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Assignment 1 Theory Database Management (SPring 2018)

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**Enter your Name Here 🡺**

# Introduction

## Researching Your Answers

Most requirements of this assignment will require you to research answers from your text book (**you must read the text book to get some answers**), from the Internet, from a video or any other reasonable source. Many Internet sources, video links, text book and Blackboard presentations are provided in this document to help you START your research.

Assignments are always a great place to read and reference your text book. May students assume that they should start by reading the text book. While this reading the text book is ALWAYS at great idea, the following assignment questions may help you focus on what is important in this course***. One strategy is to review an assignment question for important keywords, e.g., multitasking, Procedure Division, virtualization, etc. Then look for those key words in either 1) your text book "detailed" table of contents in the beginning of the book, or 2) in the index at the end of the book. Some text books have key word glossaries at the end of the chapter or end of the book.***

Every semester the Internet sources, e.g., a Google keyword search, or Internet video, e.g., a YouTube keyword search may be improved. Better students start with research sources provided in this assignment, and then search for improved or updated answers. ***While your objective may be to demonstrate your knowledge to EARN an excellent grade on this assignment, better students are always looking towards the future to impress internship and career recruiters for those interesting and high entry-level salaries.*** Employers don't pay you for a grade in any single class or assignment. Employers will pay you BIG MONEY for demonstrated knowledge or skills. Hopefully, this assignment will prepare you.

A single research source maybe very incomplete or the formator the content may not be appropriate for some required answers. Some students do not READ the text book or review the Blackboard presentations provided to you in Blackboard. Some answers are only available from Blackboard presentations or update documents. When assignment requirements may be only answered by viewing a YouTube video, you will be notified.

You may cut-and-paste answers whenever appropriate.You MUST synthesize your answers to include multiple sources. I would be impressed that you consult a Google image search and paste and appropriate image to supplement your answer.

While I permit cut-and-paste, I do expect you use your own words so that you:

1. Organize the answer

2. Demonstrate that you have read what you have cut-and-pasted

3. Use any means that clearly displays that you have gained knowledge.

## A Little Advice Before you start

There is NO requirement to read each reference link or view each video in detail. Some of the links will have overlapping content. Some links will provide more information than the question requirements, but employers consider these topics to be minimal knowledge of a RMU CIS graduate.

It is recommended to visit each reference link and overview the content. Then read each question and return to each reference link or video as needed. You may supplement your answers with content from your text book by using a question keyword and looking up in the glossary or index in the back of the book. PDF text books can be easily searched for keywords.

It is not required to read your text books before working on this assignment unless specified in a requirement. Text book contents are used to support quiz questions (which contain the answers), which are used on the tests. The reference links and videos are excellent resources.

The topics presented in the course assignments have been highly recommended by two or more employers who recruit RMU CIS students as minimum computer hardware, operating system, and application development knowledge. Employers expect that students should be able to present one or two sentences of the majority of keywords applicable to job requirements in a face-to-face interview.

On the other hand, each assignment is allocated 100 points out of a total of 1000 points. The number of questions or hands-on activity on each assignment varies. Assume that an average assignment has 50 requirement questions. This means that a requirement may be worth 2 points towards your final grade. The bottom line is that missing a few questions will have little effect of your assignment or final grade. Not completing an assignment will generally decrease your final grade by at least a letter grade. Do not waste time on the small problems.

## Demonstrating Knowledge and Increased Penalties for Irrelevant Answers

If you can DEMONSTRATE your knowledge of the topic for the requirement there will be no penalty for your answer. It is not the intention of this assignment to be "not picky". Parital credit will be awarded as appropriate.

If you cut-and-paste and pray that your instructor will not read your inappropriate and irrelevant answer, the question will be penalized by increasing the deduction points beyond the original requirement points. The instructor hates irrelevant cut-and-paste BS, or answers that appears that the student is guessing and hopes the instructor does not read the answer.

***The instructor reserves the right to increase the penalty for any submitted question or assignment that may be construed as "wasting the instructor's time".*** Therefore, a four-point requirement may be penalized as six-points (two additional point penalty for wasting the instructor's time). Sometimes blank answers will earn you’re a high assignment grade than BS answers. For example, a submitted 100-point assignment may be penalized as 125 minus points when your final grade is calculated for any assignment that should have never been submitted in the first place.

## You Must Submit YOUR Answer in this Original Word Document to Blackboard

***This Assignment Word Document will contain hidden markers that may be used to detect plagiarism and provide an audit trail of those who may have modified the Word document.***  Many students in my classes work very hard to complete and learn from their assignments. It is not fair to those students who have professionally demonstrated their knowledge to receive the same grade as those who have plagiarized their assignments

**You MUST answer ALL requirement in this Word document and ONLY THIS Word Document. You MAY NOT use or edit any other word processor, except any version of Microsoft Word.**

**Do not use GOOGLE DOCS or Open Office DOCX files at any time. If you use any other Word Processor you will be assigned ZERO credit.**

**If you do not have a copy of WORD**, you may use VMWARE VIEW (available from the RMU website) to access a virtual lab computer which contains any software needed for this course.

<http://www.rmu.edu/web/cms/departments-offices/administration-services/it/Pages/vmware-view.aspx>

NEVER STORE ANY DOCUMENTS ON THE DESKTOP OF VMWARE VIRTUAL COMPUTER. You will lose your document. It is preferable to store your documents on RMU Drive U: If necessary you can email the document to yourself.

## You Must RENAME this Original Word Document to Include your LAST NAME

**YOU MUST enter your name in the beginning of this document as provided and "Save As" this document using a new name that starts with your LAST NAME, assignment number and semester, e.g., Jones Assignment 1Fall 2017.docx**

If you do not rename your document your assignment will be penalized by 10%.

## NEVER submitted an Assignment as an Email Attachment

All assignments are to be submitted to the instructor by using the Assignment Link in the Blackboard system. Assignments submitted as an email attachment will NOT be graded. THE INSTRUCTOR NEVER ACCEPTS ANY ASSIGNMENT AS AN EMAIL ATTACHMENT FOR ANY REASON.

## ONLY Submit a FINAL Version of ALL Assignment

Never submit an incomplete assignment for grading. Only submit your final version of ALL assignment documents for grading. You can only submit an Assignment once.

## Requests to Clear Previously Assignments for Re-Submission

If you make an error submitting an assignment you must contact the instructor to clear your previous assignment submission. If you made an error on any assignment you may request that the previous assignment submission be cleared so that you may resubmit the assignment again. Please only submit a completed assignment.Summer 2018.

## Submitting Late Assignments

While the assignments have a recommended due date, the instructor does not penalized your assignment grade if you are slightly late. Please do not send the instructor an email if you are going to submit your assignment late. The instructor is flexible and assumes you have a good excuse. But, after you are more than two weeks late the instructor does reserve to penalize the assignment or not accept the assignment if this late submission is unfair to other students enrolled in the course who had completed their assignments on time.

It has been the experience of the instructor that students who are excessively or consistently late asks a friend to provide them a copy of their assignment which will violate the RMU Academic Integrity Policy. (Please carefully read the next section!) ***If a friend asks you for a copy of your assignment "to get an idea what the instructor wants", you are risking a zero assignment grade, an F final grade, or a RMU Academic warning or suspension.***

## Academic Integrity and Plagiarism

When an instructor has possession of an electronic document it is easy to detect plagiarism. Microsoft Word provides a variety of FREE anti-plagiarizing tools. The content of your submitted Assignment WORD document will be COMPARED to each other student who has submitted this assignment in the current class or any previous class as time permits. ***The content of each student's assignment may NOT be copied from any other current or past student enrolled in this class. Each assignment is to be prepared by ONE student. Assignments are NOT a group-prepared assignment.***

Some students may attempt to SAVE AS another student's completed assignment and rename it using their name. Some students may attempt to Cut-and-Paste answers from one student's assignment document to another student's assignment document. But as time permits, the forensic tools used to compare ALL student's assignments with other assignment will often detect anomalies which will provide absolute proof of plagiarism. ***On-ground tests may be used to compare the student’s knowledge to performance on assignments. All acts of plagiarism and forensic data will be submitted the RMU Academic Integrity Board to determine university-wide penalties, such as grade penalties, warnings, suspension, and change of a previous course grade for previous course students. All current and previous students involved in the plagiarism may be affected RMU Academic Integrity Board.***

***If a friend asks you for a copy of your assignment "to get an idea what the instructor wants", you are risking a zero assignment grade, an F final grade, or a RMU Academic warning or suspension. You are responsible to protect your assignment Word Document.***

***You, however, may discuss assignment requirements, provide research assistance, assist other students to debug programs or other hands-on-requirements, tutor students, or provide other advice that may assist the students in acquiring knowledge. But the actual preparation of an individual assignment must have been completely prepared by the student who submitted the assignment. Sections of the assignments may be copied from the internet as per the individual assignment's directions. Please contact the instructor if you need assistance interpreting this RMU Academic Integrity Policy. (Ref.16-1.)***

Many believe that if you a "stupid" enough provide another student, whom may compete with you for a future internship or career, a copy of your assignment, then you deserve the same penalty as the other student. If you are a "real" friend, tutor your friend.

***The instructor reserves the right to require face-to-face hands-on demonstrations or face-to-face tests to provide additional evidence to be submitted to the RMU Academic Integrity Board.***

## How to complete Content Questions

Review questions are also be provided at the end of the tutorial. The following is an example of a review question format. Since type the answer in provided grey or colored box.

1. What is the purpose of a partitioned data set? Answer:

Type in the answer to the question into the grey or colored box.

**It is recommended that you use Table of Contents at the beginning of the tutorial to review and navigate to the concept presented in the review question. Students will find that using the document FIND tool or searching GOOGLE may also be valuable for researching the review question answer.**

# 1.0 File Processing and Database Management Systems

**Review the Introduction to DB2 and IMS handout or the Introduction to Database Management**

Review Unit 1

Video-The Fundamental Concepts of Database system PART 1 - <http://www.youtube.com/watch?v=fR_xnOv2r6E&feature=relmfu>

Video - The Fundamental Concepts of Database system PART 2 - <http://www.youtube.com/watch?v=3ywXh3NyUO0>

Video - The Fundamental Concepts of Database system PART 3 - <http://www.youtube.com/watch?v=ZWDGIHhvkNU&feature=relmfu>

## 1.1 Questions - Operating Systems, File Systems, and DBMS

1. What are the functions of an operating system? Answer =>

Task management is the function of the operating system to manage the execution of multiple applications, implement priorities to allocate CPU time, processors or processors cores. The operating attempts to manage and allocate computing resources to competing applications.

2. What are the functions of an operating system file system? Answer =>

Each operating system supports one or more file systems, which is a collection of system programs that control the manner in which files are named , created, and data are stored and later retrieved.

3. What is the function of a Storage Area Network in relationship to a DBMS? Answer =>

Most DBMS use a Storage Area Network which provide the ability to have multiple physical computers or virtual machines to share, are easy to scale and manage.

4. What IBM mainframe file system concept is similar to a Window’s, Linux or UNIX file? Answer =>

5. What IBM mainframe concept is similar to a Window’s, Linux or UNIX hard disk drive? Answer =>

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## 1.2 Questions - VSAM Flat Files

Virtual Storage Access Method - <http://en.wikipedia.org/wiki/Virtual_Storage_Access_Method>

Access Methods - <http://www.mainframes360.com/2009/07/vsam-tutorial-01-introduction-to.html>

6. The VSAM subsystem provides access method to organize and access IBM mainframe data sets for any programming language or subsystem, .e.g., Oracle, DB2, etc. Unlike other platforms which require the programming language or subsystem to provide the access methods, VSAM centralizes these file access services and types of data sets?

|  |  |
| --- | --- |
| **Type of VSAM data set access methods** | |
| **Types of VSAM Data Sets** | **Description** |
| **ESDS - Entry Sequence Data Sets** | A type of data set used by VSAM computer data storage system and access method is based on the sequential order,in which they were written in the file. |
| **RRDS - Relative Record Data Sets** | Records are access besed on their ordinal position in the file.RRDS consists of data records in sequence, with a record number indicating the records logical position in the data set. |
| **KSDS - Key Sequenced Data Sets** | KSDS consists of two parts,the data component and separate index file which enables system to locate the record in the data file by the key value. Records can be accessed randomly or in-sequence |
| **LDS - Linear Data Sets** | This data set allows for physical addressing, which allows it to be used by system such as that Operating system |

7. Describe and provide an example of a flat file or file processing? Answer =>

A flat file contains records that have no structured relationship. One of the most common flat file is comma-seperated values in which table data is gathered in lines of American standard code for information interchange text with the value from the each table cell separated by a comma and each row represented by a new line.

Disadvantages of file processing Systems - <https://www.tutorialcup.com/dbms/file-processing-system.htm>

Disadvantages of File Processing System - <http://whatisdbms.com/disadvantages-of-file-processing-system/>

Data independence - http://www.webopedia.com/TERM/D/data\_independence.html

DBMS Data Independence - https://www.tutorialspoint.com/dbms/dbms\_data\_independence.htm

Data independence - https://en.wikipedia.org/wiki/Data\_independence

8a.Provide a description AND example each of the following limitations of a flat file processing system using the following table.

|  |  |
| --- | --- |
| **Limitations of Flat File Processing** | |
| **Limitations** | **Description and Example** |
| **Separation and Isolation of data from the application** | As data is stored in different files,data is isolated. These files can be in a different format. Example we want to generate a single student report like his course, library books,academic instructors,and all these information are stored in a different file. Since all datas are isolated from each other and programming becomes difficult. |
| **Incompatible application formats** |  |
| **Duplicated data** | Data is stored in more than once in a different files, so duplicated data may occur in all these files.Example, a student’s name is enrolled in college library and in examination department. Then his name, id, father’s name, courses will be same in both department.So it creates a lots of duplicate values and if he wants to change or modify anything he has to update both department information. |
| **Data Dependence** | As in file system data is dependent to each other,if the format of any file is changed then other files which are dependent on that file must be change.example, if a student course change suddenly then, we have to update course table and instructor’s name as well. And also books allotted for that course. |
| **Fixed Queries** | If we need to check for a certain insertion criteria while entering data into file it is not possible directly. We can do it by writing programs. Example,if we have to restrict students under age 18, then it is by means of program alone. There is no direct checking facility in the file system. |
| **Proliferation of application programs** | As there are lots of duplicate data values, each file needs different kinds of application programs to access that value. |

8b. A large scale processing system used by some commercial banks use VSAM flat files instead of a database like Oracle or DB2? What are the advantages of using VSAM flat files in this case instead of using a DBMS? Answer =>

VSAM data sets provided additional data structures that made it faster and easier to lookup an individual record inside a data set. For example in banks there is large scale processing and if we want to lookup someone’s account, it keeps data dynamically sorted when records were added modified or deleted. Sometimes the response time to retrieve account balance at an ATM machine may take10-30 seconds for a sequential file, but less than a second for VSAM RRDS.

Video- Introduction to DBMS

<http://www.authorstream.com/Presentation/rapti_2003-34064-Fundamental-DBMS-Data-Storage-Hierarchy-DATABASE-MODEL-HIERARCHICAL-NETWORK-RELATIONAL-Object-Oriented-Main-Comp-tdbms-Education-ppt-powerpoint/>

<http://www.buzzle.com/articles/advantages-of-relational-databases.html>

9. What is the relationship between a flat file and an operating system? Answer =>

A flat file system is a system of files in which every file in a system must have different name. In most operating system today, files are managed in a hierarchical file system with a hierarchy of directories and sub directories. OS allows more than one file to have the same name as long as it is stored in a different directory.

10. What is the relationship between a database, e.g., DB2 or Oracle and a flat-file, e.g., Sequential (ESDS), Relative (RRDS) and Indexed (KSDS)? Answer =>

There are lots of limitations of flat files and DB2 will provide an extra layer of software that is designed to overcome those limitations. Most important thing to remember that DB2 in built on the top of a structure of flat files.

## 1.3 Advantages and Disadvantages of a Database Management System

Database Management systems - <http://en.wikipedia.org/wiki/Database_management_system>

[**http://whatis.techtarget.com/definition/0,,sid9\_gci212066,00.html**](http://whatis.techtarget.com/definition/0,,sid9_gci212066,00.html)

11. What is a database management system (DBMS)? Answer =>

A database management system is a software for creating and managing database. It helps users and programmers a systematic way to create , retrieve, update and manage data.

9 Advantages of Database Management System over File System - <http://www.csestack.org/advantages-of-database-management-system-over-file-system/>

Advantages of Database Management System over File System - <http://www.manik.in/StudSupp/Docs/DBMS-1.pdf>

9 Disadvantages of Database Management System (DBMS) – http://whatisdbms.com/disadvantages-of-database-management-system-dbms/

### 1.3.1 Questions - Advantages of a DBMS

12. List 9 or more advantages of a database management system and provide an example each advantage using the following table.

|  |  |
| --- | --- |
| **Advantages of a Database Management System** | |
| **Advantages** | **Example** |
| **Control of Data Redundancy** | The data is stored in a single file and is not duplicated. For example In relational database model entities are connected with primary key and foreign key. One can retrieve information y using primary key which is unique for every entity. |
| **Sharing Of data** | In DBMS data can be shared by the authorized users of organization. The DBA manages the data and gives rights to the users to access the data. |
| **Data of consistency** | By controlling the data redundancy, data consistency is obtained. If a name of a student is changed or updated, the updated value is immediately updated to the user. |
| **Integration of data** | Database integrity refers to the validity and consistency of stored data. An integrity constraint could state that a member of staff’s salary could not be greater than $40000. Integration  Allows the DBA to define integrity constraints and DBMS to enforce them. |
| **Data security** | Database security is the protection of the database from unauthorized users. DBA has all access to all data in the database. |
| **Report writers** | Most of the DBMSs provide the report writer tools used to create report. If any one wants to create any report of enrollment or sale products , the user can create very easily and quickly. |
| **Economy of scale**  **Improved data accessibility and responsiveness**  **Increased concurrency** | Combining all the organization’s operational data into one database and creating a set of applications that work on this one source of data can result in cost savings.  As a result of data integration, data that crosses departmental boundaries is directly accessible to the end users. This provides a system with potentially much more functionality that can, for example, be used to provide better services to the end-user or the organization’s clients  Many DBMSs mange concurrent database access. Multiple even thousands of users can access one database simultaneously without any interruption |

### 1.3.1 Questions - Disadvantages of a DBMS

13. List 9 or more disadvantages of a database management system and provide an example each disadvantage using the following table.

|  |  |
| --- | --- |
| **Disadvantages of a Database Management System** | |
| **Disadvantages** | **Example** |
| **complexity** | DBMS is an extremely complex piece of software. Failure to understand the system can lead to bad design decisions, which can have serious consequences for an organization |
| **Size** | The complexity and breadth of functionality makes the DBMS an extremely large piece of software. |
| **Cost of DBMSs** | Cost of DBMSs can varies depending on the environment and functionality. Single user DBMs for a personal computer may only cost $100 , a large mainframe multiuser DBMS servicing hundreds of users can be extremely expensive. |
| **Additional hardware cost** | The disk storage requirements for the DBMS and the database may necessitate the purchase of additional storage space. |
| **Cost of conversion** | Sometimes conversion of any existing system to run on the new DBMS may cost extremely expensive in compare to the cost of DBMS and extra hardware |
| **Performance**  **Greater impact of failure**  **Technical Staff requirement**  **Concurrency maintenance** | As DBMS system is written in a general form, some application sometimes may not run as fast as they used to.  As all users and application rely on the availability of the DBMS, the failure of certain components can bring operations to a halt.  A team of technical staff is required who understand DBMS and company have to pay handsome salary to them too.  As new threats comes daily, DBMS should be updated according to the current scenario. |

14. What is the function of a database query language (SQL)? Answer =>

Database query language is a computer programming language used to retrieve data from a database. SQL is the most common query language. It is used in programming and managing data held in relational database management system.

15. How is SQL different than a programming language like VB.NET, Java or COBOL? Answer =>

SQL is non procedural language that is designed especially for data access operation. The difference between SQL and other programming language is that SQL statements specify what data operation should be performed rather how to perform it.

16. What is the function of the SQL Data Definition Language (DDL)? Answer =>

DDL enables DBA or user to describe and name the entities, attributes, and relationships. It is used to define a schema or to modify an existing one.

17. What is the function of the SQL Data Manipulation Language (DML)? Answer =>

Data manipulation mainly used to insert a new data information, modification of a new data, retrieval of a data contained in the database and deletion of data from database.

18. Using the previous diagram describe the details of the process of an application using SQL to access the Oracle Database to process data stored on a physical storage device. Answer =>

## 1.4 Questions - Database Administrators

Database administrator (DBA) - <http://searchsqlserver.techtarget.com/definition/database-administrator>

Functions and responsibilities of DBAs - <http://tutorialink.com/dbms/functions-and-responsibilities-of-dba.dbms>

Logical database design - <http://searchdatamanagement.techtarget.com/answer/Logical-database-design>

Overview of Physical Design - https://docs.oracle.com/cd/A84870\_01/doc/server.816/a76994/physical.htm

19. List five or more functions of a Database Administrator? Answer =>

a. DBA is responsible for the physical realization of the database including physical database design and implementation.

b. DBA also decides how the data to be represented in database

c. DBA provides assistance to application programmers to develop application program.

d. DBS control access system and decides which user needs access to which part of the database.

e. DBA always ensures about better performance by making changes in physical and logical database scheme.

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20. How is an application programmer different than a DBA? Answer =>

A DBA is responsible for the ongoing correct and efficient operation of the database engine. Application programmer is responsible to make computers perform specific tasks based on client specification.

21. What are the differences between a logical database designer and a physical database designer?

Logical database designer is responsible for identifying the data like entities, attributes , the relationship between different data , constraints of the data that is to be stored in the database. Physical databse designer decides how logical database design is to be physically realized through set of tables and integrity constraints.

22. Which type of database designer, i.e., logical or physical database designer, would more concerned between the technical differences between Oracle and DB2? WHY? Answer =>

Physical database designer would more concern about the technical difference between oracle and DB2 because physical database designer fully aware of the functionality of the target DBMS and concerned about the implementation.

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## 1.5 Questions - Database Performance

Five easy steps to improve your database performance - https://www.dynatrace.com/blog/five-easy-steps-improve-database-performance/

Top 6 Database Performance Metrics to Monitor in Enterprise Applications -<https://blog.appdynamics.com/engineering/top-6-database-performance-metrics-to-monitor-in-enterprise-applications/>

22. List three or more hardware, operating system, or network factors that may affect the performance that has nothing to do with the implementation of a database. Answer =>

Query Performance- query performance is the most important thing in database performance. Problems can result from the query that it sometimes take long time to identify the required data.

Insufficient join between tables can cause performance issue in database system. Join cause database to bring multiple sets of data into memory. And various factors can slow down join like joining on colomns that are different kind of data.

As we all know database is for multiple users, but this can create conflict when two or more users simultaneously try to update data.

ANSI-SPARC Architecture - http://en.wikipedia.org/wiki/ANSI-SPARC\_Architecture

DBMS Architecture: An Overview of the 3-Tier ANSI-SPARC Architecture - https://blog.udemy.com/dbms-architecture/

## 1.6 Questions - Three-Tier ANSI-SPARC Database Architecture Model

23. In 1975, the three-level ANSI-SPARC database architecture standard was defined. Use the following table to describe and provide an example of use for the level of data abstraction used by the ANSI-SPARC specification.

|  |  |
| --- | --- |
| **Three-Tier ANSI SPARC** | **Description and Use** |
| **External Level or user View** | This level consists of a number of different external views of the database,and this part is familiar for that user. |
| **Conceptual Level or Schema** | This level describes the logical data of the database which is seen by DBA. |
| **Internal Level or Schema** | This level describes the physical appearance of the database to achieve optimal runtime performance and storage space utilization. |
| **Physical Database Organization** | This level resides below the internal level and is managed by the OS under the direction of DBMS |

24. Use the following table to describe and provide an example of each ANSI-SPARC advantage.

|  |  |
| --- | --- |
| **Advantages of the Three-Tier ANSI SPARC** | **Description** |
| **Database Abstraction** | It hides the description of how data is stored physically in the electronic system. This makes easier to understand and easier to use for an average user. |
| **User Data Customization** | Each user should be able to access a source of data and any change made to their customized data source should not effect the data sources being used by the other users. |
| **Conceptual Changes or Logical data Independence** | The model also allows a database admin to make changes to the database structure or make upgrades to it without disturbing a user currently on the system |
| **Migration to another storage system or platform or Physical Data independence** | The database looks same even if it is migrated from one system to another, even if the physical storage is changed. |

**Video - Relational Database Concepts -** [**https://www.youtube.com/watch?v=NvrpuBAMddw**](https://www.youtube.com/watch?v=NvrpuBAMddw)

**Video - Database Tables, Primary Keys, Foreign Keys, and Relationships -** [**https://www.youtube.com/watch?v=FCtGbrou5DM**](https://www.youtube.com/watch?v=FCtGbrou5DM)

**Video - What is the difference between unique key and primary key -** [**https://www.youtube.com/watch?v=8iIvyNPwruU**](https://www.youtube.com/watch?v=8iIvyNPwruU)

## 1.7 Questions - Database Security

**Video- Introduction to the Database Security -** [**http://www.youtube.com/watch?v=yZBgiMSDNyM&feature=relmfu**](http://www.youtube.com/watch?v=yZBgiMSDNyM&feature=relmfu)

**Video- DB2 for z/OS Best Practices: Security to .Protect Your Assets -** [**https://www.youtube.com/watch?v=PMpDfKia36s**](https://www.youtube.com/watch?v=PMpDfKia36s)

**Video- DB2 for z/OS Best Practice: Software Maintenance -** [**https://www.youtube.com/watch?v=gJjqYcQV7Uk**](https://www.youtube.com/watch?v=gJjqYcQV7Uk)

Introduction to Database Security - https://docs.oracle.com/cd/B19306\_01/server.102/b14220/security.htm

Basic Database Security: Step by Step - <http://searchsecurity.techtarget.com/magazineContent/Basic-Database-Security-Step-by-Step>

Separation of Duties in Information Technology - <http://www.sans.edu/research/security-laboratory/article/it-separation-duties>

Enforcing Separation of Duties - <https://blogs.oracle.com/securityinsideout/entry/enforcing_separation_of_duties>

24. List five or more examples of database security? Answer =>

Give a secure password after installing the database immediately. Public account should be removed.

Some restrictions should be there to access the database.

If there are two administrators, their work should be divided.

The session between applications and the database should be encrypted, especially web applications.

Create an environment and process to perform a sanity functions check on database patches prior to production deployment.

25. Use the discussion and the beginning of this assignment and explain the differences between operating system authentication and authorization and a DBMS authentication and authorization? (Please discuss the advantages of DBMS authentication and authorization in your answer) Answer =>

Operating system only provides security for a particular group of users logon user or group of uers to access file or folder. But DBMS contains lots of confidential data table, the requirements to limit that access to that table is not managed by the operating system.

In Relational database system, it can be assigned permission to users to access some data table. User accounts are assigned to roles and permissions are then assigned to the role as a whole. This can be accomplish through the SQL GRANT statement.

26 What are the advantages of a security server in relationship to operating system, DBMS, user-interface, etc. authentication and authorization security? Answer =>

## 1.8 Questions - DatabaseTransactions and ACID

Database Transactions- <http://en.wikipedia.org/wiki/Database_transaction>

Database Transactions - <http://simple.wikipedia.org/wiki/Database_transaction>

Introduction to Transactions - <http://www.sqlteam.com/article/introduction-to-transactions>

Transaction Integrity Is Integral to Business Success - <http://www.ibmsystemsmag.com/mainframe/Business-Strategy/Competitive-Advantage/transaction_integrity/>

The Advantage Database Client Server - <http://masterlinksoftware.com/ADS.htm>

START TRANSACTION, COMMIT, and ROLLBACK Syntax - <http://dev.mysql.com/doc/refman/5.5/en/commit.html>

Transaction Control Language (TCL) - http://www.oracle-dba-online.com/sql/commit\_rollback\_savepoint.htm

27. What is a database transaction? Answer =>

A transaction, in the context of database, is a logical unit that is independently executed for data retrieval or updates. This logical unit of work must exhibit four properties called the atomocity, consistency,isolation, and durability (ACID) to qualify as a transaction.

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28. What statements in SQL are used to control database transactions? Answer =>

In SQL transaction begin with BEGIN command. When system possesses a COMMIT statement, the transaction ends with successful completion. ROLLBACK statement ends the transaction but without performing any work. If auto commit was disabled using START TRANSACTION, autocommit will also re enabled at the transaction’s end.

29 Assume that you are going to register for a class. There are many database or common sense steps necessary to complete this transaction. List some the major steps that need to perform for you to register for the class that has several perquisites and ultimately you will pay for that class.

Answer =>

http://en.wikipedia.org/wiki/Transaction\_processing

<http://en.wikipedia.org/wiki/Online_transaction_processing>

<http://www.businessdictionary.com/definition/online-transaction-processing-OLTP.html>

<http://www.businessdictionary.com/definition/ACID-qualities.html>

ACID <http://en.wikipedia.org/wiki/ACID>

ACID -http://databases.about.com/od/specificproducts/a/acid.htm

Data Integrity - <http://en.wikipedia.org/wiki/Data_integrity>

30. What is an OLTP or a Transaction Processing system? (Transaction Processing is a more comprehensive comparison to information support than OLTP. OLTP is a subset of transaction processing.) Answer =>

OLTP (online transaction processing) is a class of software programs capable of supporting transaction oriented applications on the internet. OLTP system used for order entry, financial transaction, customer relationship management, and retail sales.

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Video- ACID Property of Databases - <http://www.youtube.com/watch?v=dZc6CP-x2d0>

Video - Data Integrity and Availability in Storage Systems, An Interview with Steve Kleiman- <http://www.youtube.com/watch?v=38lMzN6SMYY>

Video - Data Availability and Integrity in Storage Systems with Prof. RemziArpaci-Dusseau - <http://www.youtube.com/watch?v=9jFhvOIxhAE&feature=relmfu>

31. As compared to information systems it is more important that a transaction processing database have ACID qualities? Using the following table describe each ACID quality and provide an example of applying ACID to your company or personal experience.

|  |  |  |
| --- | --- | --- |
| **ACID Quality** | **Description** | **Practical Example** |
| **Atomicity** | Each transaction should be All or Nothing. If a part of transaction fails, then the entire transaction fails. | Monetary transfer between two accounts. That is withdrawing from one account and saving it to another. Database will be in the consistent state. |
| **Consistency** | It refers to the requirement that any given database transaction must change affected data only in allowed ways. | A database tracking a checking account may only allow unique check numbers to exist for each transaction. |
| **Isolation** | This property determines how transaction integrity is visible to others and the system. | A teller looking up a balance must be isolated from the concurrent transaction involving a withdrawal from the same account. Only when the withdrawl transaction commits successfully and the teller looks at the balance again will the new balance be reported. |
| **Durability** | This property guarantees that the transaction that have committed earlier will survive permanently even if the there is any problem in the system. | If a flight booking reports that a seat has been permanently booked, it will be booked even if the system crashes. |

## 1.9 Questions- Entities and Attributes

Database entities -[**http://www.ewebarchitecture.com/database\_entities.php**](http://www.ewebarchitecture.com/database_entities.php)

Entities and Attributes -[**http://wiki.answers.com/Q/What\_are\_attributes\_and\_entities\_in\_database\_system\_management**](http://wiki.answers.com/Q/What_are_attributes_and_entities_in_database_system_management)

Attributes - [**http://www.pcmag.com/encyclopedia\_term/0,2542,t=attribute&i=38140,00.asp**](http://www.pcmag.com/encyclopedia_term/0,2542,t=attribute&i=38140,00.asp)

Relationships Between Entities - <http://www.webopedia.com/TERM/E/entity_relationship_diagram.html>

32. Explain and provide an example of the concept of an entity. Answer =>

An entity is an object in the system that we want to model and store information about. It can be any recognizable concepts either concrete or abstract. Example, employee, student, lecturer

33. Explain and provide an example of the concept of an attribute. Answer =>

An attribute is the characteristics of an entity, it describes an entity in detail. Example, if ‘Customer’ is the entity in a database ,attributes are ‘name’, ‘address’, ‘email’, ‘contact no’.

32. Explain and provide an example of the concept of a relationship between and entity and an attribute. Answer =>

The relationship between an entity and an attribute is that entity refers to the name of the object and attributer describes some detail of that particular object.

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33. You are manager of the new Low-Cal Sub shop. Using the following table indicate whether the following concept is more likely a database entity or a database attribute.

|  |  |
| --- | --- |
| **Database Storage Concept** | **Entity or Attribute** |
| **Foot Long Price** | Attribute |
| **Type of Submarine Sandwich** | Entity |
| **Employee** | Entity |
| **Condiments** | Entity |
| **Ingredients** | Attribute |
| **Customer Type** | Entity |
| **Active Customers** | Attribute |

Video - Data Models(hierarchical,network relational) <https://www.youtube.com/watch?v=NO9Ln34T_40>

Video - Relational Database Concepts - <https://www.youtube.com/watch?v=NvrpuBAMddw>

Video - Database Tables, Primary Keys, Foreign Keys, and Relationships - <https://www.youtube.com/watch?v=FCtGbrou5DM>

Video - What is the difference between unique key and primary key - <https://www.youtube.com/watch?v=8iIvyNPwruU>

# 2.0 Data Models: Hierarchical, Network and Relational

**Video - Data Models (hierarchical, network, or relational)** [**https://www.youtube.com/watch?v=NO9Ln34T\_40**](https://www.youtube.com/watch?v=NO9Ln34T_40)

Database Model - <http://en.wikipedia.org/wiki/Database_model>

Databases models - <http://www.peter>-lo.com/Teaching/DB212/L04.pdf

1. What is a database schema or a database model? Answer =>

Database model is a type data model which which describes the logical structure of the database and fundamentally determines in which manner data can be stored, organized and manipulated.

2. What are the differences between a database model and a database management system (DBMS)? Answer =>

Database model shows the structure of the database and the determines which manner data can be stored and DBMS is set rules that helps to retrieve insert or update data in the preferred way of an user.

## 2.1Hierarchical model and databases

### 2.1.1 Introduction

What does Hierarchical Database mean? - https://www.techopedia.com/definition/19782/hierarchical-database

The Hierarchical Database Model - <http://www.dba-oracle.com/t_object_hierarchical_database.htm>

Hierarchical database model - http://www.computerbusinessresearch.com/Home/database/hierarchical-database-model

Information Management System (IMS)- <http://en.wikipedia.org/wiki/Information_Management_System>

DL1 - <http://en.wikipedia.org/wiki/Data_Language/1>

IMS (Information Management System) - <http://searchdatacenter.techtarget.com/definition/IMS-Information-Management-System>

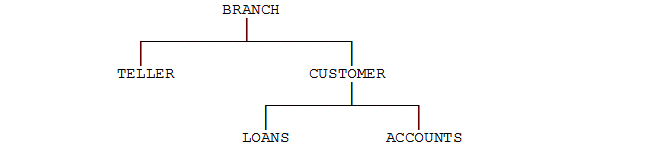
What is an IMS Database? <http://suite101.com/article/what-is-an-ims-database-a310404>

IMS Database Basics - http://www.scribd.com/doc/8728775/IMS-basics

Hierarchical databases are the oldest and still most popular database models in use today. The hierarchical databases use a tree (not a binary tree) as its basic data structure organizing data in a hierarchy of nodes (records). Objects or Entities for a particular record-type are called segments. Each database may contain several tightly related objects. For any segment or record in the data base there is a single path called the hierarchical path. In other words, each file or segment should only be designed with one parent. Using the following hierarchical database design one must know the BRANCHID to look up the customer's ACCOUNT.

### 2.1.2 Sample Hierarchical design of a Bank Data Base.

**The BANK Database**

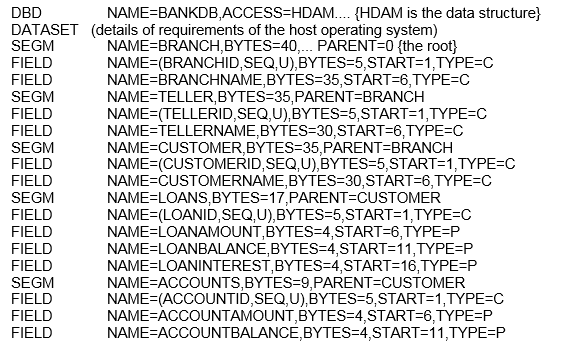


In a flat-file system, one would create five independent sequential or VSAM data sets. A TELLER record would be independent of the BRANCH that the teller was working. Likewise, a customer ACCOUNTS record would be independent of the CUSTOMER who owned the account. In 1966, IBM introduced the hierarchical mode to connect or relate independent flat files. Therefore, an application could easily share the customer information with the loan information.

While may be comfortable with the concept of a record or table, the hierarchical data base model uses the terminology of a **hierarchical node**, which is conceptually similar to a record or table. Just as a record or table has fields or columns, so does a hierarchical node have fields or columns, e.g., BRANCHID, BRANCHNAME, etc.

### 2.1.3 Sample IMS Physical Database Definition code

The BANK Physical Database (PDBs ) would be defined similar to the following IMS code:



The above Physical Database provides the full description of the tree. Each record type in the database is called a segment, e.g., BRANCH, TELLER, CUSTOMER, etc. In the early days, a hierarchical database the database was simply a modified sequential data file (HSAM) that could store various records or segments of different types.

The original physical IMS hierarchical database combined the five previously independent record types, into one related storage structure. The selection root record, e.g., BRANCH was originally very important since all lower level nodes was originally accessed through the root node. For example, a customer could not look up their personal information or loans without knowing their BRANCH NAME. This made sense in a day that all banking transactions were processes at the local branch, and batch sequential transaction processing and sorting were the dominant technologies. Over time, hierarchical databases had to adapt to modern online transaction processing technology requirements.

Each IMS Database contain multiple segments types. A segment type is simply a user defined category of data, and each segment contains fields. To make it easier to understand a segment type is a record layout. The record layout or segment type can have multiple fields. Each segment contains data for ONE branch, CUSTOMER, as so forth

Each segment had only one-parent segment, which was defined by the PARENT= clause.

Each segment had one field, which was defined the hierarchical sequence key, i.e., SEQ modifier and U means unique.

### 2.1.4 Hierarchical Sequence Key versus Primary Keys

The original IMS databases did not uniquely identify a segment by a primary key. Rather, a segment was identified by a hierarchical sequence keys, which represented the path to the segment from the database root node to the specific subordinate node. For example, assume that the BRANCHID was104, the CUSTOMREID was 20555, and the ACCOUNTID was 102-345. The Hierarchical Sequence Key, or the path to this account record was 104 2055 102-345. Hierarchical sequence keys provided great performance for batch processing.

### 2.1.5 IMS Secondary Keys

While the original hierarchical database storage system stored data contiguously, pointers were eventually used to store data in a noncontiguous fashion. The original hierarchical database provided excellent performance for batch processing, but provided terrible performance for online, real time applications.As OLTP became a dominate technology, IMS provided an indexed-like structure called a secondary key, to directly lookup any subordinate segment, without the requirement to transverse (follow) the path from the root segment.

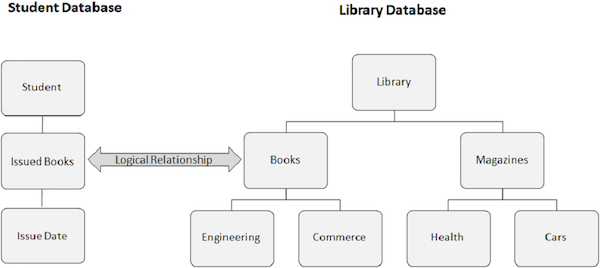
The field in the index source segment over which the secondary index is built is called as the secondary key. Any field can be used as a secondary key. It need not be the segments sequence field. IMS secondary keys can be any combination of single fields within the index source segment. IMS secondary key values do not have to be unique.

### 2.1.6 IMS Logical databases

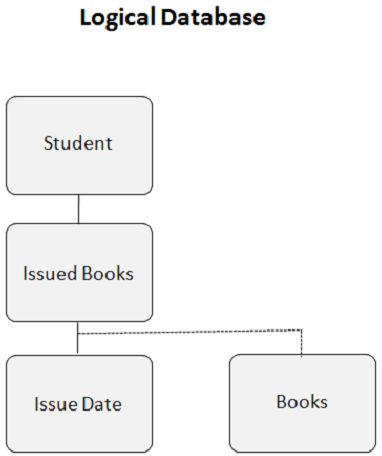
Eventually, database design concepts encouraged hierarchical databases to be separated into multiple physical databases, e.g., BRANCH and CUSTOMER, instead of one large multi-record database, e.g., BANK. A Logical Database could then be defined to share data between segments of two or more physical databases through the use of inter-database pointers.

IMS database has a rule that each segment type can have only one parent. This limits the complexity of the physical database. Many DL/I applications require a complex structure that allows a segment to have two parent segment types. To overcome this limitation, DL/I allows the DBA to implement logical relationships in which a segment can have both physical and logical parents. We can create additional relationships within one physical database. The new data structure after implementing the logical relationship is known as the Logical Database.

The following image shows two different physical databases. One is a Student database, and the other is a Library database. We create a logical relationship between the Books Issued segment from the Student database and the Books segment from the Library database.



This is how the logical database looks when you create a logical relationship:



### 2.5.7 DLI

Data Language Interface (Data Language/I, DL/I, Data Language/Interface, Data Language/One is the language system used to access IBM’s IMS databases, and its data communication system.

Originally, Programmers embedded DL1 commands into a host program, e.g., a COBOL program. Within the program, each user's view of the database (external schema) is defined in a Program Communication Block PSB). Today, SQL commands may be used to access an IMS database through a previously defined PCB.

### 2.5.8 Questions – Introduction to IMS

3. Describe the concept of a parent/child relationship? Answer =>

The earliest model was the hierarchical database model, resembling a upside-down tree. In hierarchical model, files are related in a parent-child manner,with each parent capable of relating to more than one child,but each child only being related to one parent. For example one company branch has many employees.

4. How many parent entities can a child entity have in a hierarchical model? Answer =>

In a hierarchical model, a child entity can have only one parent entity.

5. How does a hierarchical node conceptually related to flat files? Answer =>

6. What is an IMS Segment? Answer =>

As IMS database is a hierarchical database, information is structured in records that are subsided into a hierarchy of related segments.

7. What is an IMS Root Segment? Answer =>

The segment that lies at the top of the hierarchy is called the root segment.

8. How is an IMS parent segment identified in a child segment Answer =>

9. How is an IMS parent segment identified in a child segment Answer =>

In a IMS database model parent segment identify child segment through hierarchical sequence key.

10. Explain the concept of a hierarchical sequence key as a unique segment identifier. Answer =>

As original databases did not uniquely identify a segment by a primary key, a segment was identified by a hierarchical sequence key which represented the path to the segment from the database root node to the specific subordinate node.

It works great for batch processing.

11. Explain the use of an IMS Secondary Key to improve OLTP processing. Answer =>

Although original hierarchical database provided excellent performance for batch processing, but the performance in online or real time application was very poor. That is why IMS provided an indexed-like structure called a secondary key, which is help to lookup directly lookup any subordinate segment, without the requirement to transverse the path from the root segment.

12. Explain the use of an IMS Logical database, or relationship, to improved OLTP processing. Answer =>

To avoid the problems of files and indexes, IMS considered a hierarchical database its pointers are used to establish the data relationships. Logical database in IMS is relationship path between two segments which are related logically. In OLTP lesser number of indexes and clusters are necessary, logical database usually provide fewer number of tables.

13. Explain the difference between an IMS Secondary key and an IMS Logical database. Answer =>

IMS secondary key is a indexed-like structure and the target segment is accessed through secondary index. logical database works like relationship , records can be one way or two way which create a virtual structure of records.

14. What is IMS DLI? What is the function of IMS DLI? Answer =>

IMS DLI ia a language system used to access IMS database, and its data communication system. Basic function of DLI is to interact with IMS DB database and its segments.

### **2.5.9Questions - Advantages and disadvantages of the Hierarchical Model**

Advantages and disadvantages of the Hierarchical Model - https://www.ukessays.com/essays/information-technology/hierarchical-data-model.php

15. Using the following table list five or more advantages and disadvantages of the Hierarchical Data Model (Hierarchical Database Schema) and IMS.

|  |  |
| --- | --- |
| **Hierarchical Database Schemas and IMS** | |
| **Advantages** | **Disadvantages** |
| In a hierarchical structure, members know to whom they report and whom reports to them. They tend to know who pose and not poses for the authority to access data | Hierarchical structure tends to adopt slowly the changing needs. This creates so much problem with many organization. |
| Hierarchical database offers clear path of advancement. Like moving from one company to another to take a better position in a similarly structured organisation | As hierarchical organizational structure tend to cahnnel communication vertically, interdepartmental or inter-agency communication suffers |
| Using a hierarchical structure establishes clear authority for work and departments. | Although it is easy to design, but very complex to implement |
| Hierarchical structure creates clear lines of communication. | There is a lack of structural independence because when we change the structure then it becomes to change the application too. |
| Hierarchical structure divides specialization areas into various department configuration. | Hierarchical model suffers from the insert, delete update anomalies, also retrival operation is difficult. |

## 2.2 Network Model

Network Model - <http://en.wikipedia.org/wiki/Network_model_(database)>

IDMS – <http://en.wikipedia.org/wiki/IDMS>

CODASYL - <http://en.wikipedia.org/wiki/CODASYL>

Data Base Task Group - https://en.wikipedia.org/wiki/Data\_Base\_Task\_Group

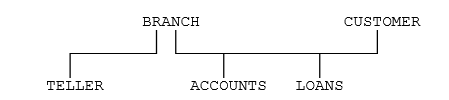
### 2.2.1 Sample Network Model Design

The Network database model provided greater flexibility in database design and the first really conceptually independent database. The Definition of a network database or physical schema starts with two majors sections: Records and Sets.

The record area define records and fields in a similar fashion to COBOL. The LOCATION MODE is CALC is one alternative to quickly lookup records by a hash key. A lookup hash key provides a very quick way to lookup individual records, even faster than VSAM KSDS data set, but not as fast as a VSAM RRDS data set.

The relationship between the records are defined in terms of OWNER-MEMBER Coupled SETS. One-time information is stored in the OWNER or parent record. Repeating information could be stored as repeating fields in a Record or as a separate MEMBER record.

SETs are also used to provide order and alternative access (secondary keys) to records. The Network database provides excellent online, real time access to the database. Assuming the record ACCOUNTS needed to be either accessed through the BRANCH or the CUSTOMER record, the physical design would be similar to the following:



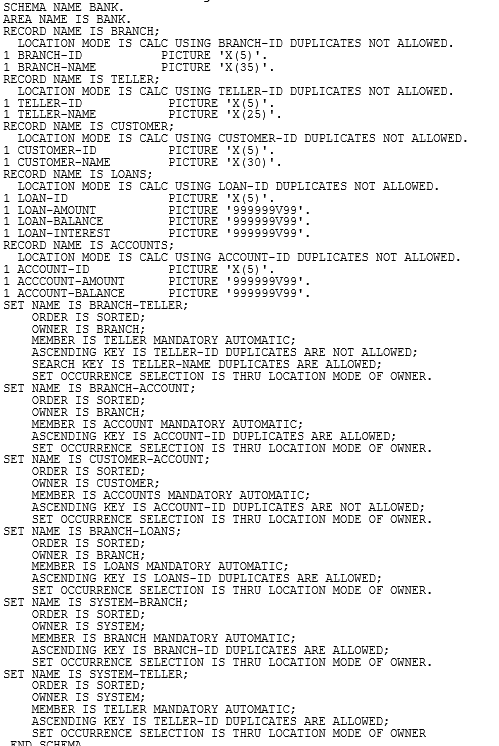
The set member key words **MANADATORY** or OPTIONAL provide a mechanism to enforce referential integrity between the MEMBER and set's OWNER record.

The set key word **SEARCH KEY**provides and alternate lookup up similar to a secondary key or index. However, a CODASYL SEARCG key does not provide dynamic ordering of record by the key values

The set key work **ASCENDING KEY** or DESCENDING KEY does provide for dynamic ordering of records. However, member records may only be ordered within the owner record. For example, a BRANCH-TELLER ASCENDING KEY, will only order tellers within a specific branch. To order all teller records no matter which branch that they belong to, an **SYSTEM OWNER set**must be used.

Historically, a special CODASYL network database language called DML and DDL was created. Today, **SQL** is used in modern network database, such as CA IDMS.

### 2.2.2 Sample Network Model Schema Code



### 2.2.3 Question – Network Database Model

1. Describe the structure of network database model (schema). Answer =>

A network database model allows multiple records to be linked to the owner files. The model can be seen as upside down tree where the branches are the member information linked to the owner. This multiple linkages allow network model to be very flexible. The relationship in the network database model is defined as many-to-many relationship.

2. How many parent entities can a child entity have in a network database model? Answer =>

In a network database model, a child can have multiple parents, and maintains the many-to many relationship.

3. Describe or explain the use of the following network database model (schema) concepts using the following concepts.

|  |  |
| --- | --- |
| **Network Database Model Concept** | **Description or Use** |
| **CODASYL** | Acronym for ‘Conference/Committee on Data System Language’. This is an association of some people or organization to guide the developing of standard programming language. Its two activities are- the development of COBOL language and the activities in standardizing database interfaces. |
| **CA IDMS** | Integrated database management system. It is a network model database management system for mainframe. |
| **SET** | Distinctive feature in Codasyl. This set represents one-to many relationship between records,one owner and many members. A network database model differs from the hierarchical model by this SET factor that a record can be a member in many different sets. |
| **Data Dictionary** | Set of programs or rules to maintain database. |
| **Owner/Member** | Multiple member record or files can be connected with multiple owner or multiple owner can be connected with multiple members. |
| **System-owned set** | It is a set with no owner record type,instead system is the owner. It servers two main purposes- provides entry points into the database via the records of the specified record type and can be used to order the records o a given records type. |

### **2.2.4Questions - Advantages and disadvantages of the Network Model**

Advantages and disadvantages of the Network Model - <https://www.ukessays.com/essays/information-technology/hierarchical-data-model.php>

4. Using the following table list five or more advantages and disadvantages of the Hierarchical Data Model (Hierarchical Database Schema) and IMS.

|  |  |
| --- | --- |
| **Network Model Database Schemas and IDMS** | |
| **Advantages** | **Disadvantages** |
| Network database model is conceptually simple and easy to design. | All the records are maintained using pointers and hence the whole database structure becomes very complex. |
| This model can handle different kinds of relationships like one-to many or many-to-many relationships. | The insertion, deletion and updating operations of any record require large numbers of pointers adjustments. |
| Data access is easier and flexible. | Any changes to the structure become very difficult. |
| Does not allow a member without its owner. | It is very difficult for the first time users. |
| This model can isolate the program from complex physical storage details. | It can create difficulties with alterations of the database because when information entered can alter the entire database. |

# 2.3 Relational Model

**Review the Introduction to DB2 handout**

<http://en.wikipedia.org/wiki/Relational_model>

<http://en.wikipedia.org/wiki/Relational_database>

<http://www.databasejournal.com/sqletc/article.php/1469521/Introduction-to-Relational-Databases.htm>

<http://www.buzzle.com/articles/advantages-of-relational-databases.html>

<http://www.ehow.com/list_5977286_disadvantages-relational-database.html>

<http://en.wikipedia.org/wiki/IBM_DB2>

<http://en.wikipedia.org/wiki/MySQL>

<http://en.wikipedia.org/wiki/Oracle_Database>

<http://en.wikipedia.org/wiki/Table_(database)>

<http://en.wikipedia.org/wiki/Foreign_key>

<http://en.wikipedia.org/wiki/Index_(database)>

<http://wiki.answers.com/Q/What_is_the_difference_between_tuple_and_attribute>

### 2.3.1 Introduction to the Relational Model

A relation is a two-dimensional table. Each relation is comparable to the description of an object or entity. Each row or tuple generally contains information concerning one person, thing or event, i.e., an instance of an object. An N-tuple relation is a relation that simply contains any number of records. The columns or fields are called attributes. Using the previous bank example, the physical design would be similar to the following:

Relation or Base Table Inverted Index

BRANCH BRANCH\_ID\_INDEX

CUSTOMER CUSTOMER\_ID\_INDEX

TELLER TELLER\_ID\_INDEX

ACCOUNTS ACCOUNTS\_ID\_INDEX

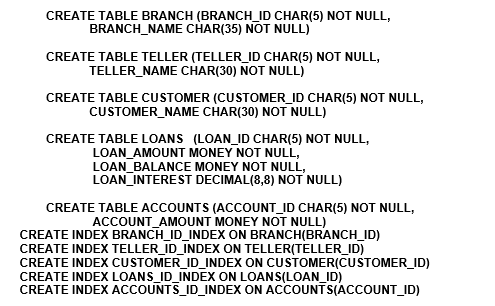
LOANS LOANS\_ID\_INDEX

Each relation or base table uses a simple independent stack data structure. Order and access is provided through a separate data structure called an INDEX. Interfile relationships are maintained through logical access to records via key fields or through the use of a VIEW. Unlike the other database physical schemas, relational databases can be easily changed, thereby making the data base more responsive to the information needs of management while keeping database administrative costs down.

The performance and storage space requirements of relational databases are as compared to the other storage databases is not as favorable. Relational databases cannot perform batch processing tasks as efficient as a hierarchical database, but does provide better perform for online applications. Relational databases cannot perform online processing requirements as efficient as a network database, but provides a greater degree of storage and conceptual independence and a wider variety of front end access tools.

A relational model design may have many parents associated with many children, by a many-to-many relationship must be physically limited to one-to-many relationships

### 2.3.2 A Sample Relational Schema



1. Describe the structure of relational database model (schema). Answer =>

Description of relational database is mathematical relation between tables and rows. It has attribute and domain. Attribute is a named column of a relation and a domain is the set of allowable values for one or more attributes.

2. How many parent entities can a child entity have in a relational database model (relational database schema)? Answer =>

In relational database the foreign key becomes the child of a parent. A child table references a parent with a foreign key. Foreign key has only a primary key.

### **2.3.3Questions - Advantages and disadvantages of the Relational Model**

Advantages and disadvantages of the Relational Model - https://www.ukessays.com/essays/information-technology/hierarchical-data-model.php

3. Using the following table list five or more advantages and disadvantages of the Hierarchical Data Model (Hierarchical Database Schema) and IMS.

|  |  |
| --- | --- |
| **Relational Database Schemas and DB2** | |
| **Advantages** | **Disadvantages** |
| Complex queries can be carried out by a programming language called SQL | If the number of tables between which relationships to be established are large and the tables themselves effect the performance in responding to SQL queries |
| By splitting data into tables, certain tables can be made confidential. | RDMS resides in multiple tables which sometimes create unnecessary complexity. |
| By having data held in separate tables, it is simple to add records that are not yet needed but may be in the future. | In relational database, if a table lacks a unique key, the database may return inaccurate result. |
| The revision of any information as tables consisting of rows and colomns is much easier to understand | Complexity of relational database required skill set by database administrator.if a developer did not understand the hidden intricacies it can lead to a broken queries or inaccurate report. |
| Different tables from which information has to be linked and extracted can be easily manipulated by operators. | As relational database is much more complex, it reqires sophisticated performance power. |

### **2.2.4Questions - Advantages and disadvantages of the Relational Model**

4. Describe or explain the use of the following relational database model (schema) concepts using the following table.

|  |  |
| --- | --- |
| **Relational Database Model Concept** | **Description or Use** |
| **Table** | A table has rows and columns, where rows represents records and table represents the attributes. |
| **Index** | An index enables user to provide quicker access for data. Indexes can be created with any combination of attributes of relation. |
| **Foreign Key** | Foreign key is a field in a relational database which matches the primary key of another table. |
| **Primary Key** | Primary key uniquely specifies a tuple or a record within a table. A perfect example of primary is that it must not be repeated. |
| **DB2** | DB2 is relational database management system originally introduced by IBM in 1983 to run on its MVS ( Multiple Virtual Storage) |
| **SQL** | Standard query language used in programming and designed for managing data in relational database management system. SQL is used to query, insert, update and modify. |
| **E.F. Codd** | E F Codd, computer scientist, has invented relational model for database management. |
| **Join** | Join combines two or more tables by using values common to each in a relational database. |

<http://en.wikipedia.org/wiki/Table_(database)>

5. What is the difference between a Table and a Relation? Answer =>

In a table each column attributes are independent. In a table row order and column order are mandatory and that can not be changed,table can be more than two directions. There may be rows and columns duplication in the table. In a Relation, in which all attributes are dependent in one or other way. Relation is always two dimensional. There cannot be any duplication of rows and columns.

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***Please review the Introduction to Database Management Systems Handout.***

6. Why should a relation row be unique? Answer =>

This property ensures that no two rows in a relational table are identical, there at least one column or set of columns the values of which uniquely identify each row. Every row in a database table is meaning ful and that a specific row can be identified by specifying the primary key value.

7. The order that can be requested by a SQL statement should always be a logical order and never a physical order, e.g., always use the ORDER BY clause. There are many reasons why two subsequent unordered retrieval requests may result in different row sequences, or two different results. List several reasons why would the retrieval in a different order? Answer =>

The order of rows returned from a statement is completely artibitrary because there are lots of sorting algorithm to retrieve data. So user does not specify in which the data should be sorted , resulting statement will always be different.

This will also vary depending on the query plan chosen by the optimizer.

8. A relational table seldom has meaning by itself. A relational database normally consists of multiple tables which are logically interconnected to provide meaningful information. Answer =>

### 2.2.5 Questions - Conceptual, Storage and Logical Views.

9. During relational database design for a particular application domain, a designer views the problem statement from three different points of view. Describe the concepts of Conceptual, Storage and Logical Views.

|  |  |
| --- | --- |
| **Type of View** | **Description** |
| **Conceptual View** | One of three ways to model data in a domain. This is the level in database architecture which contains the definition of all the data to be stored in the database and also contains about the structure and type of that data. |
| **Storage View** | This view structures the data and file organization which is used to store data on storage devices. |
| **Logical View** | Contains the logical structure of the database seen by DBA. |

10. The use of SQL to create databases and tables would be most appropriate to which view? Answer =>

The use of SQL to create databases and tables would be appropriate in Conceptual view.

11. Consideration of the application domain would be most appropriate to which view, i.e.Conceptual, Storage and Logical Views? Answer =>

Application domain would be most appropriate in logical views

### 2.2.6 Questions - Type of Table Relationships

An optional relationship exists for a table when there is no requirement for any records to exist in that table before any records can be added to the associated table.

Consider the following example,

A customer may place many orders; every order is placed by a customer.

According to this rule, a customer may place many orders, or place just one order, or never place an order at all (potential customers are often found in databases, as are potential suppliers).

All three possibilities are options for actual customers who exist in the Customers table. Put simply, it is not necessary for any records to exist in the Orders table before customers can be entered into the Customers table.

Reverting again to the language of entities, the type of participation for the ORDER entity in the CUSTOMER:ORDER relationship is designated as optional.

The optional entity is termed a weak entity.

To understand how important it is to know that CUSTOMER is a mandatory entity and ORDER is a weak entity, consider once more the general rule for 1:N relationships:

A one-to-many (1:N) relationship exists when, for one instance of entity A, there exists zero, one, or many instances of entity B; but for one instance of entity B, there exists zero or one instance of entity A.

Now plug in the entities from the CUSTOMER:ORDER relationship, again focusing on the italicized portion:

A 1:N relationship exists when, for one instance of CUSTOMER, there exists zero, one, or many instances of ORDER; but for one instance of ORDER, there exists zero or one instance of CUSTOMER.

To accommodate the weak entity ORDER, the “zero” must be removed from the italicized portion; it is mandatory that one instance of CUSTOMER exist.

That is why CUSTOMER has mandatory participation.

12. There are three types of business and data base design relationships. Using the following table list each and provide a real life example.

|  |  |
| --- | --- |
| **Business and Database Relationships** | **Real Life Example of Each Relationship** |
| 1:1 | Each country have only one flag and each flags belong to only one country. |
| 1:N | Some one have many works of art. In this case, each work of art can only be in one museum at a time, but a museum can have many work of arts. |
| N:M | Each book can be written by many authors and a author can write many books. |

13. What is a mandatory relationship? Provide a real-world example. Answer =>

In 1:1 relationship, if one entity has optional participation and the other has mandatory participation, the weak entity receives the key attribute from the mandatory to establish link. Mandatory relationships can be of three types like – mandatory at both ends, mandatory at one end and optional at the other, optional at both ends.

a. two entities are EMPLOYEE and CONTRACT, each employee must have one contract and each contract must have one employee associated with it.

b. Two entities are player and team. One player may captain one team and each team must have one captain. However there are other player who are not the captain of the team. So mandatory in one direction and optional to the other.

c.one employee may lease one can car and one car may be leased by one employee. There are also employee who do not lease cars and cars that are not allocated to any employee. Optional from both directions.

14. What is a cascading relationship? Provide a real-world example. Answer =>

Cascading behavior of a relationship defines when parent record is shared, re-assigned, re-parented, deleted or merged with another record. Example, if an account is assigned to a new user, all relaed leads, cases, opportunities, activities also get assigned to a new user.

### 2.2.7 Questions - Entity, Referential and Domain Integrity

Data Integrity - <http://en.wikipedia.org/wiki/Data_integrity>

15. What is meant by database integrity? Answer =>

Data integrity is the completeness, accuracy and consistence of data. Data integrity usually imposed during the database design phase through the standard procedures and rules.

Referential Integrity: Best Practices for IBM DB2 - http://www.databasejournal.com/features/db2/article.php/3870031/Referential-Integrity-Best-Practices-for-IBM-DB2.htm

16. Describe/define the following types of database integrity and give a practical example using the following table.

|  |  |  |
| --- | --- | --- |
| **Type of Integrity** | **Definition** | **Your Practical Example** |
| **Entity Integrity** | It is concerned with ensuring that each row of a table has a unique and non-null primary key. Primary key value is used to identify individual rows in table. | In the car rental database in the car table, each car must have a proper and unique reg\_no. |
| **Referential Integrity** | It is used to maintain the consistency among rows between the tables. | Using the same example, you cant delete any rows in the car type table since all car type are in use in the car table. You can change the model\_ids in the car type table. If you want to enter the value in car type table, that must be in the model\_id field in the CarType table. The model\_id field in the car table can have a null value which means that car Type of that car is not known. |
| **Domain Integrity** | Definition of a valid set of values for an attribute. | A domain of date is the set of all possible valid dates, a domain of integer is all possible integer. |

17. There are two different methods of enforcing Referential Integrity. i.e., Database Management System - Enforced (Constraint clauses) and Application-enforced (SQL triggers). Describe the use of each Answer =>

Pupose of referential integrity is to prevent orphan and keep references in sync. Once this enforced, access rejects any operation that violates referential integrity for that table relationship. Application trigger is can be used by DBMS to restrict some application to write bad data. They are specially useful for business policies.

18. In a transaction processing system there are two ways of enforcing data integrity? Please specify each way and give an example of each. Answer =>

Two ways of enforce data integrity is atomicity which means whether entire transaction will happen at once or doesn’t happen at all. Money transfer from two accounts. Another data integrity is consistency.for example there will be no change of any data in account before and after transaction.

### 2.2.8 Questions - Concurrency

19. What is meant by database integrity or concurrency? Answer =>

Database concurrency is accessing the same information by multiple users at the same time. Modern relational database systems potentially allow hundreds of simultaneous connections to the data.

20. When using a multi-user database how is database integrity or concurrency implemented? Answer =>

Database integrity implemented through creating some access control of some users. There are lots of records and data in the database, it is not always right to give access to every file. By implementing read only or write only or update only option, database integrity can be maintained.

21. When using a multi-user database how is database deadlock prevented? Answer =>

One method of deadlock prevention is Wait-Die Scheme, in this method if a transaction request for a resource which is already locked by other transaction, then the DBMS checks for the timestamp for of both the transaction and allows the older transaction to wait until the resource is available for execution. Another one is Wound-Wait scheme. In this method if an older transaction requests for a resource held by younger transaction then the older transaction forces younger transaction to kill the transaction and release the resource.

### 2.2.9 Questions - Types of Database Keys

<http://en.wikipedia.org/wiki/Candidate_key>

<http://databases.about.com/od/specificproducts/a/keys.htm>

Unique Key - <http://en.wikipedia.org/wiki/Unique_key>

Surrogate Keys - <http://en.wikipedia.org/wiki/Surrogate_key>

Natural keys - <http://en.wikipedia.org/wiki/Natural_key>

Choosing a Primary Key: Natural or Surrogate? -http://www.agiledata.org/essays/keys.html

Video - Introduction to Logical Data Modeling - http://www.youtube.com/watch?v=IiVq8M5DBkk&feature=channel&list=UL

Video - Candidate Key - http://www.youtube.com/watch?v=BGMwuOtRfqU&feature=relmfu

22. Describe each type of key and provide a practical example

|  |  |  |
| --- | --- | --- |
| **Keys** | **Definition** | **Your Practical Example** |
| **Primary Key** | Primary key uniquely identifies each record in a table and must never be same for the 2 records. | Driver license number, social security number |
| **Unique Key** | Set of one or more fields/columns of a table that uniquely identify a record in database table |  |
| **Surrogate Key** | Surrogate key is a unique identifier used in a databases for an modeled entity or an object. It is the only unique key whose only significance is to act as primary identifier of an object or entity. |  |
| **Candidate Key** | A candidate key is a columns or set of columns in a table than can uniquely identify any database record without referring to other data. |  |
| **Natural Key** | A natural key is a key which is made up of columns having a logical relationship within a table with other columns | Example suppose a table named as People, when we use the columns as Address, first\_name, last\_name together to form a key, then this will be a natural key as those columns are something that are completely natural to people and there is also logical relationship among all the columns |
| **Composite** | A composite key is a combination of two or more columns in a table that can be used to uniquely identify each row in the table. | You have database holding CD collection, one of the entities is called tracks which hold details of the tracks on a CD. This has composite key of CD name and track number. |
| **Foreign Key** | A foreign key is group of columns that provides a link between two columns. Acts as a cross reference between table. | In a Employee table, employee ID is a primary key, another table employee details has a foreign key which references employee id in order to uniquely identify the relationship between two. |
| **Smart keys** |  |  |

23. Compare the difference between a Unique Key and a Primary Key. Answer =>

Primary key can not accept null values whether unique key can accept only one null value. We can have only one primary key in a table but we can have more than one unique key in a table.

24. Compare the difference between a Candidate Key and a Primary Key. Answer =>

Candidates key are the combination of attributes which can be uniquely defined in a table/relation. There can be more than one candidate key possible. Among those candidate key , any one of the keys can be chosen to be the primary key.

### 2.2.10 Questions - Normalization and De-normalization

http://www.dbnormalization.com/database-anomalies

http://www.blurtit.com/q181903.html

<http://en.wikipedia.org/wiki/Index_%28database%29>

<http://www.websitedatabases.com/database-index.html>

25. Why are transactional databases normalized? Please give a practical example in your answer. Answer =>

Database normalization is the process of organizing data into tables in such a way that the using the database are always unambiguous.

Normalization is necessary for data integrity, controlled data manipulation and performance of database.

26. Explain the concept of database anomalies? Please give a practical example in your answer. Answer =>

Database anomaly is normally the flaw in databases which occurs because of the poor planning and normalization in database and storing everything in a flat database. There are three kind of anomalies like update , deletion and insertion anomalies. An update anomaly is a data inconsistency that result from data redundancy and a partial update. A deletion anomaly is an unintended loss of data due to the deletion of other data. Insertion anomaly is the inability to add data in the database due to the absence of another data.

Advantages and Disadvantages of Database Normalization? - <http://sql-databases.blurtit.com/q362724.html>

Database normalization - <http://en.wikipedia.org/wiki/Database_normalization>

De-normalization - http://en.wikipedia.org/wiki/Denormalization

Databases: Normalization or De-normalization. Which is the better technique? - <http://www.ovaistariq.net/199/databases-normalization-or-denormalization-which-is-the-better-technique/>

**Video - Normalization - http://www.youtube.com/watch?v=ZiB-BKCzS\_I&feature=relmfu**

**Video - Normalization Example - http://www.youtube.com/watch?v=pJ47btpjAhA&feature=relmfu**

**Video - Normalization 1st Normal Form - http://www.youtube.com/watch?v=q3Wg2fZENK0&feature=relmfu'**

**Video - Normalization - 2nd Normal Form - http://www.youtube.com/watch?v=vji0pfliHZI&feature=relmfu**

**Video - 3rd Normal Form - http://www.youtube.com/watch?v=HH-QR7t-kMo&feature=relmfu**

27. List and describe the advantages and disadvantages of normalized database design using the following table.

|  |  |
| --- | --- |
| **Advantages of Normalized Database Design** | **Disadvantages of Normalized Database Design** |
| **Normalization produces smaller tables and smaller rows.** | A highly normalized database with many tables and joins between the tables is much slower than a database without those attribute. |
| **Searching sorting creating indexes is faster, since tables are narrower and more rows fit in a data page.** | As normalization of database is much more complex task, it requires detailed analysis and design. |
| **As you have more clustered indexes, you will get more flexibilities in tuning queries.** | Joins are required because indexing doesnot work efficiently. This makes read time slower because the joins typically not work well with indexing. |
| **More tables allow better use of segments to control physical statement of data.** | Query making becomes more difficult because is consists of an SQL that is constructed dynamically. |
| **Database becomes more compact, as null values becomes fewer and less redundant data.** | As the process of normalization progresses, the database becomes slower. |

28. List and describe the advantages and disadvantages of de-normalized database designs.

|  |  |
| --- | --- |
| **Advantages of De-normalized Database Design** | **Disadvantages of De-normalized Database Design** |
| **It minimizes the need for joins.** | De normalization creates data duplication, so it specifies the disk space. |
| **In some cases it reduces the number of tables.** | De normalization creates data anomalies. |
| **It helps to speed up if we want to make any report from live data.** | De normalization needs to document properly. If we want to modify database we have to take all of these into consideration. |
| **We can have some values ready computed so we don’t have to generate them in real time.** | By doing de normalization, it is expected to slow down some other operation like insert modification deletion. |
| **It helps maintain history in database table.** | As de normalization is always application specific, it needs to be evaluated if the application changes. |

29. Why are some databases de-normalized? Answer =>

The reason behind de normalization is to decrease the running time of some select queries by making data more accesseible and by generating summarized reports in separate tables.

### 2.2.11 Questions - NoSQL

NoSQL - <http://en.wikipedia.org/wiki/NoSQL>

NoSQL: An Overview of NoSQL Databases - http://newtech.about.com/od/databasemanagement/a/Nosql.htm

10 things you should know about NoSQL databases - <http://www.techrepublic.com/blog/10things/10-things-you-should-know-about-nosql-databases/1772>

Cassnadra - <http://newtech.about.com/gi/o.htm?zi=1/XJ&zTi=1&sdn=newtech&cdn=b2b&tm=56&gps=98_9_1440_783&f=10&tt=2&bt=1&bts=1&zu=http%3A//cassandra.apache.org/>

Video - NoSQL Tutorial for Beginners - <https://www.youtube.com/watch?v=yflmkAUcXT4>

Video - NoSQL vs SQL: a Database Tutorial - Differences and advantages of NoSQL and SQL - https://www.youtube.com/watch?v=Jt\_w2swkXAk

30. What is a NoSQL Database? Does this mean that SQL data access is not supported? Answer =>

NoSQL is non relational database. It is optimized for scalable performance schemeless data models. It is also widely recognized for their ease for deployment, low latency, and resilience.

31. List and describe the advantages and disadvantages of a NoSQL databases.

|  |  |
| --- | --- |
| **Advantages of No SQL Databases** | **Disadvantages of NoSQL Databases** |
| **Databse able to handle large volumes of structured semi structed and unstructured data** | Security issue is most important drawback with NoSQL database. |
| **Object oriented programming that is easy to use and flexible.** | Most NoSQL database lack in performing ACID transaction |
| **Efficient architecture rather expensive monolithic architecture.** | The design and query language of NoSQL database vary widely between different NoSQL products. |

### 2.11.12 Questions - Codd's Rules

Normalization of Database - <http://www.studytonight.com/dbms/database-normalization.php>

Codd's Rule - http://www.studytonight.com/dbms/codd-rule  
Database Normal Forms - <http://www.phlonx.com/resources/nf3/>

Database Normalization Basics - <http://databases.about.com/od/specificproducts/a/normalization.htm>

32. List and describe each of the Codd's Normal forms and provide a practical example of each?

|  |  |  |
| --- | --- | --- |
| **Normal Forms** | **Definition** | **Your Practical Example** |
| **First Normal Form** | It should only have single valued attributes or columns. Values stored in attributes should be in the same domain.all columns in the table should have unique name. | Two tables like product\_id and product\_color. One table describes product price with ID and another one describes product color with ID. |
| **Second Normal Form** | It should be in 1NF and should not have partial dependency. | Two tables.table\_purchase and table\_store. Table\_purchase have two columns like customer id and store id and 2nd table have store id and purchase location. Table TABLE\_STORE is fully dependent on the column Purchase\_location. |
| **Third Normal Form** | It is in the 2nd normal form and doesn’t have transitive dependency. | Like two tables(TABLE\_BOOK and TABLE\_GENRE) 1st one has three columns(Book ID, Genre ID,Price),2nd table has two columns (Genre ID Genre TYPE). In Table\_Book, Genre ID and Price are only dependent on BOOK id. In Table\_Genre, genre type is only dependent on Genre ID. |
| **Boyce-Codd Normal Form** | Higher version of 3NF and deals with certain type of anomaly that is not handled by 3NF |  |
| **Fourth Normal Form** | Should be in the Boyce-Codd Normal Form and it doesn’t have multi valued dependency. |  |

# 4.0 Introduction to Oracle Database Conceptsand Middleware

Oracle database -<http://en.wikipedia.org/wiki/Oracle_Database>

What Is an Oracle Instance? - <http://dba.fyicenter.com/faq/oracle/What-Is-Oracle-Instance.html>

Oracle versus Database Instances - <https://asktom.oracle.com/pls/apex/f?p=100:11:0::::P11_QUESTION_ID:1631683800346891854>

Database Instance- <http://databases.about.com/od/administration/g/instance.htm>

What does Database Object mean? - http://www.techopedia.com/definition/24081/database-object

Table Space- <http://en.wikipedia.org/wiki/Tablespace>

Tablespaces (Oracle) <http://www.adp-gmbh.ch/ora/concepts/tablespaces.html>

What's in an Oracle Schema? - http://www.databasejournal.com/features/oracle/article.php/3804451/What146s-in-an-Oracle-Schema.htm

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Database Views - <http://www.zuggsoft.com/zmud/help6/Data0170.htm>

What is a database view and why should the business analyst understand it? - <http://www.modernanalyst.com/Careers/InterviewQuestions/tabid/128/Default.aspx?ArticleType=ArticleView&ArticleID=1558>

SQL technique: views and indexes - <http://www.tomjewett.com/dbdesign/dbdesign.php?page=views.php>

DATABASE TRIGGERS - <http://srikanthtechnologies.com/books/orabook/ch20.pdf>

Introduction to SQL Triggers - <http://www.mysqltutorial.org/sql-triggers.aspx>

**Video - Introduction to Oracle Database Administration - Oracle -** [**http://www.youtube.com/watch?v=14y6mveAiCw&feature=relmfu**](http://www.youtube.com/watch?v=14y6mveAiCw&feature=relmfu)

**Video - Oracle Database and Instance - http://www.youtube.com/watch?v=W5vILcBNn\_8&feature=relmfu**

**Video - Oracle - Tablespaces - http://www.youtube.com/watch?v=F80USb01xDE&feature=relmfu**

**Video - Oracle Tables -** [**http://www.youtube.com/watch?v=sBdGHfqE8sc&feature=BFa&list=ULCS389MCbmfs**](http://www.youtube.com/watch?v=sBdGHfqE8sc&feature=BFa&list=ULCS389MCbmfs)

**Video - Oracle Extents and Segments - http://www.youtube.com/watch?v=ihVMkvT0VTg&feature=relmfu**

**Video - Oracle Blocks -** [**http://www.youtube.com/watch?v=CPCGU\_6JyFU&feature=relmfu**](http://www.youtube.com/watch?v=CPCGU_6JyFU&feature=relmfu)

**Video - Oracle SQL Tutorial - Creating a view - http://www.youtube.com/watch?v=3oi9bW\_zBds&feature=channel&list=UL**

**Video- QL Tutorial - Creating an Index - http://www.youtube.com/watch?v=ttE4a6hADgI&feature=fvwrel**

V13 - Oracle SQL Tutorial - Creating a sequence - http://www.youtube.com/watch?v=wGN38JN4xiA&feature=channel&list=UL

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## 4.1 Questions – Oracle Concepts

1. Define and describe the function of each concept as it applies to Oracle.

|  |  |
| --- | --- |
| **Oracle**  **Concepts** | **Define and describe the function** |
| **Instance** | Database instance is set of memory structure that manages database files. Every running oracle databse has one instance. Just because instance exists in memory and database exits on disk, both can exist without each other. |
| **Table Space** | Oracle database made of one or more logical units called tablespace. Database’s data collectively stored in database’s tablespace. |
| **Database** | Oracle database is a relational database management system from oracle corporation. It is a collection of data treated as unit. |
| **Database Objects** | Database object is used to store and reference data. |
| **Table** | Table is a set of data elements, including vertical columns and horizontal rows. |
| **Extents and Segments** | An extent is a specific number of contigious data blocks allocated for storing a specific type of information. Segments is a set of extents. |
| **Columns** | Set of data values, one value from each row. |
| **Constraints** | Oracle constraints are most useful for scalability, flexibility and integrity of database data. Containts is enforcing some rules on the database. |
| **Schema (Logical)** | Schema is a set of all tables and other objects that make up the database for a given system. |
| **Catalog or Data Dictionary** | Data dictionary is the information about the database. Oracle dictionary is the repository of information of oracle database. |
| **Indexes** | An index is a schema object that contains an entry for each value that appears in the indexed column which provides direct and fast access to rows. |
| **Synonym** | prophecy |
| **View** | View is a named and confirmed SQL query which is store in the oracle data dictionary. It is just a stored query in the database. |
| **Triggers** | A trigger can include SQL and PL/SQL statements to execute as a unit and can invoke stored procedures. |
| **Control files** | Oracle control file is a small binary file that records the physical structure of the database. Control file contains the database name,Names and locations of associated datafiles and redo log files,the timestamp of database creation, the current log sequence number, checkpoint information. |
| **SGA** | SGA acronym stands for System Global Area. It forms the part of the system memory shared by all the processes belonging to the single oracle database instance. SGA includes all the information necessary for the instance operation |
| **PGA** | PGA stands for Program Global Area, it is a private memory region which includes the data and control information for a server process. PGA can be accesses only by a serve process. |
| **Client Processes** | A client program acting on behalf of the user,such as oracle enterprise manager. Client process has its own server process |
| **Oracle Processes** | Oracle database uses some additional process which is called background processes. These processes perform maintenance task which is required to operate the database and to give flexibility of multiple users. |
| **Buffer Cache** | Buffer cache is an important part in oracle. It provides storage for data blocks that have been retrived from data files. |

## 4.2 Questions – Indexes and Keys

7. List three advantages of using an Oracle index

|  |
| --- |
| **Purposes of Using DB2 Indexes** |
| Provide quick access to rows in the table. |
| Provide faster access to data for operation. |
| Indexes help to speed up queries. |
|  |

8. Explain the function of each of the following types of DB2 keys using the following table.

|  |  |
| --- | --- |
| **Types of Keys** | **Description** |
| **Primary** | It is a special type of unique key and can not contain null values. |
| **Unique** | Unique key ensures a constraint that the values of a key is valid only if they are unique. |
| **Foreign** | Foreign key is specified in the definition of a referential constraint. It is related to a parent key. |
| **Parent** | Parent key is either a primary key or a unique key in the parent table of a referential constraint. |

8. How may primary keys may be used for atable? Answer =>

A table can have no more than one primary key.

9. What is anOracle Schema? Answer =>

Oracle database contain logical and physical structure to process the data. Schema also contain logical structure to process the data in the database. When user is created, it has been created automatically by oracle. It contains all objects created by the user associated with that schema.

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10. Where does Oracle store information about the structure of tables, indexes and views? Answer =>

## 4.2 Questions - PL/SQL

PL/SQL Tutorial - https://www.tutorialspoint.com/plsql/

PL/SQL - <http://en.wikipedia.org/wiki/PL/SQL>

Beginners Guide to PL/SQL <http://www.plsql-tutorial.com/>

What is the difference between Oracle, SQL and PL/SQL?

<http://it.toolbox.com/blogs/oracle-guide/what-is-the-difference-between-oracle-sql-and-plsql-9602>

Advantages of PL/SQL - http://plsql-tutorial.com/plsql-advantages.htm

PL/SQL Advantages- http://www.way2tutorial.com/plsql/plsql\_advantages.php

Video- Oracle PL/SQL - Introduction - <http://www.youtube.com/watch?v=wUpvZRhb77Q&feature=relmfu>

Video - Oracle PL/SQL - Express Tour of PL/SQL - <http://www.youtube.com/watch?v=9BdkJdkK_po&feature=relmfu>

Video - Introduction to PL/SQL programming -

<http://www.youtube.com/watch?v=7lTV4POTkWY&feature=relmfu>

1. List five or more features of PL/SQL. Answer =>

PL/SQL is programming language developed by oracle.

PL/SQL is a high performance transaction processing language

It provides a built-in interpreted and OS independent programming environment.

It offers a variety of programming structure.

It supports object-orient programming.

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2. Explain the differences between PL/SQL and SQL? Answer =>

PL/SQL is a programming language used to write full programs using variables loops and operator etc. SQL is a single query language. PL/SQL can be considered as the application language similar to Java or PHP. SQL is a object orient language used to select and manipulate sets of data.

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3. List five or more advantages of PL/SQL. Answer =>

PL/SQL supports both static and dynamic SQL.

PL/SQL helps to reduce network traffic and provides high performance for the application by sending an entire block of statement to the database at one time.

It provides high security level.

It provides support for object-orient programming.

It also helps for developing web application and server pages.

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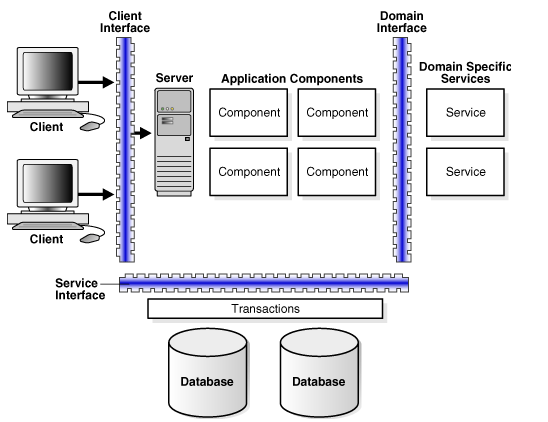
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# 5.0Middleware

Middleware is the software that connects software components or enterprise applications. Middleware is the software layer that lies between the operating system and the applications on each side of a distributed computer network. Middleware includes Web servers, application servers (CICS, J2EE, ASP.NET, PHP, etc.), database management systems, and similar tools that support application development and delivery. Middleware provides core services like concurrency, transactions, threading, messaging, and security and enables high availability. It is especially integral to information technology based on Extensible Markup Language (XML), Simple Object Access Protocol (SOAP), Web services, SOA, Web 2.0 infrastructure, and Lightweight Directory Access Protocol (LDAP) etc.

Middleware is the infrastructure which facilitates creation of business applications, and provides core services like concurrency, transactions, threading, messaging, and the SCA framework for service-oriented architecture (SOA) applications. It also provides security and enables high availability functionality to your enterprise.

Applications use intermediate software, called middleware that resides on top of the operating systems and communication protocols to hide the distributed nature of the application.



The Purpose of Client/Server Computing - <http://clientserverarch.blogspot.com/2013/03/introduction-to-clientserver-computing.html>

Advantages And Disadvantages of Client application server - <https://www.esds.co.in/blog/advantages-and-disadvantages-of-client-application-server/#sthash.qQAsNnJc.dpbs>

Client Server Architecture Advantages & Disadvantages - <https://www.techwalla.com/articles/client-server-architecture-advantages-disadvantages>

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ODBC- <http://en.wikipedia.org/wiki/Open_Database_Connectivity>

ODBC - <http://www.webopedia.com/term/o/odbc.html>

ODBC - <http://support.microsoft.com/kb/110093>

JDBC - <http://en.wikipedia.org/wiki/Java_Database_Connectivity>

JDBC- <http://www.webopedia.com/TERM/j/jdbc.html>

What is Middleware?-<http://www.computerworld.com/s/article/52066/Middleware>

Transaction Processing System,-<http://en.wikipedia.org/wiki/Transaction_Processing_System>

Oracle Develop Suite- <http://en.wikipedia.org/wiki/Oracle_Developer_Suite>

Oracle Fusion -<http://en.wikipedia.org/wiki/Oracle_Fusion_Middleware>

Video - Oracle Fusion Middleware Whiteboard

http://www.youtube.com/watch?v=6SYIv7b9cGk&feature=related

Video- Oracle Middleware

http://www.youtube.com/watch?v=kHYx7OT1DTE&feature=related

Video - Oracle Fusion Middleware in a Real Life Example

http://www.youtube.com/watch?v=Acmjq0XTR7I

Video Intro to Oracle Fusion Applications

http://www.youtube.com/watch?v=gGHOQ8\_sSX0&feature=related

## 5.1 Questions – Client-server architecture

5a. Explain the components and functions of a three-tier client server-architecture. Answer =>

Components of three tier architecture are-

Presentation tier-topmost level of application. This layer provides the application user interface. This involves the use of Graphical user interface for smart client interaction and web based intechnologies and browser based interaction.

Logic tier( business layer,or data access tier or middle tier) it controls an application’s functionality by performing detailed processing.

Data tier-this tier consists of database servers which actually DBMS access layer. Here information is stored and retrived.

5b.Which component of the client-server architecture would one find a Oracle server? Answer =>

In a data tier component of the client-server architecture one would find a oracle server.

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6a. List several advantages of client-server architectures. Answer =>

Just because each tier is independent of the other tiers, updates or changes can be carries out without affecting the application as a whole.

Each tier is flexible because they can be managed or scaled independently.

Scaling out an application is reasonably straight forward, because tier are based on the deployment layer.

6b. List several disadvantages of client-server architectures. Answer =>

If anyone wants to implement even small part of application,it will consume lots of time.

The physical separation of the tiers may affect the performance between three.

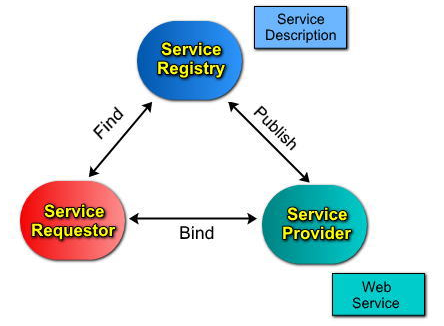
More difficult to set up and maintain it well.

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## 5.2User-based HTTP Transaction Systems versus Web Services

Most are familiar with the traditional ***HTTP HTML Form/Web transactional architectures***. A user interacts with a HTML form in their browser, submit form data to a web application, the web application processes the data, and then may return a response form to the user/browser. The web applications are likely stored at a centralized server and the user knows the location of the server to start a transaction. For example, you access Expedia data entry HTML Form and request flights between two locations which meet certain criteria (the message). The message is sent the web application, which retrieves a response and returns a message. To summarize, the user interacts with a web application.

The ***Web (or application) services architecture*** is based upon the interactions between three primary application roles: service provider, service registry, and service requestor. A service requestor is an application which requests the services of a service provider. Since the service requester may not know the application name or location (IP address, port, and application name) of the service provider application, a web service database called the service registry may be consulted. To summarize, one application requests the services of a second application, normally across the internet.



**Web Service Message**

The Web (or application) services architecture is also called a Service-oriented Architecture (SOA). To keep it simple, think of a service as an application. A message that contains data must be transmitted across some communication channel between the service requestor and service. This overview introduces three basic security issues: 1) authenticating the identity of the service requestor, 2) authenticating the identity of the service provider, and 3) encrypting the web service message. The concept of one application program requesting (calling) the services and sending messages to a second remote program is very basic. The calling programrequests the services of a remote application bysending a message.

## 5.3Advantages of Web Services

### 5.3.1 Exposing the Existing Function on the network

A web service is a unit of managed code that can be remotely invoked using HTTP, that is, it can be activated using HTTP requests. Web services allows you to expose the functionality of your existing code over the network. Once it is exposed on the network, other application can use the functionality of your program.

### 5.3.2 Interoperability - Loosely Coupled

Web services allow various applications to talk to each other and share data and services among themselves. Other applications can also use the web services. For example, a VB or .NET application can talk to Java web services and vice versa. Web services are used to make the application platform and technology independent.

Web services allow clients to invoke procedures, functions, and methods on remote objects using an XML-based protocol. Remote procedures expose input and output parameters that a web service must support.

Component development through Enterprise JavaBeans (EJBs) and .NET Components has increasingly become a part of architectures and enterprise deployments over the past couple of years. Both technologies are distributed and accessible through a variety of RPC mechanisms.

A web service supports RPC by providing services of its own, equivalent to those of a traditional component, or by translating incoming invocations into an invocation of an EJB or a .NET component.

### 5.3.4Standardized Protocol

Web services use standardized industry standard protocol for the communication. All the four layers (Service Transport, XML Messaging, Service Description, and Service Discovery layers) use well-defined protocols in the web services protocol stack. This standardization of protocol stack gives the business many advantages such as a wide range of choices, reduction in the cost due to competition, and increase in the quality.

### 5.3.5Low Cost of Communication

Web services use SOAP over HTTP protocol, so you can use your existing low-cost internet for implementing web services. This solution is much less costly compared to proprietary solutions like EDI/B2B. Besides SOAP over HTTP, web services can also be implemented on other reliable transport mechanisms like FTP.

### 5.3.6Ability to be Synchronous or Asynchronous

Synchronicity refers to the type of connection (binding)between the client and the execution of the service. In synchronous invocations, the client blocks and waits for the service to complete its operation before continuing. Asynchronous operations allow a client to invoke a service and then execute other functions.

Asynchronous clients retrieve their result at a later point in time, while synchronous clients receive their result when the service has completed. Asynchronous capability is a key factor in enabling loosely coupled systems.

## 5.4Service-Oriented Architecture (SOA)

Service-Oriented Architecture (SOA) is an architecture of loosely coupled components that can be distributed across platform, technology, and physical topologies. Service components can be combined to provide a business process, or to provide more complex services for a client application. Services are the preferred communication technique across application boundaries, including platform, deployment, and trust boundaries.

### 5.4.1 Key attributes of SOA:

* **Interoperable**. Components can be interoperable across platform and technology boundaries.
* **Componentized**. Services are exposed as autonomous components that can be versioned and managed independently.
* **Composable**. Services can be composed by an application to perform more complex operations or to enact a business process.
* **Message-based interfaces**. Interfaces are defined by message contracts and schemas. Operation calls and parameters are passed in XML message envelopes.
* **Distributable**. Service components can be consumed from the same machine or distributed to remote machines. The service interface and logic is independent of the transport and protocol used to access the service.
* **Discoverable**. Services publish their metadata as WSDL so that client applications can discover the interfaces and schemas and generate a client-side proxy to consume the service.

### 5.4.2 SOA Tenets

You can further define the SOA attributes based on a set of four SOA tenets. Microsoft architect Don Box was the first to provide this set of design tenets that govern SOA:

* **Boundaries are explicit**. Operations are called over well-defined boundaries, passing explicitly defined messages.
* **Services are autonomous**. Each service is maintained, developed, deployed, and versioned autonomously.
* **Services share schemas and contracts, not class**. Services share contracts and schemas to communicate.
* **Compatibility is based upon policy**. Policy in this case means definition of transport, protocol, security, etc.

## 5.5 REST

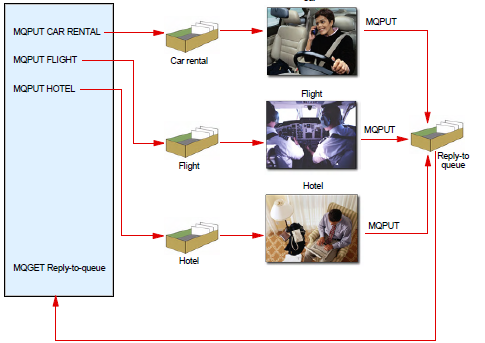
REST defines a set of architectural principles by which you can design Web services that focus on a system's resources, including how resource states are addressed and transferred over HTTP by a wide range of clients written in different languages. If measured by the number of Web services that use it, REST has emerged in the last few years alone as a predominant Web service design model. In fact, REST has had such a large impact on the Web that it has mostly displaced SOAP- and WSDL-based interface design because it's a considerably simpler style to use.

While REST stands for Representational State Transfer, which is an architectural style for networked hypermedia applications, it is primarily used to build Web services that are lightweight, maintainable, and scalable. A service based on REST is called a RESTful service. REST is not dependent on any protocol, but almost every RESTful service uses HTTP as its underlying protocol. In this article, I examine the creation of RESTful services with HTTP.

## 5.6 Real World Web Services Example

Let's return to our User/Expedia example. Assume that we need to 1) register for a given flight on a specific airline, 2) reserve a car at a specific car rental agency, and 3) reserve a room at a specific hotel. Notice that three complex transactions must be successfully orchestrated and executed by the Expedia reservation application (service requester) at three different service provider's applications which may use three programming languages, executing on three different remote platforms, using three input and output data formats.

The Expedia reservation system must format three different types of web services messages (applicable to each service provider and sent to three different locations and service providers. The Expedia reservation system cannot confirm your Expedia reservation until all three applications confirm.



Batch Processing has no user interface. OLTP system interface with a commercial, consumer or other user. Web services was constructed to have one computer program or electronic device to use the services of another computer program or electronic device, no matter what the programming language, operating system, or physical location of the computer program. The flexibility to design programs to communicate with each other is call interoperability.

Many web services are often started by a user request. For example, the travel site named Kayak, permits a user to input flight information which queries the databases of various airline reservations using web services. This is only one example, called a metasearch engine, of the many which use web service applications. This process can also query hotel reservation systems or car rental systems.

Web services can be implemented by two different programming approaches: traditional SOAP-based web services and Restful-based web services. While both technologies have value those systems that rely on web-based user transaction are be transitioned to the easier-to-use and more powerful Restful-based technologies.

It is important to notice that 70% of new application programming hires require knowledge or SOAP. Questions are provided in another requirement.

## 5.7 Web Services Primary Technologies

|  |  |
| --- | --- |
| **Web Services Architecture** | **Description** |
| **TCP/IP** | Basic host communication protocol of the Internet which identifies hosts and routes messages. |
| **HTTP** | Basic application communication protocol that delivers application messages |
| **XML-RPC** | This is the simplest XML-based protocol for exchanging information between computers. Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. |
| **SOAP** | Simple Object Access protocol, is a protocol specification for exchanging structured information in the implementation of web services in computer networks.SOAP defines an XML document format that describes how to invoke a method of a remote piece of code. Assume an application creates an XML document that describes the method I want to invoke, passing it any necessary parameters, and then it sends that XML document across a network to that piece of code. The code receives the XML document, interprets it, and invokes the method I requested, then sends back an XML document that describes the results. |
| **WSDL** | An XML-based interface definition language that is used for describing the functionality offered by a web service. The Web Services Description Language is an XML vocabulary that describes a Web service. It's possible to write a piece of code that takes a WSDL document and invokes a Web service it's never seen before. The information in the WSDL file defines the name of the Web service, the names of its methods, the arguments to those methods, and other details. |
| **UDDI** | a platform-independent, Extensible Markup Language (XML)-based registry by which businesses worldwide can list themselves on the Internet, and a mechanism to register and locate web service applications.If you have a piece of code that you'd like to deploy as a Web service, the UDDI spec defines how to add the description of your service to the registry. If you're looking for a piece of code that provides a certain function, the UDDI spec defines how to query the registry to find what you want. |

## 5.8 Questions - Web Services

### 5.8.1 Questions – Introduction to Web Services

1. What are Web Services? Answer =>

Web service is piece of software that makes itself available over the internet and uses a standardized XML messaging system for application-to-application interaction.

2. What is the difference between web servicesand HTML/HTTP form processing? Answer =>

Http is protocol which is designed for the exchange of files between remote devices specially adapted for web contents. A web service is an application which runs on the top of HTTP, it is intended to be read by other application rather than human.

3. What is the role of Oracle in a web service architecture? Answer =>

4. List and explain five Advantages of Web Services (WebSphere Messaging and Queuing).

|  |
| --- |
| **Advantages of Web Services** |
| 1.Web service offers to the developers a non-proprietary route to their solution, as it typically works outside of private network. |
| 2.Web services allow developers to use their preferred programming languages, web services are virtually platform-independent. |
| 3.Web services allow the business logic of many different system to be exposed over the web.. this gives application freedom to chose web services that they need. |
| 4.in web services the closest thing possible to zero coding deployment which makes it easy to reuse Web service components as appropriate in other service |
| 5.Web service are deployed over standard internet technologies. |

### 5.8.2 Questions – Real Life Application of WebSphere Messaging and Queuing)

How does Healthcare.gov really work - <https://thedoctorweighsin.com/healthcare-dot-gov-how-does-it-work-infographic/>

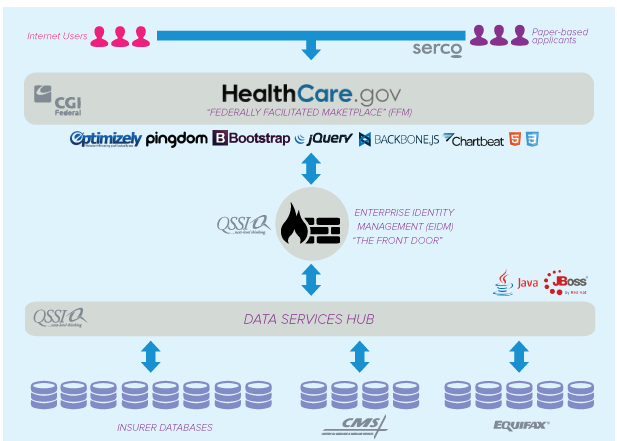
Technical deep dive on what’s impacting Healthcare.gov - https://blog.appdynamics.com/product/technical-deep-dive-whats-impacting-healthcare-gov/

6 Software Development Lessons From Healthcare.gov's Failed Launch - <http://www.cio.com/article/2380827/developer/developer-6-software-development-lessons-from-healthcare-gov-s-failed-launch.html>

The Untold Story of Rescuing Healthcare.Gov - <http://www.marklogic.com/resources/the-untold-story-of-rescuing-healthcare-gov/resource_download/whitepapers/>

IT Experts Say The Architecture Of The Obamacare Website Is Deeply Flawed - http://www.businessinsider.com/it-experts-say-the-architecture-of-the-obamacare-website-is-deeply-flawed-2013-10

5. The Obama Health Care web site will use your personal information and will query several health insurance companies for health insurance quotes for insurance products appropriate for your personal information.



**Explain how databases were used in the Obama Health Care architecture.**

**Use an appropriate amount of detail.**

**Explain how web services is an important technology between the Obama Health Care web applications and the health care insurance web applications. Use an appropriate amount of detail.**

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**List several database and other IT project reasons why the initial design of the Obama web site failed.**

**Use an appropriate amount of detail.**

### 5.8.3 Questions – Architectural Components of Web Services

6. In a reasonable amount of detail describe and explain the functionality/role the following Web Service infrastructure component:

|  |  |
| --- | --- |
| **Web Services Architecture** | **Description, Functionality and Web Service Role** |
| **HTTP** | Application-layer protocol for transferring hypermedia document like HTML. Helps in communication between web browsers and web servers. |
| **XML-RPC** |  |
| **SOAP** |  |
| **WSDL** |  |
| **UDDI** |  |

### 5.8.4 Questions - Restful

<http://en.wikipedia.org/wiki/Representational_State_Transfer>

<http://www.xfront.com/5-minute-intro-to-REST.ppt>

<http://www.javaworld.com/javaworld/jw-10-2008/jw-10-rest-series-1.html>

<http://www.xfront.com/files/tutorials.html>

<http://en.wikipedia.org/wiki/Apache_Axis>

9. What is REST? What is its relationship to Web Services? Answer =>

### 5.8.5 Questions – Advantages and Disadvantages of Web Services

Advantages & Disadvantages of Webservices - ttps://social.msdn.microsoft.com/Forums/en-US/435f43a9-ee17-4700-8c9d-d9c3ba57b5ef/advantages-disadvantages-of-webservices?forum=asmxandxml

9. Describe the advantages of using web service technologies using the following table.

|  |  |
| --- | --- |
| **Advantages of Web Service technologies** | **Describe** |
| **Interoperability** |  |
| **Usability** |  |
| **Reusability** |  |
| **Deployability** |  |

10. Describe the disadvantages of using web service technologies using the following table.

|  |  |
| --- | --- |
| **Disadvantages of Web Service technologies** | **Describe** |
| **Plain Text Protocols** |  |
| **Long Term Session Management** |  |
| **Stateless** |  |
| **Session Authentication** |  |

RESTful Web services: The basics - http://www.ibm.com/developerworks/library/ws-restful/

RESTful Web Services: A Tutorial - <http://www.drdobbs.com/web-development/restful-web-services-a-tutorial/240169069>

Here is a breakdown of when it's best to use REST or SOAP Web services. - <http://searchsoa.techtarget.com/tip/REST-vs-SOAP-How-to-choose-the-best-Web-service>

11. SOAP-based web service technologies are currently being replaced by RESTful web services. Describe why RESTful web services may be better than SOAP-based web services. Answer =>

12. What is the function of Oracle (SQL) Middleware, or Oracle Fusion Middleware? Answer =>

### 5.8.6 Questions - SQL Middleware services

13. Describe the following list of SQL Middleware services.

|  |  |
| --- | --- |
| **Middleware Services** | **Description or Use** |
| **Client/Server Connectivity** |  |
| **Platform Transparency** |  |
| **Network Transparency and Isolation** |  |
| **Single System Login** |  |
| **ODBC** |  |
| **JDBC** |  |
| **Database Middleware** |  |
| **Application Middleware** |  |
| **Message-oriented Middleware** |  |
| **Replication Services** |  |

14. What is the difference between Oracle Middleware and an Oracle Database? Answer =>

### 5.8.7 Questions - OLTP and OLAP Databases

OLTP vs OLAP - <http://www.dataonfocus.com/oltp-vs-olap/>

OLTP vs OLAP and Data Warehouse - http://its-all-about-oracle.blogspot.com/2015/03/oltp-vs-olap-and-data-warehouse.html

Online transaction processing - https://en.wikipedia.org/wiki/Online\_transaction\_processing

OLTP vs. OLAP - <http://datawarehouse4u.info/OLTP-vs-OLAP.html>

Best practices to database design for beginners?

http://www.sqlwatchmen.com/blogs/jim/2011/03/28/best-practices-for-database-schema-design/

15. Review the beginning of this assignment and yourtext book describe the differences between the design of transactional databases (OLTP databases) and data warehouses (OLAP). Answer =>

16. Explain whether Oracle is better classified as either a transactional database or a data warehouse. Answer =>

# 5.0 Cloud Computing

## 5.1 Introduction ot Cloud Conmputing

For decades we have been accustomed to the definition of the "cloud" as being a metaphor for the Internet. Over time the "cloud" evolved into an architecture that shared computer resources using technologies such as time-sharing, distributed or grid computing

Many data centers often utilized IT resources at a rate of less than 10%. There were many reasons for this underutilization, e.g., economies of scale, meeting peak period demand, backup capacity, etc., required extra capacity. In 1960, John McCarthy (of artificial intelligence fame) expressed his opinion that computing could be viewed as a "service", which could distribute this excess capacity similar to any public utility company. It was Amazon's vision in 2006 to become an IT utility company to serve large businesses. IBM SmartCloud and Oracle Cloud frameworks followed Amazon's lead and introduced proprietary cloud computing services in late 2011.

Building on the previous success of free Gmail service, Goggle and other cloud providers introduced more sophisticated cloud applications in 2010. Cloud Multitenancy refers to ability to shared applications and middleware in a cloud computing architecture. Google's strategy was to serve small businesses, education and consumers through a variety of low-cost or free, cloud-based applications and storage. But, Google does not provide VM provisioning services such as Amazon. Windows Azure and iCloud later followed adding cloud services to support their proprietary product lines.

There is no universal agreement on the definition of cloud computing. To conduct a micro and macro analysis of cloud computing one must first agree on some operational definitions and boundaries. For the purpose of this analysis, cloud computing is defined by the following 1) the commoditization of private or public, distributed-virtualized IT resources at various service levels, 2) designed to take advantage of economies of scale, dynamic scalability, and with low barriers of entry, and 3) where Information and Communication Technology (ICT) costs may be allocated, charged, and shared using either a service-level or pay-per-use model governed by terms set by Service Level Agreements (SLA). Statistics concerning the diffusion of private cloud may be under estimated since many virtualization managers incorrectly classify their architectures and private clouds]

## 5.2 What is Cloud Computing?

Cloud Computing is a "***shared***" private or public ***network of computer resources***, e.g., hardware, storage, operating systems, and applications, which may be ***free, rented or paid for on an as-needed basis*** (a service), and can be ***quickly deployed (provisioned) and scaled*** to meet the needs of any organization's requirements.

## 5.3 Cloud Computing Service Layers

Cloud computing services are often delivered to organizations and end-users by reference to popular service levels. **Infrastructure as a Service (IaaS)** may be classified as renting or usage-based pricing of virtual machines, processing cores, memory, storage, and network bandwidth. Renting a resource involves paying a negotiated cost to have access to a resource over some time period, whether or not you use the resource. Usage-based pricing is not renting. Pay-as-you- go involves metering usage and charging based on actual use, independently of the time period over which the usage occurs.

**Platform as a Service (PaaS)** may be classified as renting operating systems and mddleware. PaaS is likely to be an extension of IaaS.

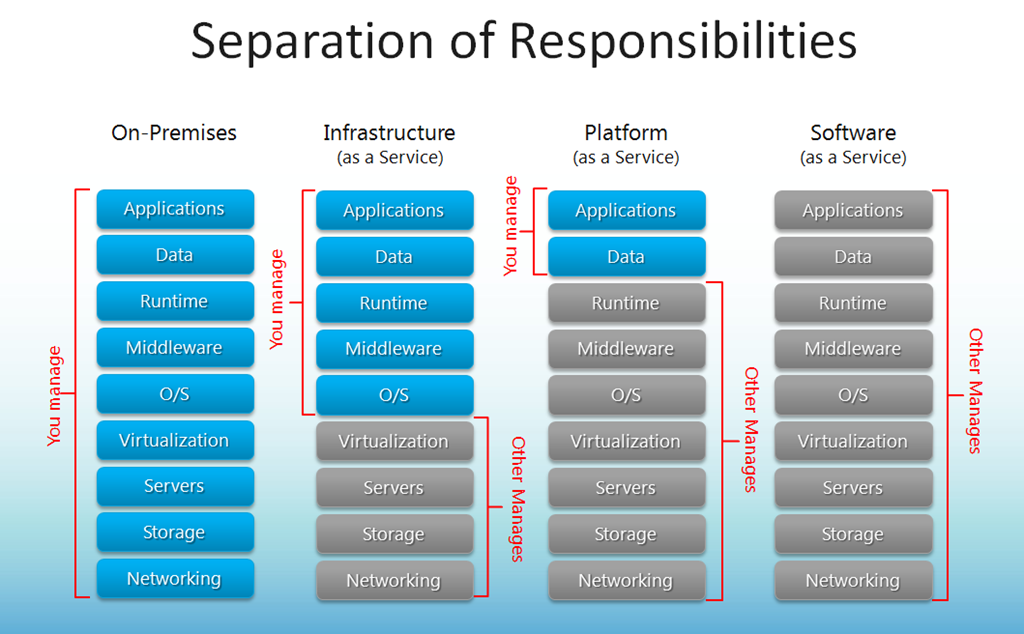
**Software as a Service (SaaS)** may be classified as renting applications, web sites, and application database content. Financial, Cost and International Accounting, Sales, Desktop, Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Customer Resource Management (CRM), Human Resources, Recruiting, Payroll, Transportation and Warehouse management applications system are a selection of SaaS applications that may be rented using a single-tenancy or multiple-tenancy model.

**Single-tenancy** architectures provide separate, multiple application instances (or hardware systems) where one instance serves one client or tenant .

**Multitenancy** refers to a principle in software architecture where a single instance of the software runs on a server, serving multiple client-organizations (tenants). The software application must be designed to virtually partition its application data and configuration, such that each client organization works with a customized virtual application instance.

You want to rent the processing power of a large computer and storage system for a few days, Cloud Computing describes this layer of cloud technology as "Infrastructure as a Service (IaaS)." You want to rent an operating system with a streaming video server for the weekend to support a class project. Cloud Computing describes this layer of cloud technology as "Platform as a Service (PaaS)." And if you want free email services, e.g., Gmail, for your school, faculty and students, this layer of cloud computing technology is described as "Software as a Service (SaaS)."

While IaaS, PaaS, and SaaS are the most frequently cited service levels, the 'as-a-Service' tag has evolved into an IT marketing tool designed to offer more granular cloud-based services. For example, Security as a Service (SaaS) integrates security services, e.g., authentication, anti-virus, anti-malware/spyware, intrusion detection, and security event management, etc., into a corporate infrastructure on a subscription basis.



## 5.4 Cloud Computing Service Layers

|  |  |  |
| --- | --- | --- |
| **Layers of Service** | **Description** | **Example(s)** |
| **Infrastructure as a Service (IaaS)** | Renting or usage-based pricing of virtual machines, processing capacity, memory, storage, and network bandwidth. Renting a resource involves paying a negotiated cost over some time period, whether or not you use the resource.  Pay-as-you- go involves metering usage and charging based on actual use, independent of the time period over which the usage occurs.  Just like renting a car can save you money, so one can save money by renting infrastructure. | Virtual Machines (cost per processor by month, or per processor cycles)  Real-time provisioning and clustering  Google Drive, Dropbox, Amazon S3 (Free or Monthly Cost Per Gb); Per I/O cycle  Data Transmission - Per Gbyte of data transmission |
| **Platform as a Service (PaaS)** | Renting operating systems, databases, and middleware. Since an operating system requires hardware, storage and network bandwidth infrastructure, PaaS is an extension of IaaS. | Windows Azure, Amazon EC2, iCloud  Windows 2012 Server. Red Hat Linux,  SQL Server, Oracle |
| **Software as a Service (SaaS)** | Renting applications. SaaS applications may be classified as single-tenancy or a multiple-tenancy model. | Google Apps, Adobe Cloud , Blackboard, Oracle Financial and SAP ERP Cloud |

## 5.5 An Economic Analysis of the COST and Benefits of Cloud Computing

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### 5.5.1 Conversion of up-front, committed fixed costs to variable discretionary costs

ICT up-front costs are often evaluated using capital budget models, e.g., net present value. Cloud-based architectures offer the opportunity to convert fixed cost into periodic, variable or mixed costs. Cloud-based capital budgeting models should treat the cloud computing similar to buy-or-lease, while incorporating differential financing, tax effects, intangible and other economic costs.

Lower break-even points will reduce operational and business risks. Flexible and dynamic provisioning will provide opportunities in technology-based industries, e.g., banking, insurance, investment, and finance. On the other hand, the same factors may also increase economic concentration in those industries.

### 5.5.2 Purchasing economies of scale for SMEs

Harms and Yamartino (2012) estimated that small-to-medium enterprises (SMEs) may enjoy 20-30% savings due to purchasing economies of scale provided to Cloud Service Providers (CSP). Is it plausible that CSPs will pass all of this saving to the customer?

### 5.5.3 Operational economies by balancing different utilization patterns

Cost saving benefits may be possible by balancing different utilization patterns by a) time-of-day, b) time zone, c) industry-specific variability (retail Christmas sales versus tax services), d) application (search versus email tasks), e) workload (batch versus OLTP), and f) uncertain growth patterns.

### 5.5.4Reduction of electric utility expenses

Electricity costs have increased represent to 15-20% of total operational costs. Power Usage Effectiveness (PUE) tends to be significantly higher in large data centers than small data centers due to geographical variability, economies of scale, and negotiated rate reductions.

### 5.5.6 Reduction of physical data center space

In additional to basic construction costs, data centers often require additional special structural, environmental, redundancy and security requirements. The possibility to reduce data center space requirements may be significant for either private or public cloud architectures.

The potential to re-purpose the data center floor space, however, may be limited for private cloud architectures. The security and structural constraints may prevent re-assignment of a data center's floor space to an alternative function. Renting or consolidating data center space with other companies ICT needs may be a possibility.

Existing data center space may be a significant fixed cost pool, but it also may represent a sunk cost. Sunk costs are a subcategory of fixed costs, which are not differential and should not affect future economic decisions. For example, the choice to outsource data center operations to a public cloud service should rarely consider data center physical costs under most conditions. It does not matter if the existing data center operational model is retained or outsourced to a public cloud service provider. There would be no difference in allocated depreciation expense or capital write-offs.

If the differential or incremental benefits exceed the differential or incremental costs, it does not matter what amount of depreciation is allocated from an economic model's perspective. The decision is to accept the proposed change. Allocated costs, such as depreciation and amortization expenses, are normally not classified as differential. Data center structural depreciation is normally a sunk cost unless one can re-purpose the facility. Estimates concerning footprint savings should be carefully analyzed.

### 5.5.7Reduction of ICT labor costs

Some ICT Labor Costs in cloud architecture decisions may decrease, but should be carefully analyzed to determine if these costs are differential. Microeconomic resource decision models state that the relative combination of capital and labor will be optimal where the ratio of the Marginal Physical Product of Capital (MPPC) relative to its Marginal Resource Cost of Capital (MRCC) is equal to Marginal Physical Product of Labor (MPPL) relative to its Marginal Resource Cost of Labor (MRCL).

Since cloud computing would be expected to lower the marginal resource cost of technology capital, one would expect that ITC labor utilization will be reduced under normal circumstances because cloud computing became a less expensive capital cost. But, the actual amount of the reduction would be determined by the substitution effect between resources. How much would ITC labor costs be reduced may vary.

Resource substitution effects are also determined by resource sensitivity factors; such as the ability to replace ITC labor by capital and the percentage of ITC labor costs in the relationship to the total IT budget. There may be labor cost savings which results operational operating system and application updates, server and application provisioning, operation monitoring, backup and recovery costs. But, other ICT jobs and costs may be actually unaffected.

In addition to IT capital/labor productivity ratio analysis, one should consider the effects of raising health care and retirement costs throughout the organization. Cloud computing may provide the opportunity to management for ITC labor to share in the pain. From a microeconomic point of view reduction of ITC labor and costs will be good. From a macroeconomic point of view, the potential for increased unemployment may be undesirable.

Some ICT jobs may be actually re-assigned within the ICT department. When ICT personnel are limited, i.e., a constraint, the "opportunity costs" to assign IT personnel to other roles and projects may be significant. As cloud computing releases IT personnel constraints, opportunity costs are lower and new IT projects may now become feasible.

The labor savings as the result of cloud computing benefits should be reduced by any retraining costs. Some ICT jobs lost may be actually re-assigned outside the ICT department to a lower value activity, which has been a popular policy in the public sector. It is important to correctly identify the net labor savings attributed to microeconomic benefits of cloud computing.

### 5.5.8 Consolidation and shared use of processing and storage resources -- Tangible and Intangible Costs and Benefits of Multitenant Applications

An application instance usually incurs a certain amount of memory and processing overhead, which can be substantial when multiplied by many customers. Multitenant applications and middleware simplifies the upgrade and new release management processes and may reduce some types of differential overhead costs by amortizing it over many customers

Multitenant applications may permit greater economies of data aggregation and potentials for data mining. Instead of storing transactional and decision support data in multiple data stores, with a potential of different database schemas, all data for all multitenant users is stored in a single database schema.

The benefits of multitenant applications and middleware may be limited by the availability and extra cost of multitenant licenses, scalability, and increased security threats and vulnerabilities, customization complexity and maintenance of per-tenant metadata. Furthermore, multitenant applications and middleware may also increase complexity and risk of an unsuccessful upgrade or new release, longer downtimes, and the coordination of user training between multiple tenants.

### 5.5.9Intangible benefits of cloud security for SMEs

Operational security hardware and expertise are normally fixed costs. Increasing the number of users and organization applications will decrease security-related costs per cloud user or organization and provide security expertise that would not be available otherwise. Intangible benefits include increased a) quality of security planning, b) security testing, and c) responsiveness to a security event.

External verification of cloud service provider's security claims is only acceptable as can be externally verified. The quality of cloud security verification standards vary and are in their infancy. For example, the SAS70 provides limited assurance. Organizations, such as the National Institute of Standards and Technology (NIST), General Service Administration (GSA), Cloud Security Alliance (CSA), the Federal CIO Council, and the European Network and Information Security Agency (ENISA) have proposed standards to verify and audit cloud service providers which vary considerably

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### 5.5.10Intangible costs of cloud security for SMEs

Private and Public Cloud architectures also increase the types and complexity of security vulnerabilities. For example if a hacker can compromise the hypervisor layer, they can avoid detection by most security software running at the application layer. This will provide the hacker greater access to the system and the possibility that they will be able to remotely control all virtual machines and storage area networks. Organizations have less control over public clouds. Proprietary extra-chassis links and protocols to enable cluster technologies present additional concerns

Hackers have always exploited a system’s biggest shortcoming, one that is virtually impossible to secure -the human user. The use of a single password and user ID across all of a computer user’s system interactions, or the use of trivial user IDs and passwords, are well-known exploits that can provide weakly defended backdoors into higher security components. The increased benefits of cloud-based security may not directly address batch, OLTP, and web application, operating system security and middleware vulnerabilities.

### 5.5.11Other intangible costs of cloud computing

Cloud computing has increased risks concerning

1) the business continuity of the cloud provider,

2) the intrinsic nature of the cloud business model,

3) erosion of control and accountability,

4) potential CSP outsourcing,

5) additional subpoena and e-discovery risks,

6) insider threats,

7) loss of governance,

8) unauthorized physical access as CSPs,

9) media destruction,

10) service isolation, and

11) privacy concerns.

### 5.5.12 Other Issues involving Cloud Storage

* Device Independence - Share ability across a variety of devices, operating systems and locations, e.g., in work computer, home computer, and mobile devices.
* Cloud-shared stored data access policies, i.e., download only, download/upload, collaboration editing, etc.?
* Individual or Group Storage Quotas? Most cloud storage solutions do not support this feature.
* Should a student have access to data outside the classroom?
* How does one prevent workers from accessing cloud stored data (security) at work or outside work?
* Policies for the content and retention of cloud data storage.

## 5.8 Cloud Computing

### 5.8.1 Questions - Cloud Computing and Virtualization

1. Oracle DBMS systems are frequently implement on the cloud. What is cloud computing? Answer:

### 5.8.2 Questions - Cloud Computing Service Layers

Oracle Cloud Services - <https://cloud.oracle.com/home>

Download IaaS for Dummies - https://go.oracle.com/LP=49675?elqCampaignId=61933

3. Provide a descriptions and at least three examples of applications of each Cloud computing Service layer

|  |  |  |
| --- | --- | --- |
| **Concept** | **Description** | **Examples** |
| **Infrastructure as a Service**  **(IaaS)** |  |  |
| **Platform as a Service**  **(PaaS)** |  |  |
| **Software as a Service (SaaS)** |  |  |

### 5.8.3 Questions - Multi-tenancy and single-tenancy

4. What is the difference between single tenancy and multi-tenancy in cloud computing service layers? Answer:

5. Explain why a company want to use single-tenancy cloud service? Answer:

6. Explain why Microsoft Office 365 is an example of multitenancy cloud service? Answer:

### 5.8.4 Questions - Advantages and Disadvantages of Cloud Computing Architectures

7. List and explain five (5) or more **tangible advantages**of Cloud Computing Architectures A tangible advantage can either be monetarily measured as a real cost saving or an increase in revenue or profit. Answer:

8. List and explain two (2) or more **intangible advantages**of Cloud Computing Architectures An intangible advantage can NOT be monetarily measured. Answer:

9. List and explain two (2) or more **tangible disadvantages**of Cloud Computing Architectures A tangible disadvantage can either be monetarily measured as a real cost increase or a decrease in revenue or profit. Answer:

10. List and explain five (5) or more **tangible disadvantages**of Cloud Computing Architectures A intangible disadvantage can NOT be monetarily measured..Answer:

### 5.8.3 Questions – Oracle Cloud Services

Download IaaS for Dummies - https://go.oracle.com/LP=49675?elqCampaignId=61933

Oracle Cloud - https://www.oracle.com/cloud/cloud-summary.html

11. Describe specific examples how Oracle Cloud services and databases can help companies of all different sizes.

|  |  |
| --- | --- |
| **Concept** | **Oracle Cloud Services** |
| **Infrastructure as a Service**  **(IaaS)** |  |
| **Platform as a Service**  **(PaaS)** |  |
| **Software as a Service (SaaS)** |  |