

## A bit of Databases history



## Computer Database

A collection of information organized in such a way that a computer program can quickly select desired pieces of data.

You can think a database as an electronic filing system.

It can be accessed by one or many users in the same time.



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## DBMS

### Database Management System

**A DBMS is a software package which will**

**help us to:**

- design,
- implement, and
- use

**a database.**



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## DBMS

### Database Management System

This package has programs that:

- set up the original storage structure (free from the computer architecture),
- manipulate the data (insert, add, update, delete)
- accept data requests from programs and users
- build information based on the data in the database (select, sort, compute, etc.)
- format retrieved data so it appears in the form the program or user expects
- hide data that a particular user should not have access (password)
- allow concurrent use of data without having users interfere each other
- perform backup and recovery procedures automatically



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### Historical development of Databases

- ☒ **Hierarchical model** (~1960, IBM's IMS, 1968)
- ☒ **Network model** (~1960, IDS General Electric, 1971)
- ☒ **Relational model** (1970, E.F.Codd, System R→DB2, SQL; 1976 P.P. Chen :E-R model)
- ☒ **Object-oriented model** (1990)
- ☒ **Hybrid object-relational model** (1990)

Pages 19-22 from Database Illuminated Chapter 1.

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### Example : COMKAM firm

The COMKAM firm has many departments. Each department manages one or many projects. A project is managed by a single department. In a project one uses one or many employees. An employee may build different types of items. Each department sells one or many types of items. One type of item is sold only by a single department.

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### Example : COMKAM firm

```

    graph TD
      EMPLOYEE ---|uses M:M| PROJECT
      PROJECT ---|manages 1:M| DEPARTMENT
      EMPLOYEE ---|builds M:M| TYPES["TYPES of ITEMS"]
      DEPARTMENT ---|sells M:1| TYPES
  
```

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### Hierarchical model (1960)

- Data is presented in a **tree** structure.
- Each **node** represents an **entity** and each **link** between nodes represents a **relation** between entities.
- A **father** entity may have one or many **children**.
- A child has an unique father.
- To access the data we may only go down from a father to his children.

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### Hierarchical model

The hierarchical model of the corresponding database will be:

- An unique tree: if all dependencies are 1:1 and/or 1:M .
- A forest of trees if there is a least a M:M dependency.

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### Hierarchical model for COMKAM

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### Hierarchical model for COMKAM

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### Hierarchical model for COMKAM

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### Advantages (hierarchical model)

The model fits to many real environments:

- administration
- a library (IMS of IBM)
- a production line

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### Disadvantages (hierarchical model)

- One can represent only dependencies type father child (1:1 or 1:M)
- Dependencies of type M:M can be solved only with a forest of trees. Hence, the database is very large even for small amounts of data.
- Lots of data redundancy

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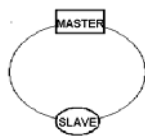
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### Network model (1960-1970)

Set of entities (records) connected by dependencies of type master-slave. The dependencies can be:

Master	Slave
1	: 1
1	: M
M	: 1

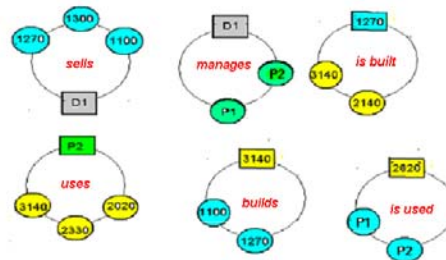


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### Network model for COMKAM

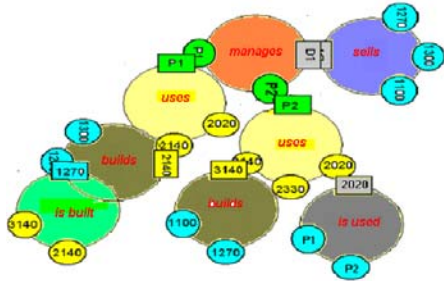


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### Network model for COMKAM



Which department produces the item 1270?

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### Advantages (network model)

The model fits better for real environments.

If we delete D1?

If we delete a record we will delete all dependencies versus that record but NOT the other records.

Update the address for employee 2140?

Update only once the data (less redundancy)

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### Disadvantages (network model)

- The design of the database is still very dependent to the data structure.
- The database administrator must have in his/her had the map of the master-slave chains. It is difficult to remember all, it is difficult to be sick.
- Each update modifies the chains and reduces the speed of the access to data.

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### Entity-relationship model

In 1976, P.P. Chen developed a new type of model the **entity-relationship** model. It is an example of a **semantic model**, one that attempts to capture the meaning of data without considering the way in which the data will be stored.

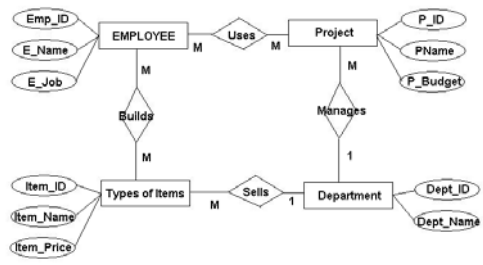
We use the entity-relationship model and the relational model to design, build and manage a relational database.

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### COMKAM firm Entity Relationship Model



### Relational model (Codd 1970)

The relational model uses tables to organize the data.

### Relational model for COMKAM

ITEMS

Item_ID	Item_Name	Item_Price
1100	Track rod	2000
1300	Cylinder head	3500
1270	Rocker arm	800

### Relational model for COMKAM

Department

Dept_Id	Dept_Name
D1	Mechanic
D2	Finance

## Relational model for COMKAM

Sells

Dept_Id	Item_Id
D1	1100
D1	1300
D1	1270

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## Relational model

The **SQL (Structured Query Language)** language is used to create and manipulate the tables in the relational mode.

```
SELECT * FROM DEPARTEMENT;
```

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## Object-oriented model (1990)

The need to store and manipulate complex data that is not easy to model with the relational model, as well as the development of programming languages using object-oriented paradigm, led to the development of **object-oriented databases (OODB)**. Database management systems for OODB are not yet commercially available. Instead we find on the market database management systems for **hybrid object-relational databases**.

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## Hybrid object-relational model (1990 -)

The object-relational model combines an object oriented application with a relational database. The complex objects defined in the object oriented application (which are transients in computer memory) are transformed in persistent data in the relational database (tables), and they are manipulated using SQL. Unfortunately, there is no way to represent in the database the relationships between the objects of the application. The programmer must write a specific program for each such relationship.

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