**Homework 9**

**DB concepts task**

1. Describe different DB models.

2. Provide pros and cons of each DB model.

3. Provide situations where each model is the best candidate.

There are five common types of database model that are useful for different types of data or information. Depending upon your specific needs, one of these models can be used.

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## 1. Hierarchical databases

It is one of the oldest database model developed by IBM for information Management System. In a hierarchical database model, the data is organized into a tree-like structure. In simple language we can say that it is a set of organized data in tree structure.

This type of Database model is rarely used nowadays. Its structure is like a tree with nodes representing records and branches representing fields. The windows registry used in Windows XP is an example of a hierarchical database. Configuration settings are stored as tree structures with nodes.

The following figure shows the generalized the structure of Hierarchical database model in which data is stored in the form of tree like structure (data represented or stored in root node, parent node and child node).

### Pros

• The model allows us easy addition and deletion of new information.

• Data at the top of the Hierarchy is very fast to access.

• It worked well with linear data storage mediums such as tapes.

• It relates well to anything that works through a one to many relationships. For example; there is a president with many managers below them, and those managers have many employees below them, but each employee has only one manager.

### Cons

• It requires data to be repetitively stored in many different entities.

• Now a day there is no longer use of linear data storage mediums such as tapes.

• Searching for data requires the DBMS to run through the entire model from top to bottom until the required information is found, making queries very slow.

• This model support only one to many relationships, many to many relationships are not supported.

### The best candidate for

The hierarchical structure is used primarily today for storing geographic information and file systems.

Currently, hierarchical databases are still widely used especially in applications that require very high performance and availability such as banking, health care, and telecommunications

## 2. Network databases

This is looks like a Hierarchical database model due to which many time it is called as modified version of Hierarchical database. Network database model organised data more like a graph and can have more than one parent node. The network model is a database model conceived as a flexible way of representing objects and their relationships.

### Pros

• The network model is conceptually simple and easy to design.

• The network model can represent redundancy in data more effectively than in the hierarchical model.

• The network model can handle the one to many and many to many relationships which is real help in modelling the real-life situations.

• The data access is easier and flexible than the hierarchical model.

• The network model is better than the hierarchical model in isolating the programs from the complex physical storage details.

### Cons

• All the records are maintained using pointers and hence the whole database structure becomes very complex.

• The insertion, deletion and updating operations of any record require the large number of pointers adjustments.

• The structural changes to the database is very difficult.

### The best candidate for

The network model contains logical information such as connectivity relationships among nodes and links, directions of links, and costs of nodes and links. With logical network information, you can analyze a network and answer questions, many of them related to path computing and tracing.

## 3. Relational Database

A relational database is developed by E. F. Codd in 1970. The various software systems used to maintain relational databases are known as a relational database management system (RDBMS). In this model, data is organised in rows and column structure i.e., two-dimensional tables and the relationship is maintained by storing a common field. It consists of three major components.

In relational model, three key terms are heavily used such as relations, attributes, and domains. A relation nothing but is a table with rows and columns. The named columns of the relation are called as attributes, and finally the domain is nothing but the set of values the attributes can take. The following figure gives us the overview of rational database model.

### Pros

• Relational model is one of the most popular used database model.

• In relational model, changes in the database structure do not affect the data access.

• The revision of any information as tables consisting of rows and columns is much easier to understand.

• The relational database supports both data independence and structure independence concept which makes the database design, maintenance, administration and usage much easier than the other models.

• In this we can write complex query to accesses or modify the data from database.

• It is easier to maintain security as compare to other models.

### Cons

• Mapping of objects in relational database is very difficult.

• Object oriented paradigm is missing in relation model.

• Data Integrity is difficult to ensure with Relational database.

• Relational Model is not suitable for huge database but suitable for small database.

• Hardware overheads are incurred which make it costly.

• Ease of design can lead to bad design.

• Relational database system hides the implementation complexities and the physical data storage details from the users.

### The best candidate for

Relational databases are ideal for complex data analysis and operations. In a non-relational database, tables can share the same data but they can’t ‘relate’ to each other. With a relational database, they can.

One use of a relational database is connecting tables for customer data and transactions. A business will have both data sets but they may be siloed. A relational database brings these together.

## 4. Object-oriented databases

An object database is a system in which information is represented in the form of objects as used in object-oriented programming. Object oriented databases are different from relational databases which are table-oriented. The object-oriented data model is based on the object-oriented- programming language concept, which is now in wide use. Inheritance, polymorphism, overloading. object-identity, encapsulation and information hiding with methods to provide an interface to objects, are among the key concepts of object-oriented programming that have found applications in data modelling. The object-oriented data model also supports a rich type system, including structured and collection types.

The following figure shows the difference between relation and object-oriented database model.

### Pros

• Object database can handle different types of data while relational data base handles a single data. Unlike traditional databases like hierarchical, network or relational, the object-oriented databases can handle the different types of data, for example, pictures, voice video, including text, numbers and so on.

• Object-oriented databases provide us code reusability, real world modelling, and improved reliability and flexibility.

• The object-oriented database is having low maintenance costs as compared to other model because most of the tasks within the system are encapsulated, they may be reused and incorporated into new tasks.

### Cons

• There is no universally defined data model for an OODBMS, and most models lack a theoretical foundation.

• In comparison to RDBMSs the use of OODBMS is still relatively limited.

• There is a Lack of support for security in OODBMSs that do not provide adequate security mechanisms.

• The system more complex than that of traditional DBMSs.

### The best candidate for

Object databases are commonly used in applications that require high performance, calculations, and faster results. Some of the common applications that use object databases are real-time systems, architectural & engineering for 3D modeling, telecommunications, and scientific products, molecular science, and astronomy.

## 5. Graph Database Model

A type of Data Model which tries to focus on building the relationship between data elements. As the name suggests Graph-Based Data Model, each element here is stored as a node, and the association between these elements is often known as Links. Association is stored directly as these are the first-class elements of the data model.

Obviously, in graph theory, we have terms like Nodes, edges, and properties, let’s see what it means here in the Graph-Based data model.

* Nodes: These are the instances of data that represent objects which is to be tracked.
* Edges: As we already know edges represent relationships between nodes.
* Properties: It represents information associated with nodes.

### Pros

* Structure: The structures are very agile and workable too.
* Explicit Representation: The portrayal of relationships between entities is explicit.
* Real-time O/P Results: Query gives us real-time output results.

### Cons

* No standard query language: Since the language depends on the platform that is used so there is no certain standard query language.
* Unprofessional Graphs: Graphs are very unprofessional for transactional-based systems.
* Small User Base: The user base is small which makes it very difficult to get support when running into a system.

### The best candidate for

* Graph data models are very much used in fraud detection which itself is very much useful and important.
* It is used in Digital asset management which provides a scalable database model to keep track of digital assets.
* It is used in Network management which alerts a network administrator about problems in a network.
* It is used in Context-aware services by giving traffic updates and many more.
* It is used in Real-Time Recommendation Engines which provide a better user experience.