defines logical structure of the database in terms of entities, relationships, attributes, datatypes etc.
- **Internal Level (Physical Level)** – Defines the way data is stored on physical storage. Low level architecture.

Database Design: Goals

- Accuracy-Integrity
- Consistency
- Speed/Performance - for all CRUD operations
- Persistency
- Extensibility
- Scalability
- Error Correction
- Robustness
- ACID Support
- Ease of Use
- Portability
- Security
- Sharing
- Ability to Perform Complex Calculations

Understand User/System's Requirements for Database Design

- Functional Requirements (+Reports Requirement)
- Data Flow
- Data Format & Validity
- Data Security Needs

Create Use Cases and Identify Data Needs for each Use Case

Data Model

- A Data Model is a plan. It’s a blueprint for building a Database.
- Defines how data in a database system get stored and represented.
- A data model uses a set of rules to provide a representation of data content, structure and constraints required by an application/system.

Learn more about these listed Data Modals.

Find out few other data models with their examples

Data Models: Types

Network Model – Data is represented in collection of records and relationship among records is in form of links (similar to pointers).

Hierarchical Model – Data is represented in collection of records, and relationship among records is represented in form of hierarchical trees.

Relational Model – Data is represented in tabular format. A table is comprises of rows and columns.

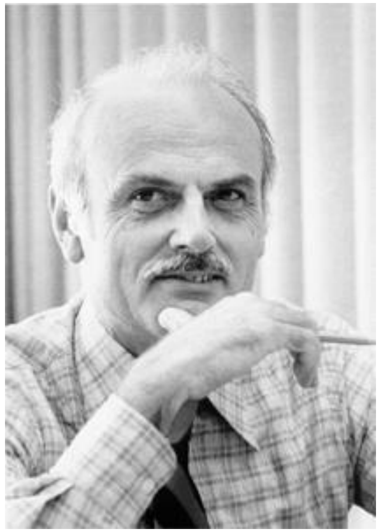
Object Oriented Model – Data is represented in form of objects and based on the concept of Object Oriented Programming (OOPs) Concepts.

Hybrid Models – Ex. Object Relational Database Management Systems

***NoSQL**

Relational [Database] Model

- First defined by Computer Scientist **Edgar Frank Codd** in 1969.
- Mathematical model, based on Relational Algebra and Predicate Logic.
- Very well defined and extremely mature model in terms of data storage and representation.
- All RDBMS (Relational Database Management Systems) derived from Relational model.



Entity Relationship (ER) Model

- Proposed by Peter Chen in 1970s.
- An object model: graphically represents logical relationship among entities (or objects).
- Describes data aspects of a system under implementation on abstract level.
- Conceptual Model, representing Logical Design of a database.
- Notations
  - Chen Notation
  - Crow-Foot Notation
  - Bachman Notation
  - Martin Notation
  - IDEF1X Notation

Database Designing for RDBMS

- Gather Functional Requirements (Data Needs)
- Convert Data Needs into a Data Model ([Interface Model ->] ER Model)
- Convert the ER Model to Relational Model
- Implement the Relational Model using RDBMS of your Choice.

→ SQL

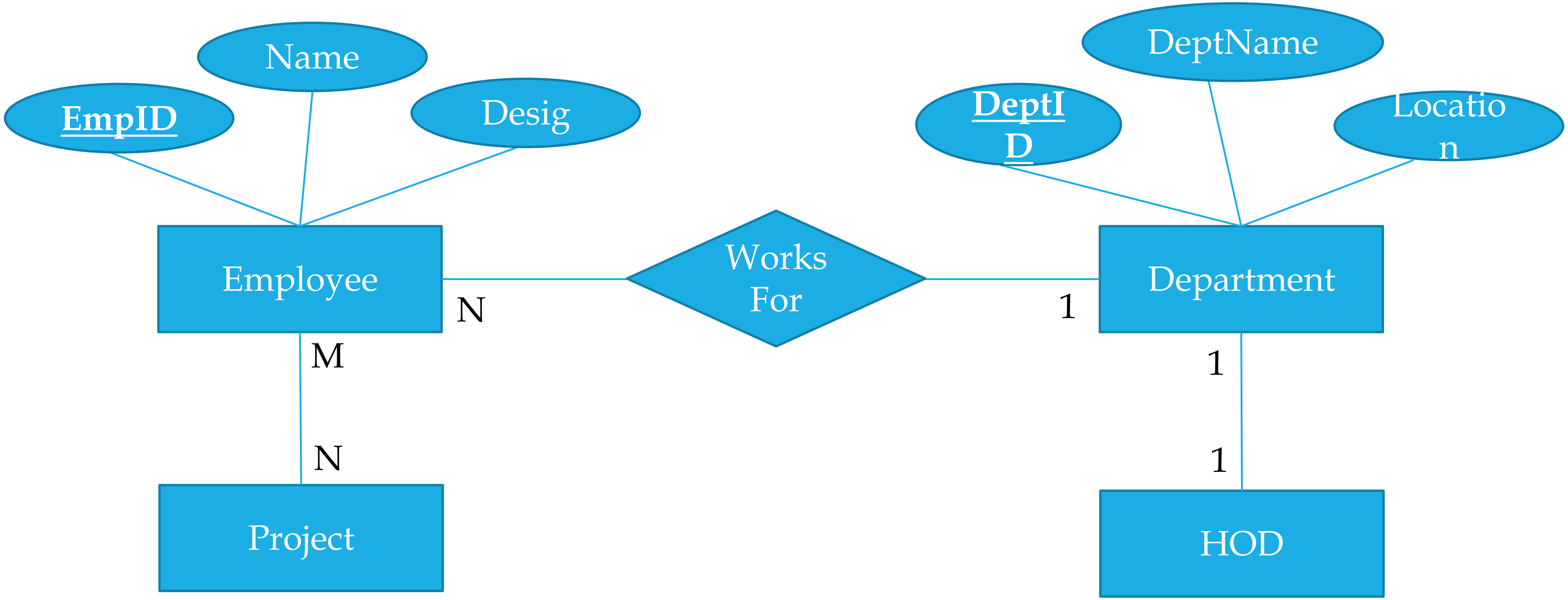
Entity Relationship (ER) Model

Learn about various symbols available in different ER notations.

Component	Symbol	Example
Entity	Rectangle	▭
Attribute	Ellipse	⬭
Link between Entity and Attribute	Line	―
Relationship Among Entities	Diamond	◇

Simple ER Depiction

Identify Entities, Relation among entities and Attributes in a System/Business and create an ER Diagram.



Cardinality Ratio of Relationship

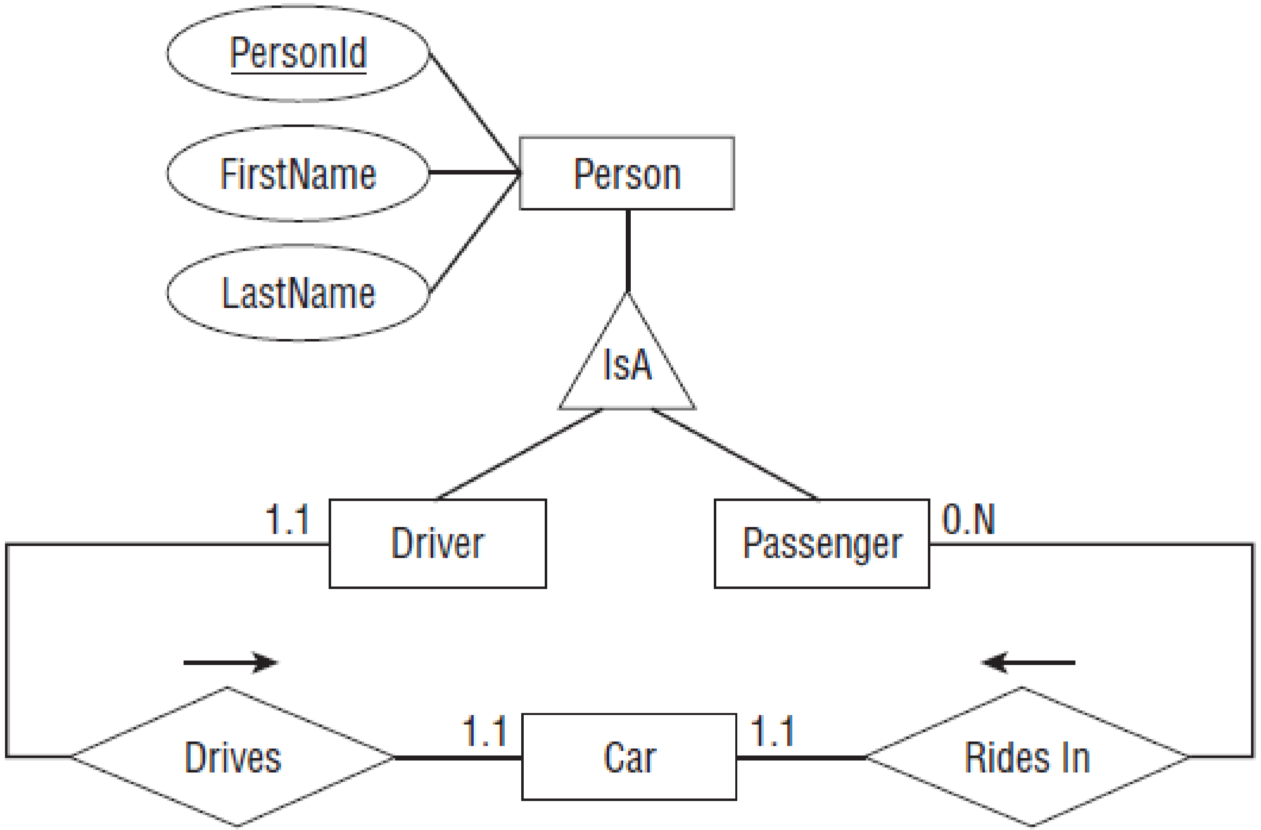
Relationship among entities can be represented in following three ways –

- One-to-one
- One-to-many or Many-to-one
- Many-to-many

Find out at least 3 examples of each type of Relationship in real world

ER Diagram….more

- An entity that can not be identified by its attributes alone is called as **Weak Entity**. Its existence depends on another entity – it is represented by **double border rectangle**.
- **Multivalued attribute** (an attribute representing more than one value for a single entity) is represented by **double line ellipse**.
- Inheritance – is A – represented by a Triangle


PersonId
FirstName
LastName
Person
IsA
1.1
Driver
Passenger
0.N
Drives
1.1
Car
1.1
Rides In

ER Diagram….more

- Entities are generally Nouns. Relationships are Verbs
- Draw relationships from Left to Right and Top to Bottom.
- Ternary or n-nary Relationship can be depicted in the same way as Binary.
- Notes and comments may be added to ERD. But it should be done in a clean way.
- The ultimate goal of creating an ERD is to help understanding the project. Hence easy information representation should be given priority over technical correctness.

ER Model to Relational Mapping: Example

Attributions:

- **Database System Concepts** – Abraham Silberschatz, Henry F. Korth, S. Sudarshan
- **Beginning Database Design Solutions** - Rod Stephens