1. Introduction

Master I – Software Engineering

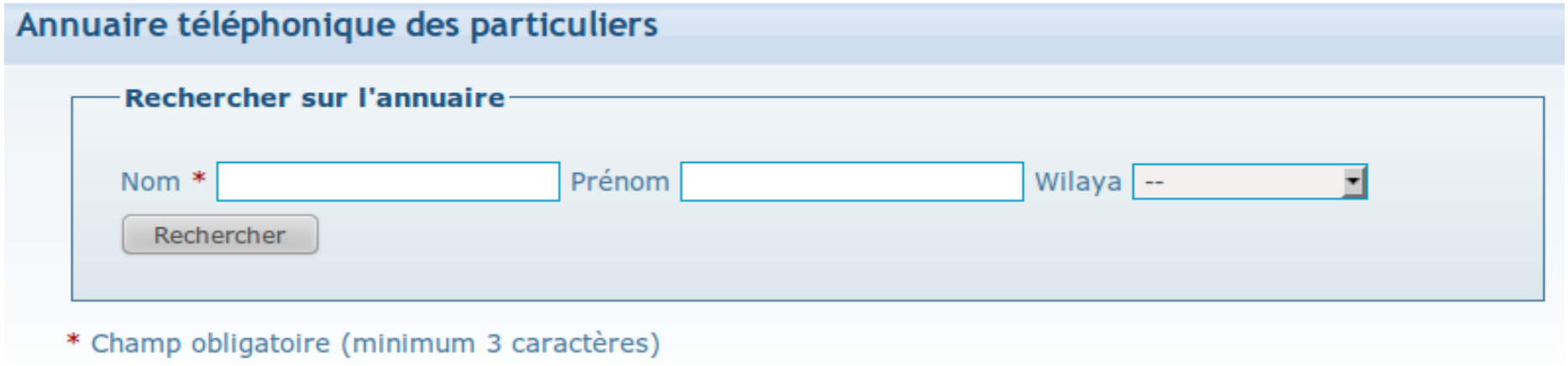
Dr. Imed Bouchrika
Dept of Mathematics & Computer Science
University of Souk-Ahras
imed@imed.ws

Motivation

Can we develop a software application without a database ?

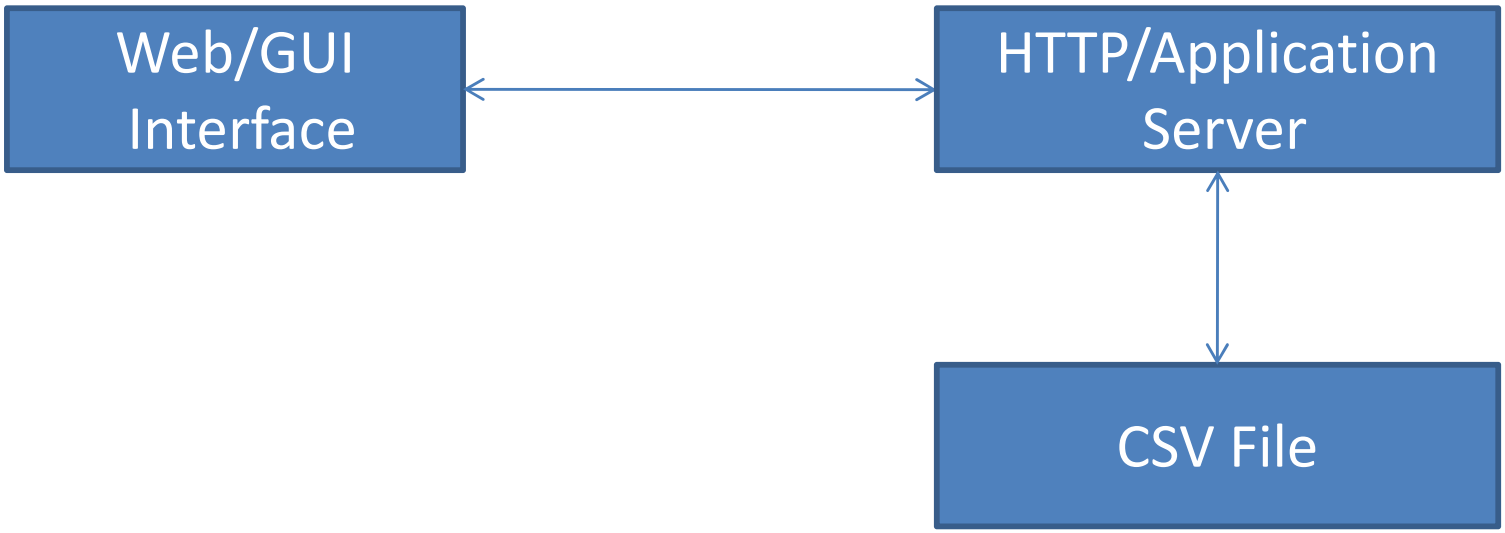
Example :

Online Phone directory ?



Motivation

Simple Design for the Phone Directory:



191,Mr A Boughan,SoukAhras,41000,037319021
192,Mr B Boughan,SoukAhras,41000,037319022
193,Mr C Boughan,SoukAhras,41000,037319023
194,Mr D Boughan,SoukAhras,41000,037319024
195,Mr F Boughan,SoukAhras,41000,037319025

Motivation

Implementation of the Application:

- 1 line : Open the csv file for rading.
- 1 line : Loop to iterate through the file.
- 1 line : Analyse every line
- 1 line : Comparaison (Condition If)
- 1 line : Return of results.

```
3   $people=file("annuaire.csv");
4   for ($i=0;$i<count($people);$i++){
5     $person=explode(",",strtolower($people[$i]));
6     if(strpos($person[1],$mot_cle)!==FALSE)
7         return $person;
8   }
```

Motivation

We can develop the application without a database, **BUT:**

- File management.
- Concurrence and multiple access.
- Search & advanced operations.
- Scaling
- New functionalities
- Integrity Checking
- Maintenance & Backup.
- Security
- …

Motivation

Salary for DBA (Database Administrator) ?

Source: www.indeed.com

Remember ?

SELECT

JOIN

GROUP BY

JDBC

ENUM

DATALOG

ENTITIE

FOREIGN KEY

SELECT

ATTRIBUT

TRIGGERS

BLOB

Database Definition

Databases ***:*** is a collection of data or information which are:

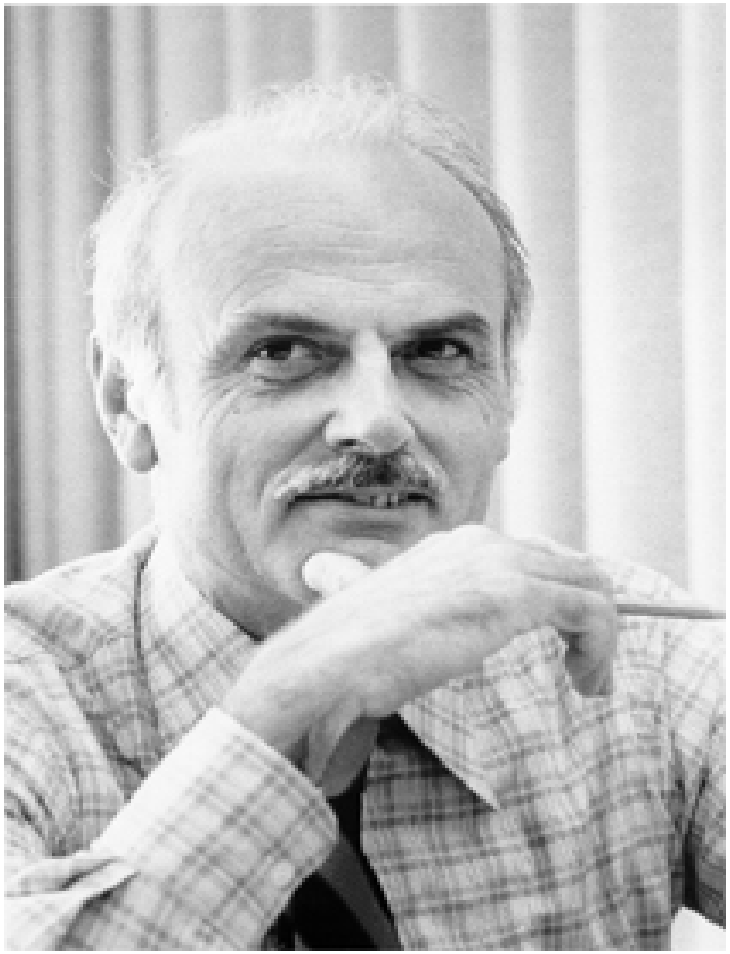
- *Inter-related.*
- *Organised*
- *Accessibles & Exploitable.*

From Oxford Dictionary:

- *Database: an organised body of related information*

E. F. Codd

Edgar F. "Ted" Codd (August 23, 1923 - April 18, 2003) was a British computer scientist who invented relational databases while working for IBM.



He was born in Portland, Dorset, studied maths and chemistry at Oxford. He was a pilot in the Royal Air Force during WWII. In 1948 he joined IBM in New York as a mathematical programmer.

He earned a doctorate in Computer Science from the University of Michigan.

He then joined IBM research in San Jose.

His 1970 paper “A Relational Model of Data for Large Shared Data Banks” changed everything.

In the mid 1990’s he coined the term OLAP.

Database Management System : DBMS

- **Database management system** (DBMS) is a software system designed to allow the definition, creation, querying, update, and administration of databases.

- Example for DBMSs :
  - ORACLE
  - dBase
  - DB2
  - SQL Server
  - MySQL
  - Ingres
  - Informix
  - PostgreSQL

DBMS Functionnalities

- Update and retrieve data:
  - View or manipulate data using SQL.
  - DBMS handles the processes and the structure of the data on a disk.

- Data Sharing
  - Concurrency Access
  - Transaction Management:
    - *locking, two-phase locking, and time stamping*

- Recovery of Data
  - In the event a catastrophe occurs
    → DBMS must provide ways to recover a database so that data is not **permanently lost**.
  - The easiest way to do this is to make regular backups of information.
  - Or Journaling or Slave-Master Config or other Advanced Options.

DBMS Functionalities

- Security :
  - Security is the prevention of unauthorized users accessing the database.
  - DBMS uses the following to provide security to the database :
    - Encryption : is when DBMS converts the data in a database to an indecipherable format.
    - Authentication : is a technique in which the database administrator can identify the person accessing the database. Usually using a Username and Password.
    - Authorization : is a set of rules that the database administrator (DBA) sets up to specify levels of usage that individuals or groups are allowed to have.

- Data Integrity
  - This is a set of rules that DBMS provides to see that data integrity is enforced, thus avoiding incorrect or inconsistent data.
    - data types
    - legal values & Format
    - Key integrity. This enforces that the primary key of a record remains unique.

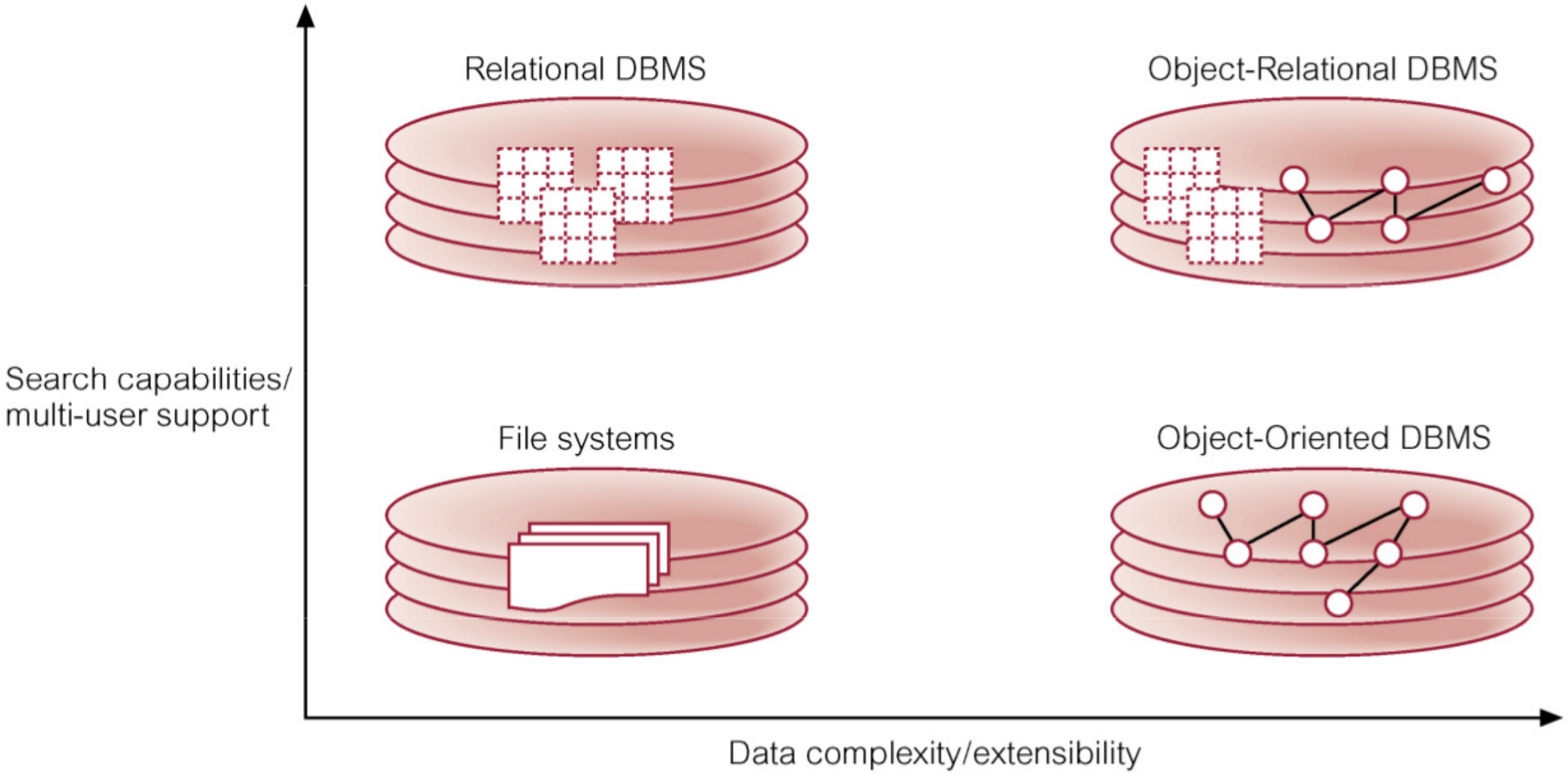
Database Models

- A **database model** is a type of data model that determines the *logical structure* of a database and fundamentally determines in which manner data can be stored, organized, and manipulated.

- In Short : Database models are cocepts used for structuring the defining data for storage.

- Popular Database Models include :
  - Hierarchical database model
  - Network model
  - Relational model
  - Object-Oriented model
  - Object-Relational database .

Database Models



Database Models

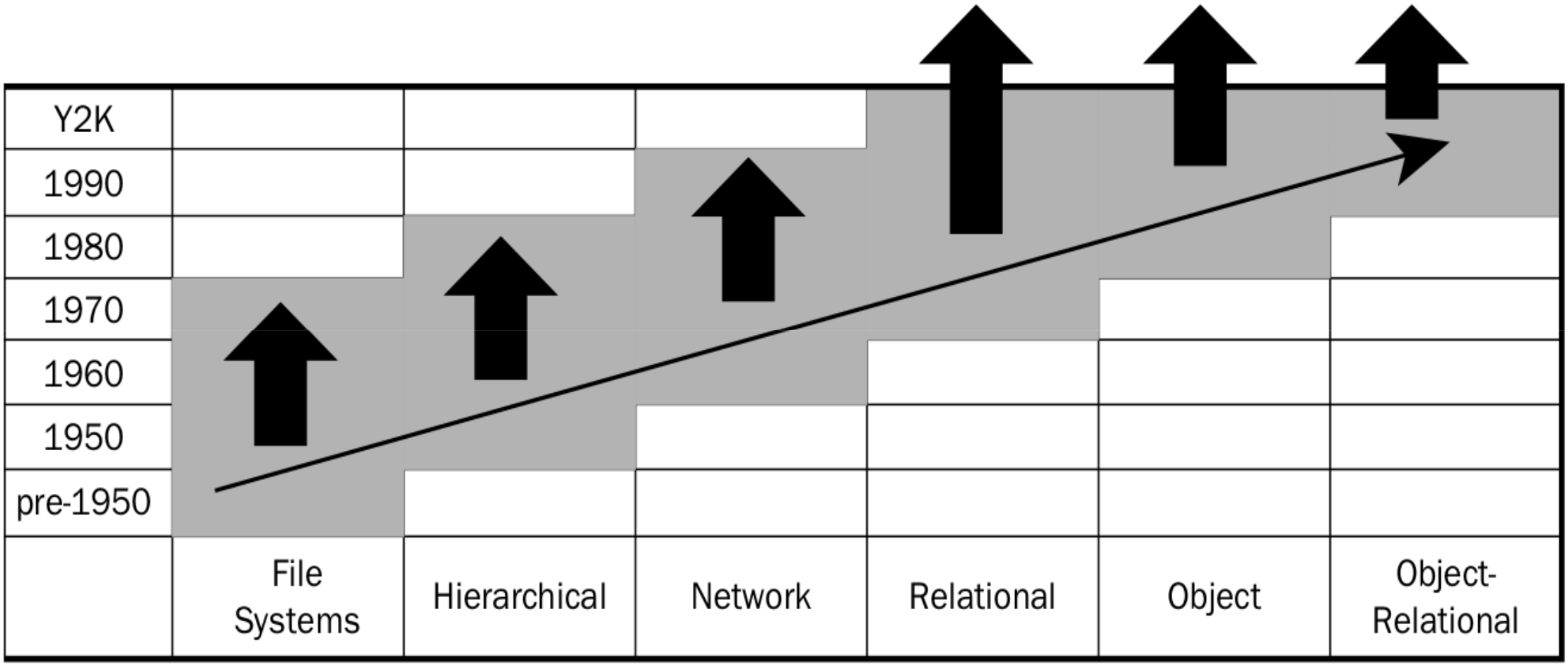


Figure 1-3: The evolution of database modeling techniques.

Database Types !

- **An in-memory database** is a database that primarily resides in main memory, but is typically backed-up by non-volatile computer data storage.
- **A cloud database** relies on cloud technology. Both the database and most of its DBMS reside remotely. Ex. Amazon S3.
- **A deductive database** combines logic programming with a relational database, for example by using the Datalog language.
- **A distributed database** is one in which both the data and the DBMS span multiple computers.
- [illegible] se is designed for storing, retrieving,

Database Types !

- A **document-oriented database** is designed for storing, retrieving, and managing document-oriented, or semi structured data, information. Document-oriented databases are one of the main categories of NoSQL databases.

- An **embedded database** system is a DBMS which is tightly integrated with an application software that requires access to stored data in such a way that the DBMS is hidden from the application's end-users.

- A **federated database** system comprises several distinct databases, each with its own DBMS. It is handled as a single database by a federated database management system (FDBMS)

- .... More

Database Languages

- Database languages are specific to a particular data model. Notable examples include:
  - **SQL** : Structured Query Language mostly used for Relational Databases.
  - **OQL** is an object model language standard (from the Object Data Management Group).
  - **XQuery** or **xPath** are standard XML query language simplemented by XML database systems such as MarkLogic and eXist
  - **SQL/XML** combines XQuery with SQL.

SQL

- Database languages are specific to a particular data model. Notable examples include:
  - **SQL** : Structured Query Language mostly used for Relational Databases.
  - **OQL** is an object model language standard (from the Object Data Management Group).
  - **XQuery** or **xPath** are standard XML query language simplemented by XML database systems such as MarkLogic and eXist
  - **SQL/XML** combines XQuery with SQL.

SQL

SQL History

- 1970 : Creation of SQL by IBM
- 1977 : IBM Sequel, first database using such system
- 1979 : Launch of Oracle SQL RDBMS
- 1986 : Normalisation of SQL1 (SQL-86)
- 1989 : Extension of SQL1 (SQL-89)
- 1992 : Normalisation of SQL2 (SQL-92)
- 1999 : Normalisation of SQL3

For you to search !

- **Encryption .**
- **Two-Phase Locking.**
- **Amazon S3**
- **Hashing**
- **NoSQL**