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TechM Full-Stack Software Development

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Course: Foundation of Database
Lecture On: Introduction to DBMS and SQL
Instructor: Vishwa Mohan

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Today's Agenda

1. Introduction to DBMS
2. Project overview
3. RDBMS
4. Overview of SQL
5. Categories of SQL
6. CREATE, INSERT, SELECT and UPDATE commands in SQL

What is Data?

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- Data is raw and unorganised facts that need to be processed.

- For example,

12121995

What does this number mean?
Is it the price of a product?
Is it a birth date?
Is it a magic number?

How is Data different from Information?

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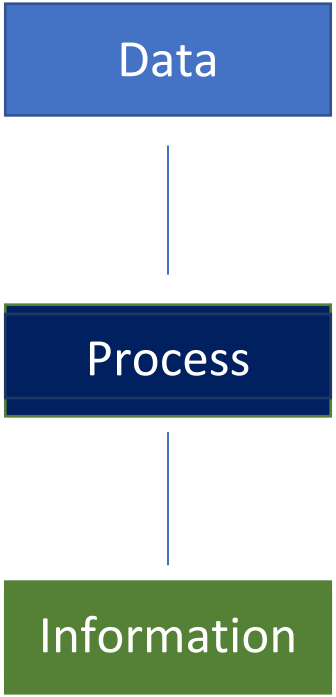

How is Data different from Information?

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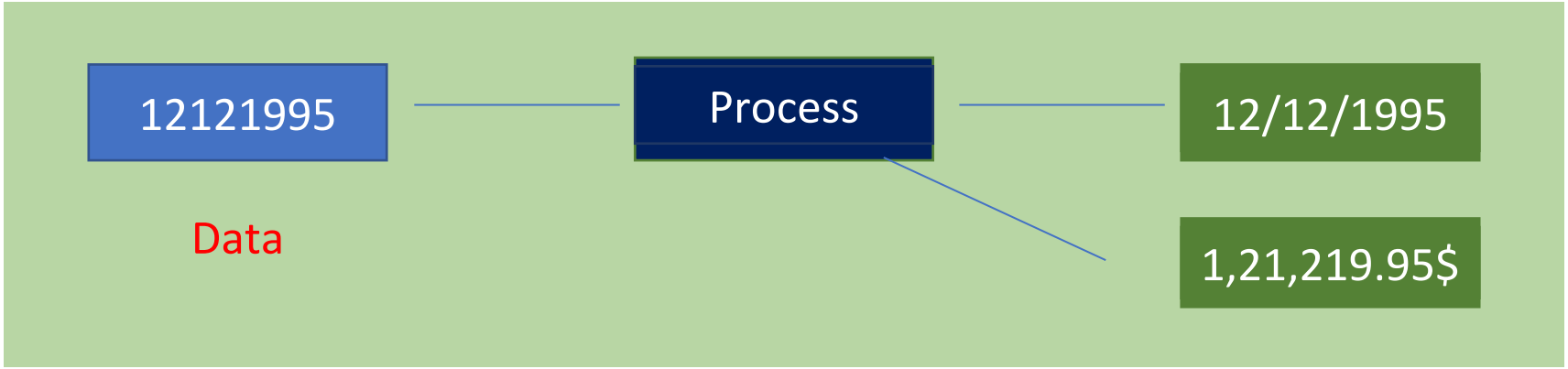

When raw data is processed, it becomes information, which is useful and meaningful.

Why is Data Storage Needed

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- We are surrounded by data of different types.
- This data needs to be stored together somewhere.
- Examples include:

Data of all the customers

Data of all tickets booked by different customers

Data of movies running in different theatres

Poll (45 sec.)

Which of the following options can be classified as information?

1. Temperature readings of last 10 days

2. Average temperature of last 10 days

3. Balance of all the accounts in a bank

4. Net worth of a bank

Poll (Answer)

Which of the following options can be classified as information?

1. Temperature readings of the last 10 days

2. **Average temperature of the last 10 days**

3. **Balance of all the accounts in a bank**

4. Net worth of a bank

File System

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So, when it comes to storing data, one storage tool comes to our mind and that is…

Our traditional file system.

Advantages of a File System

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- Universal
- No need to learn any new language
- Low maintenance cost

But are these advantages enough???

Well, the answer is **NO**!

Disadvantages of File Systems

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- Data redundancy
- Data inconsistency
- Difficulty in accessing data
- Integrity and atomicity are not achieved
- Concurrent access is not allowed
- Lack of security

What is a Database?

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- To overcome the shortcomings of file systems, we use databases.
- A database is an organised collection of meaningful and useful information stored and accessed through computers.
- In other words, it is a method that is used widely to store, retrieve and manage data.

How does a Database make up for the Limitations of a File System?

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	File System	Database
Data Consistency	Data is highly inconsistent	Data is consistent
Data Sharing	Data sharing is difficult	Data sharing is easy
Redundancy	High data redundancy	Low data redundancy
Security	Not very secure	Secure by use of roles, passwords, etc.
Backup and recovery	No backup and recovery processes in place	Backup and recovery processes are in place

Types of Databases

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Relational Databases

Non-Relational Databases

Relational Databases

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- We have been talking a lot about data, right? So, where are we going to store our data? Well, in our **TABLE**.
- A relational database means a collection of data items stored in a tabular (table) format with a predefined relationship between them.
- These items are organised as sets of tables with rows and columns.

Non-Relational Databases

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- A non-relational database is one in which data is in an unstructured format and does not fit well into rows and columns.

- Unlike relational models, there is no relation between the tables in non-relational database.

key	document

1	{
	“name”:”John”,
	“dimensions”:[
	{
	“height”:”13.3cm”,
	“weight”:”40,
	}]
	}

What is a Database Management System?

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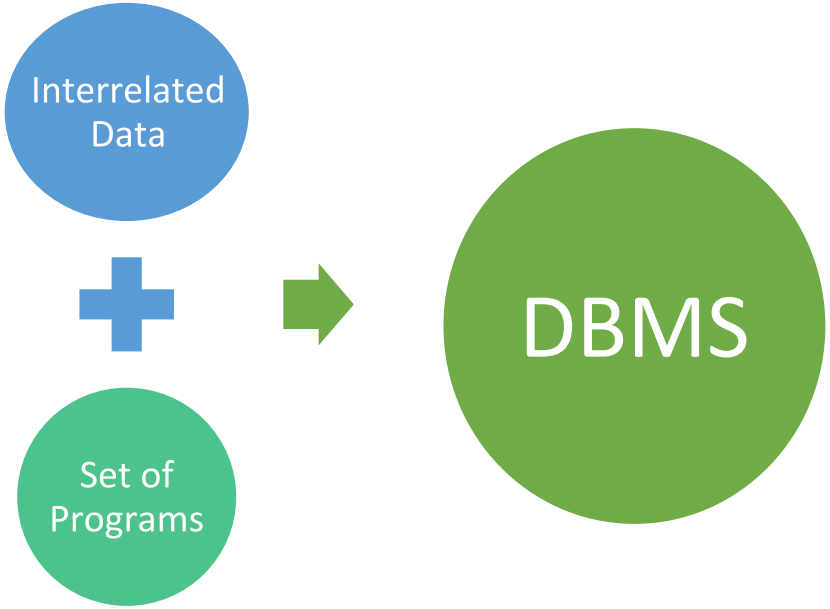
- A Database Management System (DBMS) is a collection of interrelated data and a set of programs to access the data.
- The primary goal of a DBMS is to provide a convenient as well as efficient way to manage the information stored in the database.



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Poll (30 sec.)

You just learnt about a DBMS and a database. Both sound quite similar. Are they actually the same?

1. Yes
2. No
1. Maybe

Poll (Answer)

You just learnt about a DBMS and a database. Both sound quite similar. Are they actually the same?

1. Yes
2. **No**
1. Maybe

Database VS. DBMS

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Database

- A database is an organized collection of information such that it can be accessed, managed and updated easily.
- In other words, a database is where we store or manage data.

DBMS

- A database management system is a system software for creating and managing databases.
- In other words, the software that helps in managing these databases is called DBMS.
- Examples of DBMS include Oracle, MySQL, MS SQL Server.

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Movie Booking Application

Overview of Movie Booking Application

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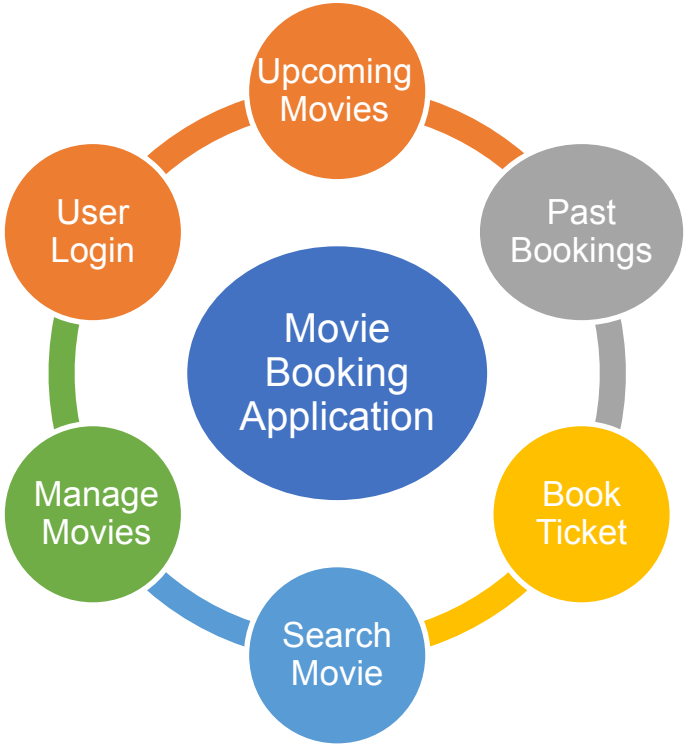

Discussion Question

Can you identify various entities that will be a part of our database for the movie booking application?

What is RDBMS?

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- RDBMS stands for Relational Database Management System.
- RDBMS is the base for learning any database language such as SQL.
- RDBMS is nothing but a Database Management System that uses a relational model (table) and there are **relationships** between these tables.
- Some examples of RDBMS are Oracle, IBM DB2, Microsoft SQL Server, PostgreSQL etc.

Relationships

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- A relationship between two objects whenever there is an association between them.

- In the context of relational databases, a relationship is a situation that exists between two tables wherein one table is connected to another.

- There are various types of relationships that can exist between two tables.

Types of Relationships

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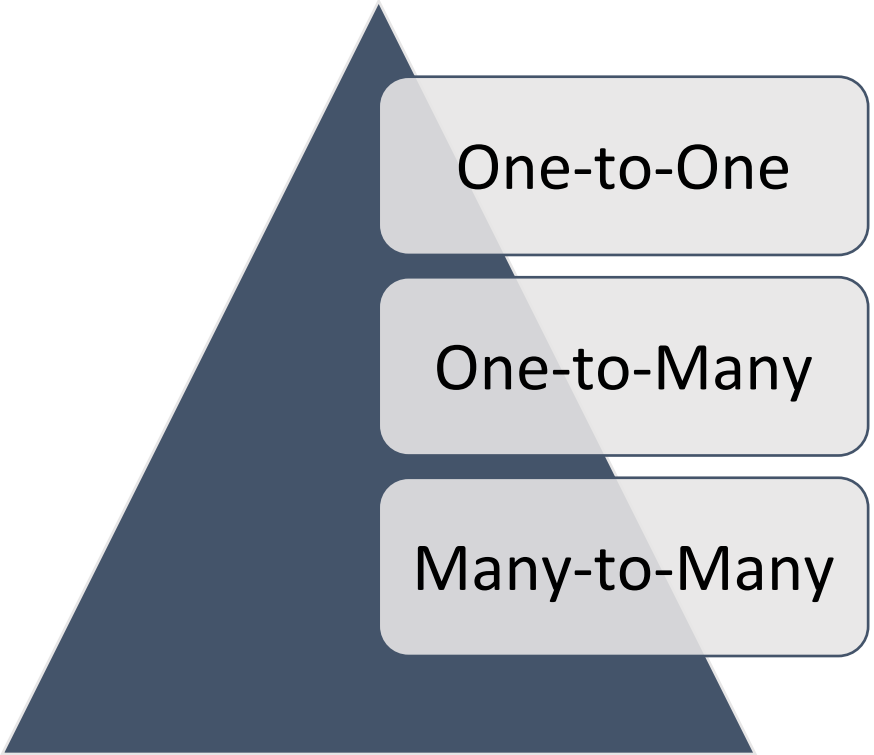

One-to-One Relationship

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- A one-to-one relationship is when at most one instance of entity A is associated with one instance of entity B.

- For example, one person, who is a citizen of India can have only one Adhaar card. Also, one Adhaar card can belong to only one person. This shows a 1:1 relationship between an Indian citizen and Aadhaar card.

One-to-Many Relationship

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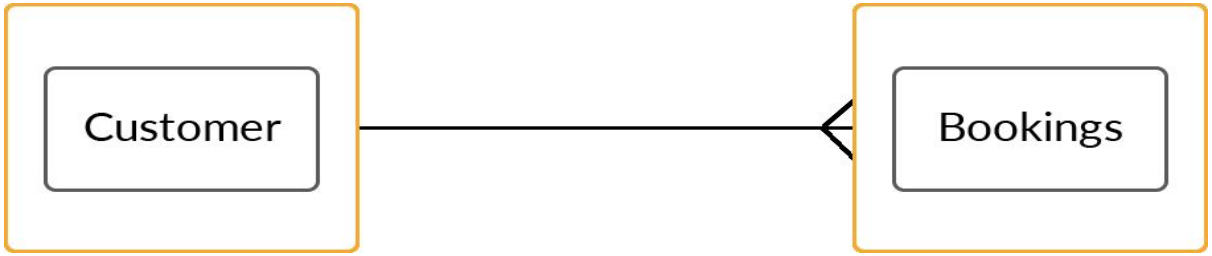
- A one-to-many relationship is when for one instance of entity A, there are many instances of entity B, but the opposite is not true; that is, for entity B, there aren't multiple instances of entity A.

- For example, while booking movie tickets, one customer can have many bookings. In other words, many bookings may belong to a single customer. However, one booking cannot belong to multiple customers. This shows a 1:M relationship between the customer and their bookings.



Many-to-Many Relationship

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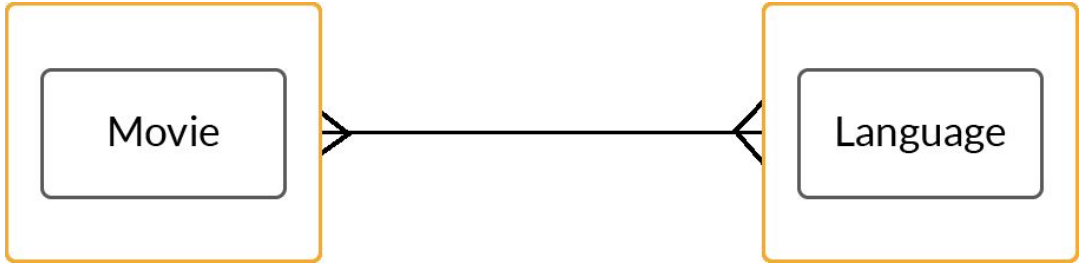
- A many-to-many relationship, also called non-specific, is when for one instance of entity A, there are many instances of entity B, and for one instance of entity B, there are many instances of entity A.

- For an example, one movie be released in multiple languages and multiple movies can be released in one language. This shows an M:M relationship between movies and language.



Poll (45 sec.)

Consider a school where there are grades from 1st to 10th. What type of relationship do you think exists between grades and students?

1. 1:1

2. 1:M

3. M:M

Poll 3 (Answer)

Consider a school where there are grades from 1st to 10th. What type of relationship do you think exists between grades and students?

1. 1:1

2. **1:M**

3. M:M

Components of RDBMS

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Relation/Table

- The data in RDBMS is stored in database objects, which are called tables.
- Each table is made up of rows and columns.
- A table is also called a ‘relation’.
- Rows are also called ‘tuples’ or ‘records’.
- Columns are also called ‘attributes’.

Components of RDBMS

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Column

movie

movie_name	movie_desc	release_date	duration	cover_photo_url	trailer_url	language
Se7en	This is a suspense thriller	02-12-2000 12:00:00	120	ww.seven.com	https://www.youtube.com/watch?v=znmZoVkCjpI	English, Hindi
Fight Club	This is a suspense thriller	02-10-2008 15:00:00	90	ww.fightclub.com	https://www.youtube.com/watch?v=qtRKdVHc-cE	English, Hindi
V for Vendetta	This is an action movie	02-02-2006 12:00:00	150	ww.vendetta.com	https://www.youtube.com/watch?v=lSA7mAHolAw	English, Hindi

row

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Attribute/Column

- An attribute/column in a table stores all the information associated with one field.
- A column is a vertical entity in a table.

movie_name
Se7en
Fight Club
V for Vendetta

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Tuple/Record/Row

- A record/row/tuple is the data entry that exists in the table for every entry.
- For example, storing information of a customer is 1 row for the ‘customer’ table.
- A row is a horizontal entity in a table.

Se7en	This is a suspense thriller	02-12-2000 12:00:00	120	ww.seven.com	https://www.youtube.com/watch?v=znmZoVkCjpI	English, Hindi

Instance vs Schema

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Schema

Instance

A collection of information stored in a database at a particular moment is known as an instance.

Schema

The overall design of a database is called the schema.

Instance vs Schema

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Instance

movie

movie_name	movie_Decription	release_date	duration	cover_photo_url	trailer_url	language
Se7en	This is a suspense thriller	02-12-2000 12:00:00	120	ww.seven.com	https://www.youtube.com/watch?v=znmZoVkCjpI	English, Hindi
Fight Club	This is a suspense thriller	02-10-2008 15:00:00	90	ww.fightclub.com	https://www.youtube.com/watch?v=qtRKdVHc-cE	English, Hindi

Instance vs Schema

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Schema

movie

movie_name	movie_desc	release_ date	duration	cover_photo_url	trailer_url	language

customer

first_name	last_name	username	password	date_of_birth	mobile_number

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Question (45 sec.)

What is the difference between a ‘schema’ and ‘table’ in Oracle?

Answer

Table

A table is a data set in which data is organised in a set of vertical columns and horizontal rows.

Schema

The overall design of a database is called schema.
Schema is the parent of a table, and it consists of tables, procedures, views, etc.

TIME FOR
SOMETHING
NEW!

SQL (Structured Query Language)

What is SQL and what is its Role?

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- SQL is a database management language aimed at storing, manipulating and retrieving the data stored in a relational database.
- It is used to communicate with a database.
- It is mainly used to insert, search, update and delete database records.
- It can also perform lots of other operations, including optimization and maintenance of databases.

History?

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- In the 1970s, IBM researchers Donald D. Chamberlin and Raymond F. Boyce developed the programming language known as SEQUEL.
- The original SQL version was designed to retrieve and manipulate data stored in IBM's database known as 'System R'.
- In 1979, a company named Relational Software, that later became Oracle, commercially released its own version of the SQL language known as Oracle V2.
- After then, the American National Standards Institute (ANSI) and the International Standards Organization (ISO) have deemed SQL the standard language for use in relational database communication.

Data Types Available in SQL

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The first step in learning any new language is gaining the knowledge of the available datatypes, right?

So, let’s begin...

NUMBER

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Syntax: NUMBER [(p, [s])]

Description: Numbers can store fixed and floating point numbers.
Example: 12, 12.45, -10, -23.567

What is p? Precision is the total number of digits in a number.

What is s? Scale is the number of digits to the right of the decimal point in a number.

Example: 123.45 has a precision of 5 and a scale of 2.
The price of a ticket can be as NUMBER(5,2);

The official documentation can be found here.

Let’s Understand Precision and Scale

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Input	Datatype	Output
12342.12	NUMBER	12342.12
786725.28	NUMBER(8,1)	786725.3
65123.65	NUMBER(7,2)	65123.65
56123.89	NUMBER(5,-2)	56100
7000	NUMBER	7000

String - CHAR

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Syntax: CHAR

Description: It stores fixed-length character strings. At the time of creation of a field, you need to mention the length between 1 and 2,000 bytes.

Example: movie_name CHAR(20);
This can store a name of up to 20 characters.

Note: If the value stored exceeds the size mentioned while declaration, then Oracle database will return an error.

String - VARCHAR2

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Syntax: VARCHAR2(size)

Description: It stores variable-length character strings. At the time of creation of a field, you need to mention the length between 1 and 4,000 bytes.

Example: movie_name VARCHAR2(20);
This can store a name of up to 20 characters.

Note: If the value stored exceeds the size mentioned while declaration, then Oracle database will return an error.

Differences between CHAR and VARCHAR2

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Input	Declared As	Format	Total Number of Bytes Occupied
Happy	CHAR(10)	Happy _ _ _ _ _	10
Happy	VARCHAR2(10)	Happy	5

DATE

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Syntax: DATE

Description:

- The DATE datatype stores the year (including the century), month, day, hours, minutes and seconds (after midnight).
- Oracle Database can store dates, ranging from 1 January 4712 BCE through 31 December 9999 AD.
- The Date data is stored in fixed-length fields of **seven** bytes each.
- The standard Oracle date format is DD-MON-YY.
- Oracle Database stores time in the 24-hour format, that is, HH:MI:SS.

Example: movie_release_date DATE;

Poll (45 sec.)

Suppose you are creating a database in which you need to store data in the following format:
‘employee_name’ and append it with employee_code’.
Which datatype would you use?

1. INT
2. CHAR
3. VARCHAR
4. DECIMAL

Poll (Answer)

Suppose you are creating a database in which you need to store data in the following format:
‘employee_name’ and append it with employee_code’.
Which datatype would you use?

1. INT
2. CHAR
3. **VARCHAR**
4. DECIMAL

Categories of SQL Languages

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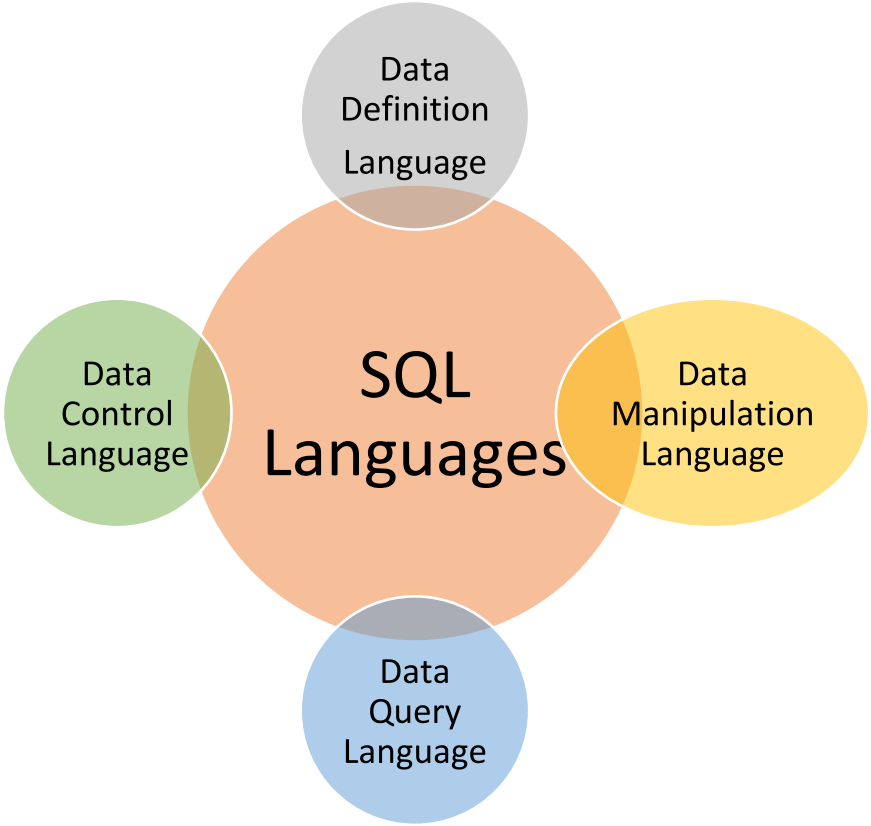

Data Definition Language (DDL)

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- DDL consists of commands that are used to create the database schema and its objects, and to make any changes to the structure of the database or the entities present in the database, if required.

- **Commands**:
  CREATE
  ALTER
  DROP
  TRUNCATE

Data Query Language (DQL)

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- DQL consists of commands that are used to query the database. This means these commands are the ones that are used to fetch data from the database.

- **Command**
  SELECT

Data Manipulation Language (DML)

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- DML consists of commands that are used to insert data and manipulate the data that is present in the database.

- **Commands:**
  INSERT
  UPDATE
  DELETE

Data Control Language (DCL)

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- DCL mainly deals with the rights, permissions and other controls of a database system.

- **Commands:**
  GRANT
  REVOKE

You can go through the below links to understand these commands:

1. **GRANT:** https://docs.oracle.com/javadb/10.8.3.0/ref/rrefsqljgrant.html
2. **REVOKE:** https://docs.oracle.com/javadb/10.8.3.0/ref/rrefsqljrevoke.html

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Poll (45 sec.)

Which of the following SQL languages will be used to fetch the records from the table?

A. Data Definition Language (DDL)
B. Data Query Language (DQL)
C. Data Manipulation Language (DML)
D. Data Control Language (DCL)

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Poll Answer

Which of the following SQL languages will be used to fetch the records from the table?

A. Data Definition Language (DDL)
B. Data Query Language (DQL)
C. Data Manipulation Language (DML)
D. Data Control Language (DCL)

Table Creation

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- To create objects in a database, we use the ‘**CREATE’** command.
- **Example:** To create a new table for a movie.
- So, let’s start our hands-on exercise by creating tables.

CREATE & DESCRIBE

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Syntax:

```
CREATE TABLE table_name
 (
   column_1   DATATYPE(Size),
   column_2   DATATYPE(Size),
   column_3   DATATYPE(Size)

 );
```

Now, to see the definition of the table created, use the syntax given below:

Syntax:

```
DESCRIBE table_name;
```

Let’s take a look at Example 1

CREATE Command - Hands-On Exercise (5 min)

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1. Let's create the following table: (Think of the datatypes on your own)
   Table Name: **movie**
   Fields: movie_name
   movie_desc
   release_date
   duration
   cover_photo_url
   trailer_url
   language
2. Describe the created table.

Insert the Records

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- Now, once we have created the table, we actually need data/records in our table. This is why we have created our table, right?
- To insert a new tuple into a table, we use the **'INSERT'** command.
- Example: Adding an upcoming movie to the Movie table.
- Now, let's learn how the INSERT commands works on a table.

Insert the Records

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Syntax:

```
INSERT INTO table_name (column_1, column_2, column_3)
VALUES ( value1, value2, value3);
```

If we are inserting values to all the columns and in the same order, then we can omit writing the column names.

Syntax:

```
INSERT INTO table_name
VALUES (value1, value2, value3);
```

Let’s take a look at Example 2

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INSERT Command - Hands-On Exercise (5 min)

In the movie table created previously, add two new movies as follows:

1. Name: 'Sev7en', Description: ‘This is a suspense thriller’ Release Date: 01-02-20, Duration: 120, Language: English, Image Link: www.Sev7en.com/image.jpg, Trailer Url: https://youtube.com/Sev7en
2. Name: ‘Life of Pi’, Description: ‘This is a suspense thriller’, Release Date: 01-03-20, Duration: 90, Language: English, Image Link: www.LifeofPi.com/image.jpg, Trailer Url: https://youtube.com/Pi

View the Records

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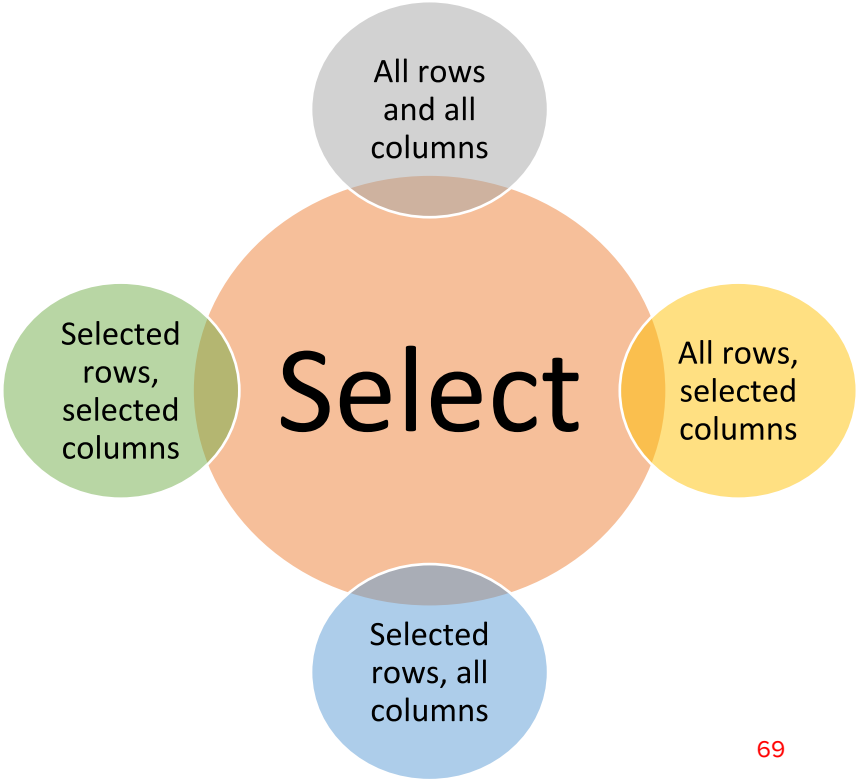
- After we have inserted, say, 100 records into a table, how do we view them now, to know whether they have been inserted according to our plan or not?

- For that, we use the **SELECT** command.



ALL Rows, ALL Columns

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1. **Selecting ALL rows and ALL columns**
   Syntax:

```
SELECT * FROM table_name;
```

2. **Selecting ALL rows and SELECTED columns**
   Syntax:

```
SELECT column1, column2, ...
FROM table_name;
```

Let’s take at look at Example 3

Renaming Columns

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- As per the Oracle standard format, column names are always written with '_' (underscore) as a separator.
- For example, the column name written as 'emp_fst_nm' to store the employee first name in the database is less user-friendly. Instead, we can use something like 'First Name'.
- So, renaming a database column is known as creating an **alias** of that column. Aliases are added to make the code more readable.

Syntax:

```
SELECT column1 AS  alias_name,  column2 AS  alias_name
FROM table_name
 OR
 SELECT column1 "alias_name",  column2 "alias_name"
FROM table_name
```

Let's take a look at Example 4

SELECTED Rows, ALL Columns

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3. **SELECTED rows and ALL columns**
   Syntax:

   SELECT * FROM *table_name*

   WHERE *condition*;

4. **SELECTED rows and SELECTED columns**
   Syntax:
   SELECT column1, column2,...
   FROM *table_name*
   WHERE *condition*;

Let's take a look at Example 5

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SELECT Command - Hands-On Exercise (5 min)

On the movie table created previously, let us perform the following operations:

1. Select all the movies from the movie table
2. Select the columns *movie_name* and *release_date* from the movie table by giving the alias *Release Date* for *movie_release_date* attribute.
3. Select the movie from the movie table with *movie_name* as Sev7en
4. Select *movie_name* as 'NAME' from the movie table with *movie_name* as Sev7en

Update the Records

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- After we have inserted a record, we might realise later that due to some reasons, we need to change the value of an existing record.

- Some examples of such a situation could be as follows:

1. We need to update the address of a customer as they have moved to a new location.
2. We need to change the price of movie tickets as the prices have increased.
3. The release date of a movie is changed due to unavailability of the selected date.

- Now, how do we make this change?

- To update an existing column, we use the ‘**UPDATE**’ command.

Update the Records

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Syntax:

```
UPDATE TABLE table_name
SET column1 = value1, column2 = value2, ...
WHERE condition;
```

Note: If you omit the where condition, then it will affect all the rows.

Let’s take a look at Example 6

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UPDATE Command - Hands-On Exercise (5 min)

1. Change the movie release date of a movie with *movie_name* as 'Sev7en'. You can set the release date to ‘03-12-2020’.
2. Change the release date of all movies to ‘01-10-2020’

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DISCUSSION TIME

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Thank You!