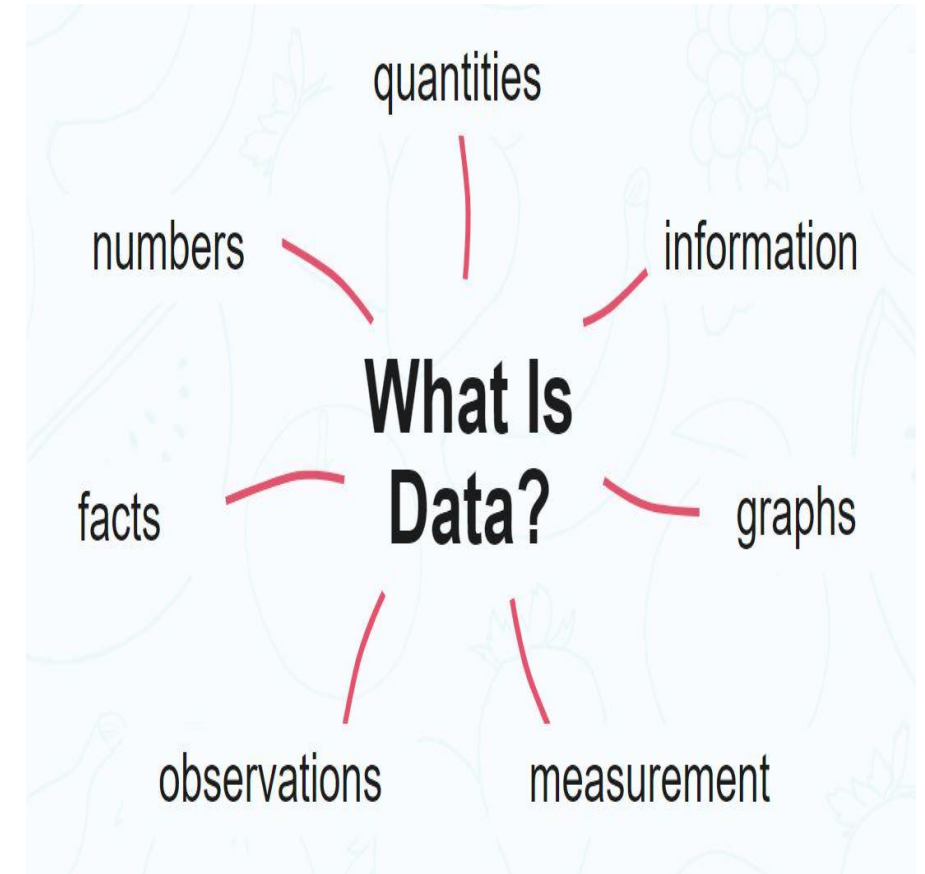


Information Management Systems (ECSE211L)

(Introduction of DBMS- Part 1)

What is Data?

- Different view points:
 - A sequence of characters stored in computer memory or storage.
 - Interpreted sequence of characters stored in computer memory or storage
 - Interpreted set of objects
 - Word 'Data' is originated from the word 'datum' that means 'single piece of information.' It is plural of the word datum.
- This maybe one of the most profound questions in computer science! It is still open and keep evolving!!



Data is the fact or information which is storable.

What is DataBase?

Database is a collection of **inter-related data**, which helps in efficient retrieval, insertion and deletion of data from database and organizes the data in the form of tables, views, schemas, reports etc.

For Example: university database organizes the data about students, faculty, and admin staff etc. which helps in efficient retrieval, insertion and deletion of data from it.

- DBMS stands for Database Management System. We can break it like this

DBMS = Database + Management System.

- Database is a collection of data, and Management System is a set of programs to store and retrieve those data.
- Based on this we can define DBMS like this: DBMS is a collection of inter-related data and set of programs to store & access those data in an easy and effective manner.
- DBMS provides an interface to perform various operations like database creation, storing data in it, updating data, creating a table in the database and a lot more.
- For example: MySQL, Oracle, etc are a very popular commercial database which is used in different applications.

Users in a DBMS environment

Component Name	Task
Application Programmers	The Application programmers write programs in various programming languages to interact with databases.
Database Administrators	Database Admin is responsible for managing the entire DBMS system. He/she is called Database admin or DBA.
End-Users	The end users are the people who interact with the database management system. They conduct various operations on database like retrieving, updating, deleting, etc.

Characteristics of DBMS

- It uses a **digital repository established** on a server to store and manage the information.
- It can provide a **clear and logical view** of the process that manipulates data.
- DBMS contains **automatic backup and recovery procedures**.
- It contains **ACID properties** which maintain data in a healthy state in case of failure.
- It can **reduce the complex relationship between data**.
- It is used to **support manipulation and processing of data**.
- It is used to provide **security of data**.
- It can view the **database from different viewpoints according to the requirements of the user**

Advantages of DBMS

- **Controls database redundancy:** It can control data redundancy because it stores all the data in one single database file and that recorded data is placed in the database.
- **Data sharing:** In DBMS, the authorized users of an organization can share the data among multiple users.
- **Easily Maintenance:** It can be easily maintainable due to the centralized nature of the database system.
- **Reduce time:** It reduces development time and maintenance need.
- **Backup:** It provides backup and recovery subsystems which create automatic backup of data from hardware and software failures and restores the data if required.
- **Multiple user interface:** It provides different types of user interfaces like graphical user interfaces, application program interfaces

Disadvantages of DBMS

- **Cost of Hardware and Software:** It requires a high speed of data processor and large memory size to run DBMS software.
- **Size:** It occupies a large space of disks and large memory to run them efficiently.
- **Complexity:** Database system creates additional complexity and requirements.
- **Higher impact of failure:** Failure is highly impacted the database because in most of the organization, all the data stored in a single database and if the database is damaged due to electric failure or database corruption then the data may be lost forever.

DBMS vs. Flat File

DBMS	Flat File Management System
Multi-user access	It does not support multi-user access
Design to fulfil the need for small and large businesses	It is only limited to smaller DBMS system.
Remove redundancy and Integrity	Redundancy and Integrity issues
Expensive. But in the long term Total Cost of Ownership is cheap	It's cheaper
Easy to implement complicated transactions	No support for complicated transactions

- A collection of related data.
 - a) Information
 - b) Valuable information
 - c) Database
 - d) Metadata

- A collection of related data.
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- DBMS is software.
 - a) True
 - b) False

- DBMS is software.
a) True
b) False

- Which of the following is not involved in DBMS?
 - a) End Users
 - b) Data
 - c) Application programmer
 - d) HTML

- Which of the following is not involved in DBMS?
 - a) End Users
 - b) Data
 - c) Application programmer
 - d) **HTML**

Evolution of Databases



File-Based Hierarchical
Data Model Network
data model Relational
Database The Object-
Oriented
Databases NoSQL
Database Cloud
based
Database

Evolution of Databases

File-Based

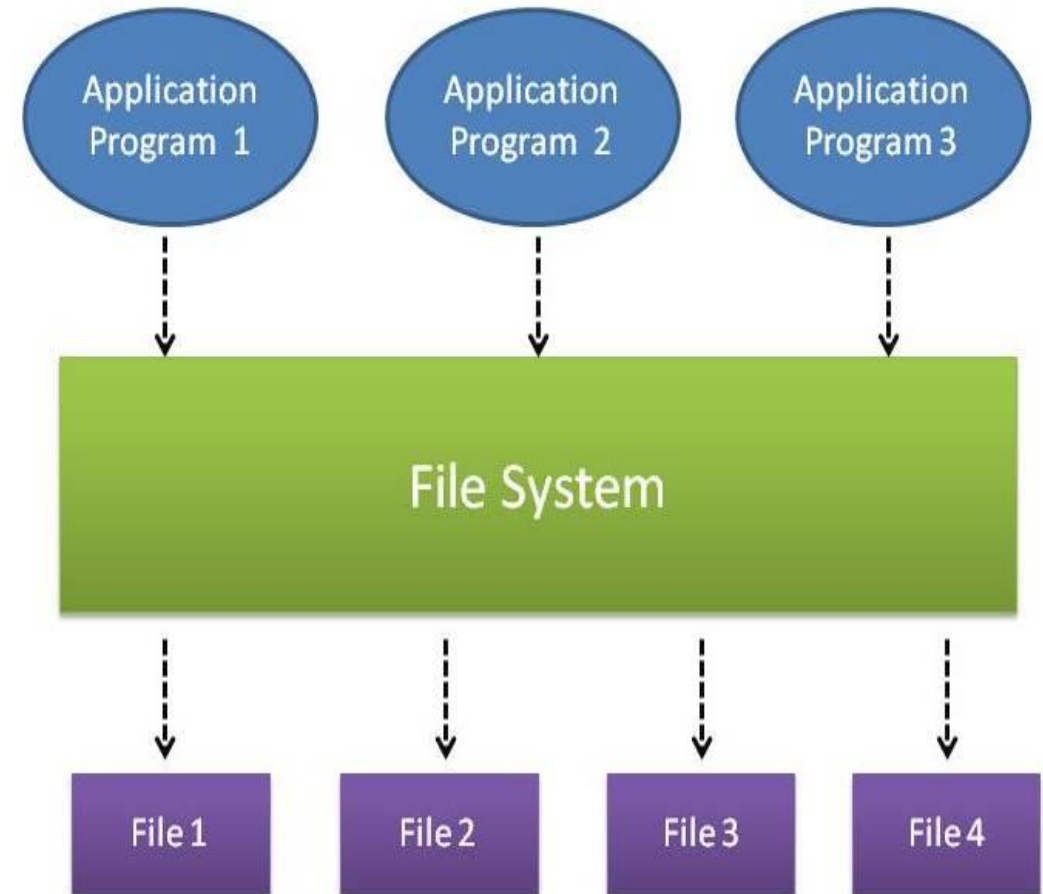
- 1968 was the year when File-Based database were introduced.
- In file-based databases, data was maintained in a flat file.

Advantages

- One of the major advantages is that the file system has various access methods, e.g., sequential, indexed, and random.

Limitations

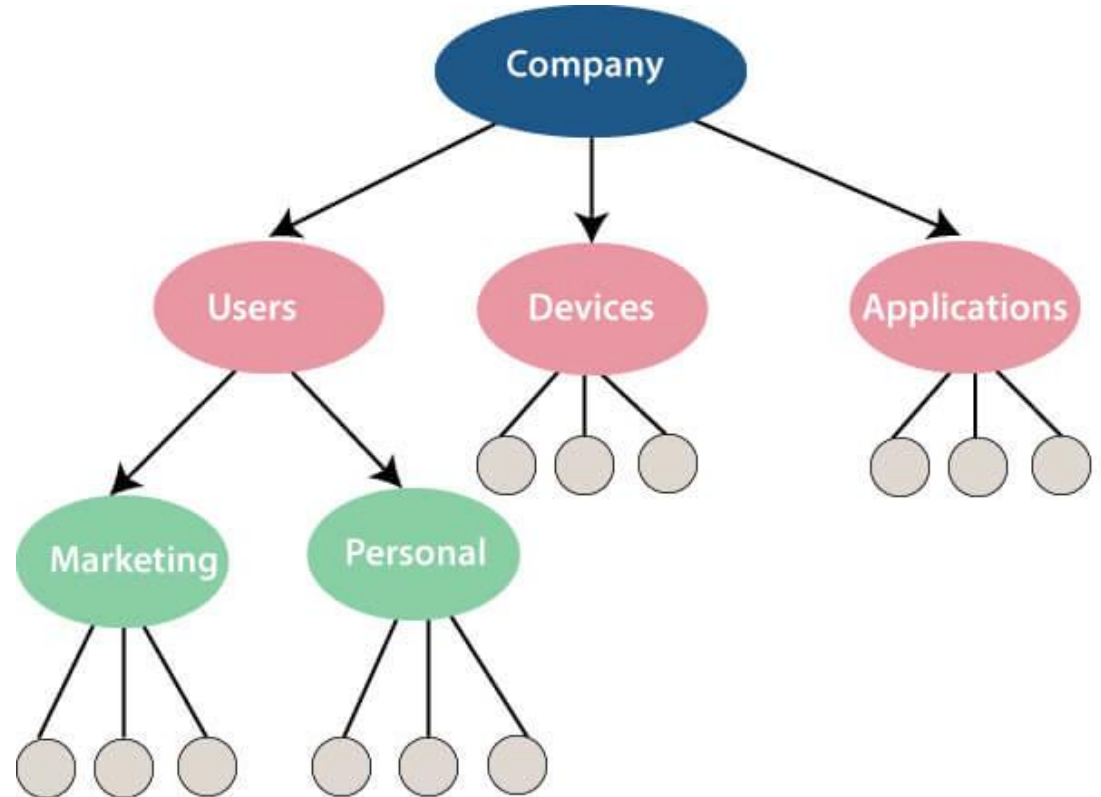
- It requires extensive programming in a third-generation language such as COBOL, BASIC



Evolution of Databases

Hierarchical Data Model

- 1968-1980 was the era of the Hierarchical Database.
- IBM's first DBMS was based on this model. It was called IMS.
- Files are related in a parent/child manner.
- It follows one to many relationship.
- This is an ideal model where the data contains nested and sorted information
- It had some limitations like complex implementation, lack structural independence, can't easily handle a many-many relationship, etc.



Evolution of Databases

Network data model

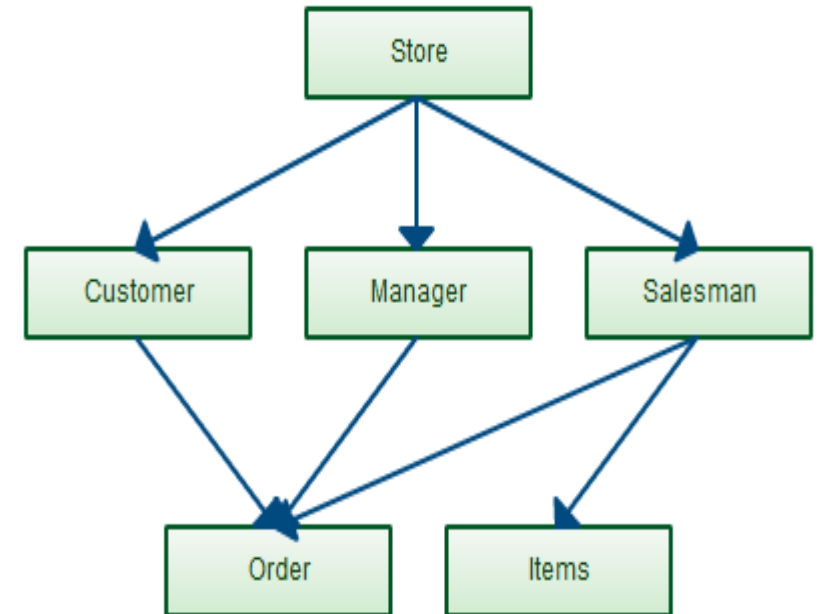
- It was standardized in 1971 by the CODASYL group.
- Files are related as owners and members, like to the common network model.

Advantages of a Network Database Model

- Because it has the many-many relationship, network database model can easily be accessed in any table record in the database
- For more complex data, it is easier to use because of the multiple relationship founded among its data
- Easier to navigate and search for information because of its flexibility

Disadvantage of a Network Database Model

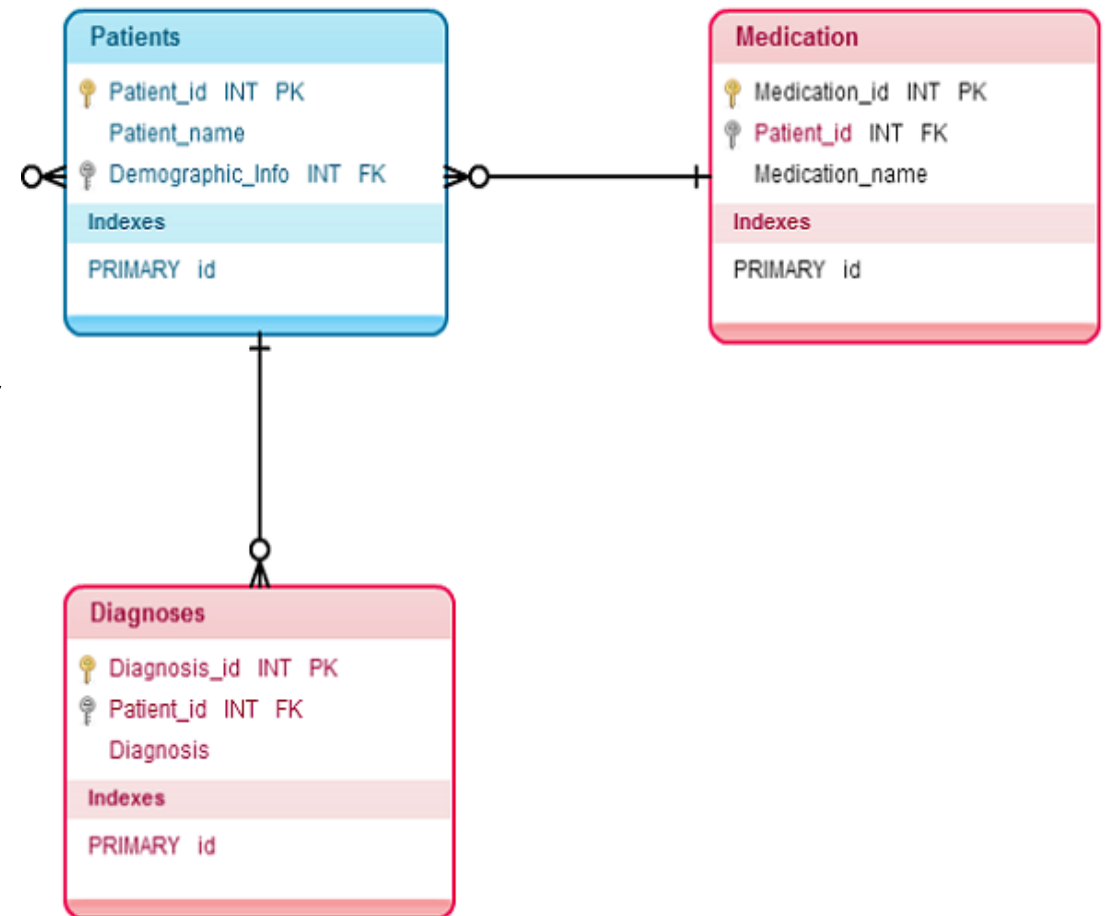
- Difficult for first time users
- Difficulties with alterations of the database because when information entered can alter the entire database



Evolution of Databases

Relational Database

- 1970 - Present: It is the era of Relational Database and Database Management. In 1970, the relational model was proposed by E.F. Codd.
- Two main terminologies: instance and schema.
- The instance is a table with rows or columns
- Schema specifies the structure like name of the relation, type of each column and name.
- It uses mathematical concept like set theory and predicate logic.
- The first internet database application had been created in 1995.
- During the era of the relational database, many more models had introduced like object-oriented model, object-relational model, etc.



Evolution of Databases

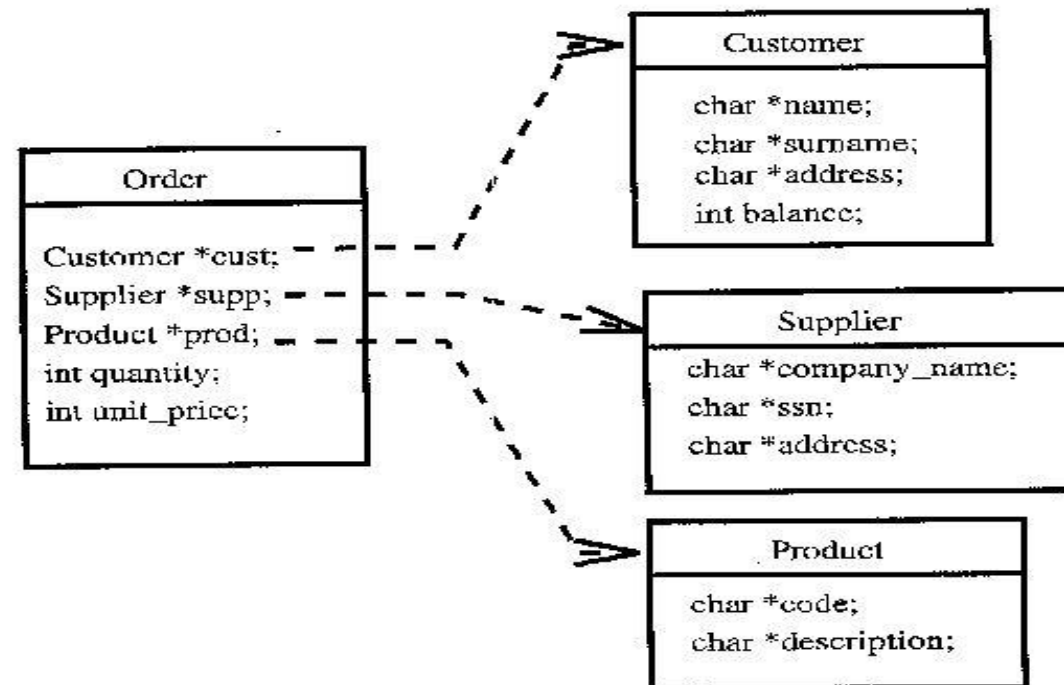
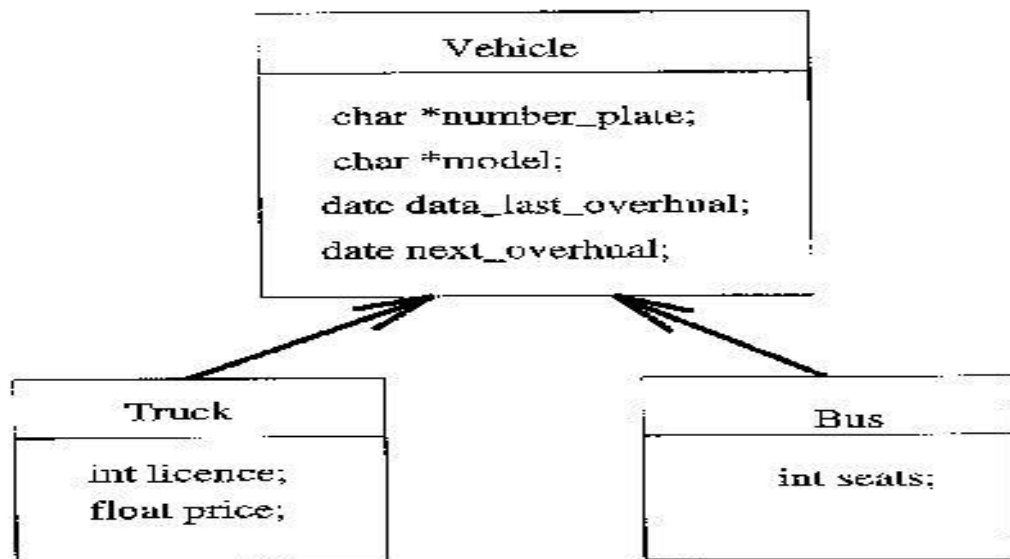
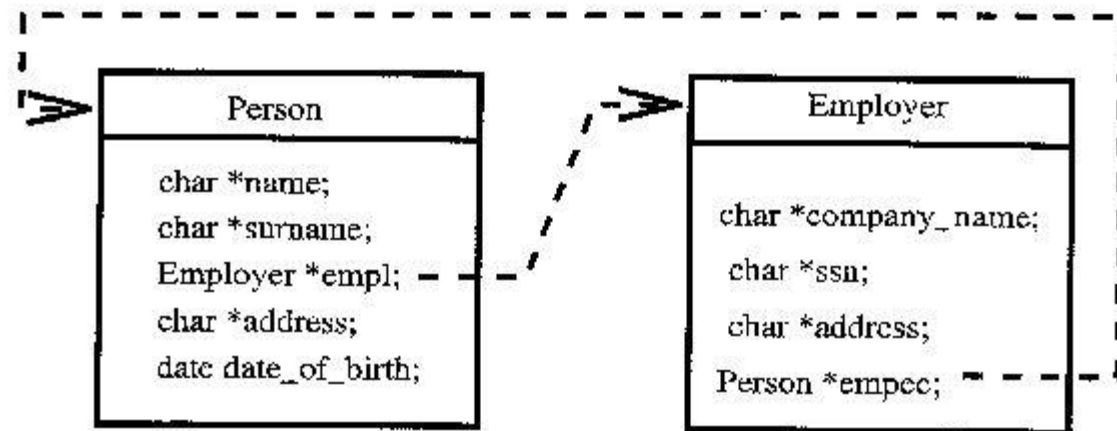
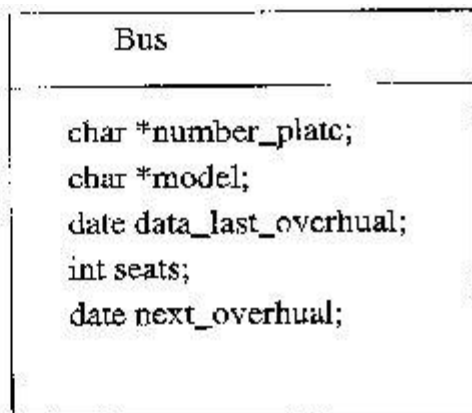
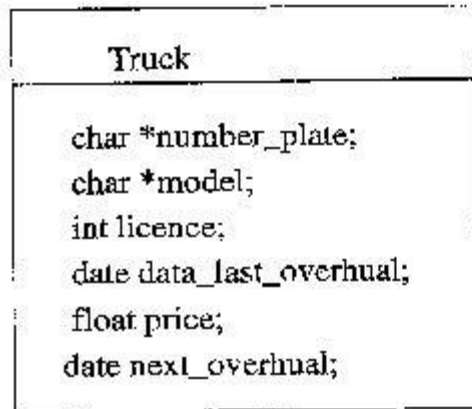
Object-Oriented Databases

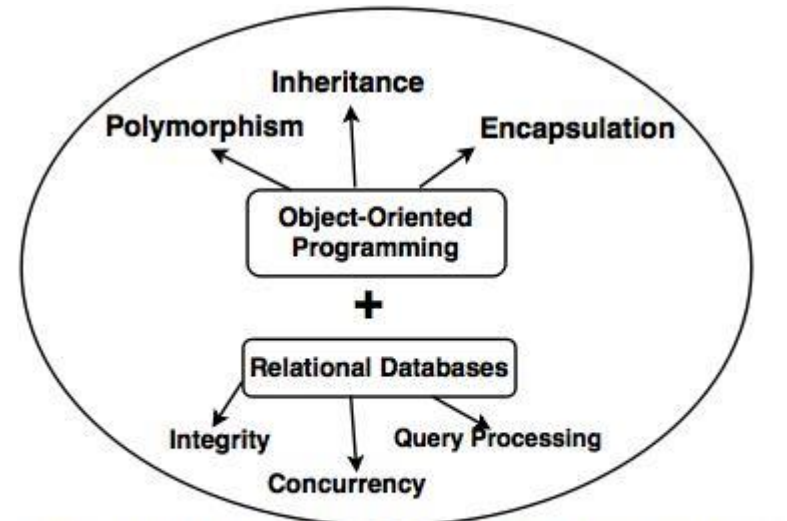
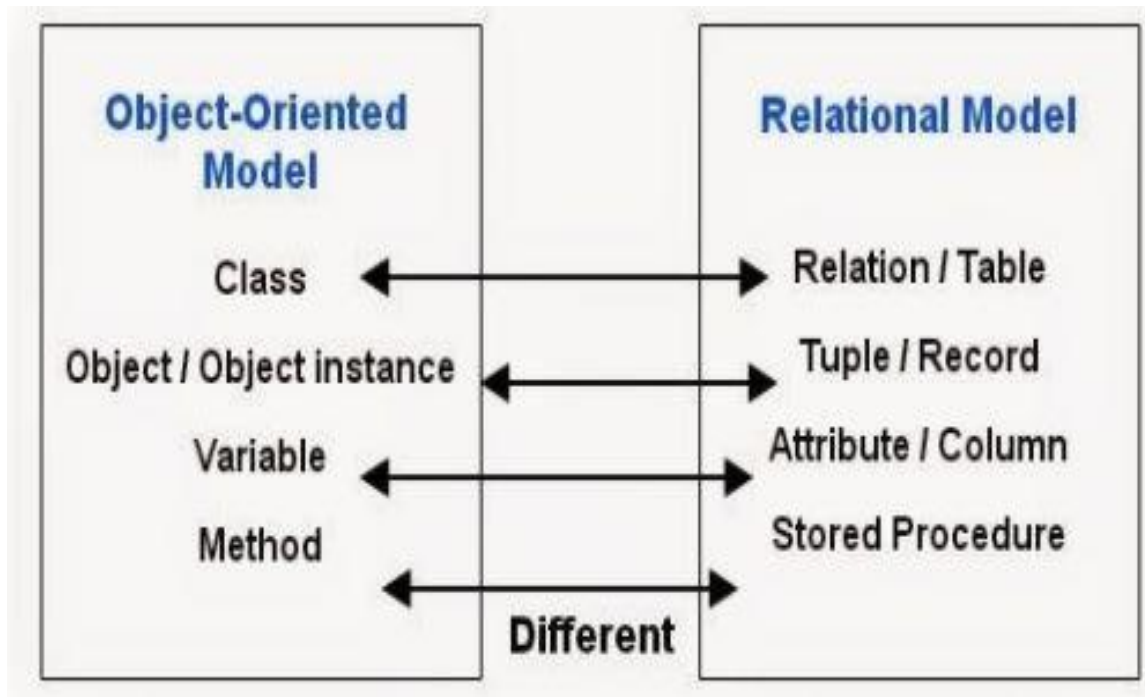
- It contains data in the form of object and classes.
- Objects are the real-world entity, and types are the collection of objects. It is a hybrid approach.
- It *maintains separate sets of memories separate memory spaces for each row*.
- Data *independence is achieved* so that all operations and transactions done in one data are independent and unaffected with other data as minimum as possible

Object-Oriented Database Features: persistence, support of transactions, simple querying of bulk data, concurrent access, resilience, security

Why OODB?

- Industry Trends: Integration and Sharing
- Seamless integration of operating systems, databases, languages, spreadsheets, word processors, AI expert system shells.
- Referential sharing: Multiple applications, products, or objects share common sub-objects through the support of object identity and inheritance. (Hypermedia links are then used to navigate from one object to another)





(Object-Oriented database is product of OOP and RDB)

Object-Oriented database

Object-Oriented Model

Object 1: Maintenance Report

Date	
Activity Code	
Route No.	
Daily Production	
Equipment Hours	
Labor Hours	

Object 1 Instance

01-12-01
24
I-95
2.5
6.0
6.0

Object 2: Maintenance Activity

Activity Code	
Activity Name	
Production Unit	
Average Daily Production Rate	

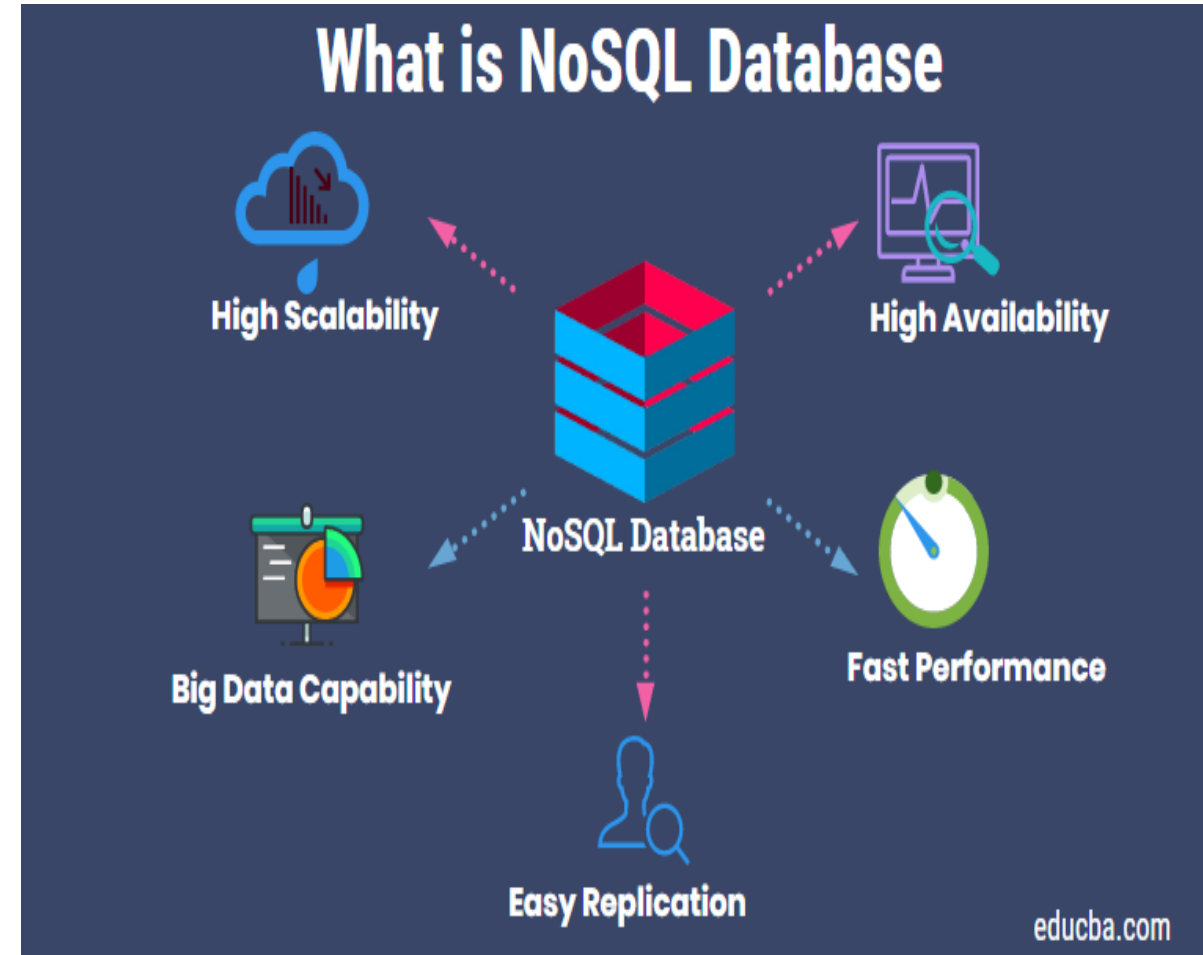
Evolution of Databases

NoSQL Database

- NoSQL databases are databases designed to be used across large distributed systems.
- Much more scalable and much faster at handling very large data loads
- NoSQL databases do not use the standard tabular relationships.
- NoSQL databases allow for the querying and storage of data by a variety of other means, depending on the specific software.

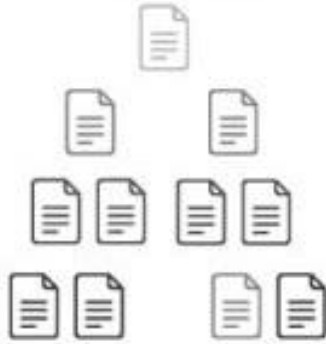
Other Features

- Multi-Model
- Concurrency
- Security
- Data Model Flexibility
- Deployment Model Flexibility

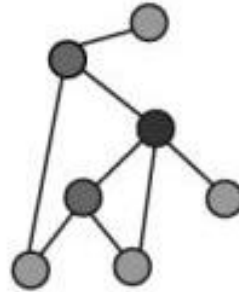


NoSQL DATABASE TYPES

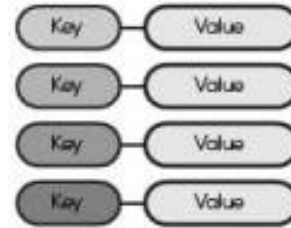
Document



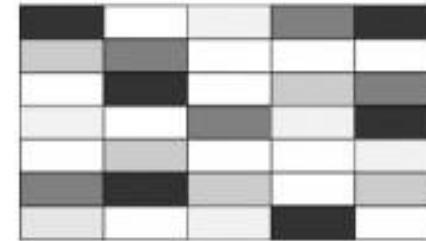
Graph



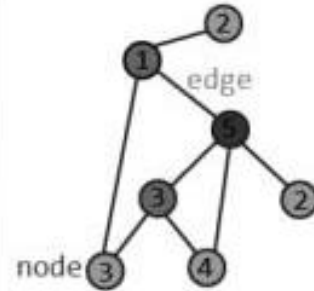
Key-Value



Wide-Column



```
{
  "user": {
    "id": "143",
    "name": "improgrammer",
    "city": "New York"
  }
}
```



1	Fruit	A Foo	B Baz	
2	City	E DC	D PLA	G FLD
3	State	A NZ	C CL	



6. Cloud database

- Cloud database facilitates you to store, manage, and retrieve their structured, unstructured data via a cloud platform. This data is accessible over the Internet. Cloud databases are also called a database as service (DBaaS) because they are offered as a managed service.
- Some best cloud options are:
 - AWS (Amazon Web Services)
 - Snowflake Computing
 - Oracle Database Cloud Services
 - Microsoft SQL server
 - Google cloud spanned

References

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- <https://www.improgrammer.net/most-popular-nosql-database/>
- <https://hackernoon.com/5-top-cloud-databases-that-works-wonders-7e628810e3ac>

Thank you