DATABASE SYSTEMS PROGRAMMING

ORACLE®

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Learning Objectives

In this course you will learn about:

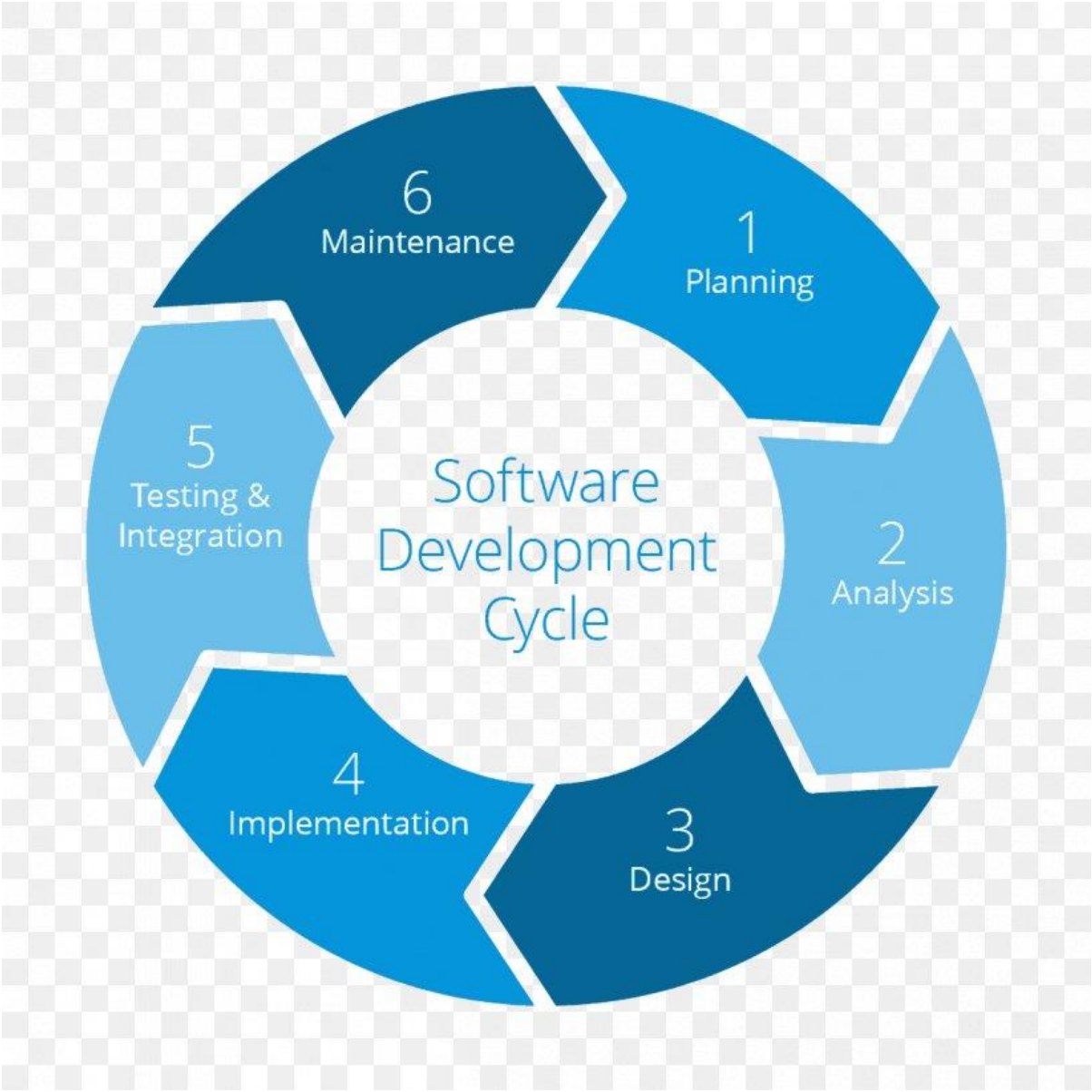
- Database Systems Overview
- SQL
- PL-SQL
- Form Builder
- Report Builder

Database Systems Overview

Database Systems Overview

- **Outlines:**
  - **Software Development Life Cycle**
  - **Database**
  - **Database Tables**
  - **Data Models & ERM**
  - **Primary Key & Foreign Key**

Software Development Life Cycle



Database Definition

- **What is Data?**

Pieces of information.

- **What is database?**

It is organized collection of information.

- **What is DBMS?**

Database management system to store and retrieve and modify data in the database.

And because Oracle is relational database, then we have:

1. **RDBMS** (Relational database management system).
2. **ORDBMS** ("Object-Relational Database Management System")

Database Definition

Database Objects

Object	Description
Table	Basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of some queries
Synonym	Gives alternative names to objects

Database Tables

- **What is the table?**

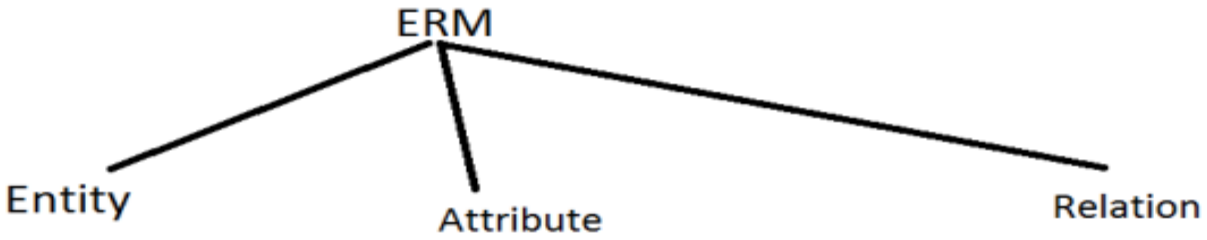
It is the basic storage of an RDBMS

- **Table names and column names:**
  - Must begin with a letter
  - Must be 1–30 characters long
  - Must contain only A–Z, a–z, 0–9, _, $, and #
  - Must not duplicate the name of another object owned by the same user
  - Must not be an Oracle server reserved word

Data Models & ERM

- **What is Data models?**

Conceptual tools to describe data. In database we have ERM (Entity Relation Model)



An entity is a real-world object that can be easily identified. **ex; in a school database: students, teachers, classes, and courses.**	**Attributes are things that describe the entity.** **ex; in the student entity: student name, age, birthday …**	**A relationship is a connection between two or more entities.** **ex; an employee works_at a department, a student enrolls in a course.**

Primary Key & Foreign Key

record

- Each row of data in a table can be uniquely identified by a primary key.
- You can logically relate data from multiple tables using foreign keys.

Table name: DEPARTMENTS

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	1700
20	Marketing	201	1800
50	Shipping	124	1500
60	IT	103	1400
80	Sales	149	2500
90	Executive	100	1700
110	Accounting	205	1700
190	Contracting	(null)	1700

Primary key

Table name: EMPLOYEES

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	DEPARTMENT_ID
100	Steven	King	90
101	Neena	Kochhar	90
102	Lex	De Haan	90
103	Alexander	Hunold	60
104	Bruce	Ernst	60
107	Diana	Lorentz	60
124	Kevin	Mourgos	50
141	Trenna	Rajs	50
142	Curtis	Davies	50

Primary key

Foreign key

Primary Key & Foreign Key

Guidelines for Primary Keys and Foreign Keys

- You cannot use duplicate values in a primary key.
- Primary keys generally cannot be changed.
- Foreign keys are based on data values and are purely logical (not physical) pointers.
- A foreign key value must match an existing primary key value or unique key value; otherwise, it must be null.
- A foreign key must reference either a primary key or a unique key column.

SQL

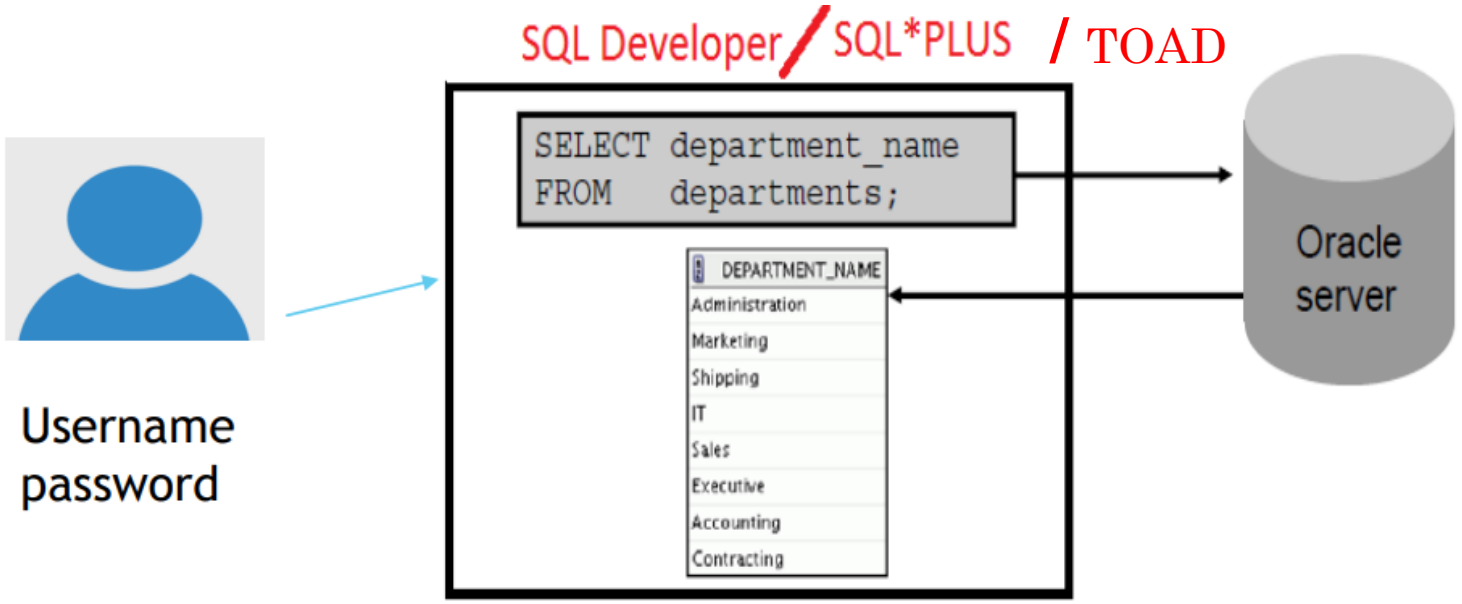
SQL

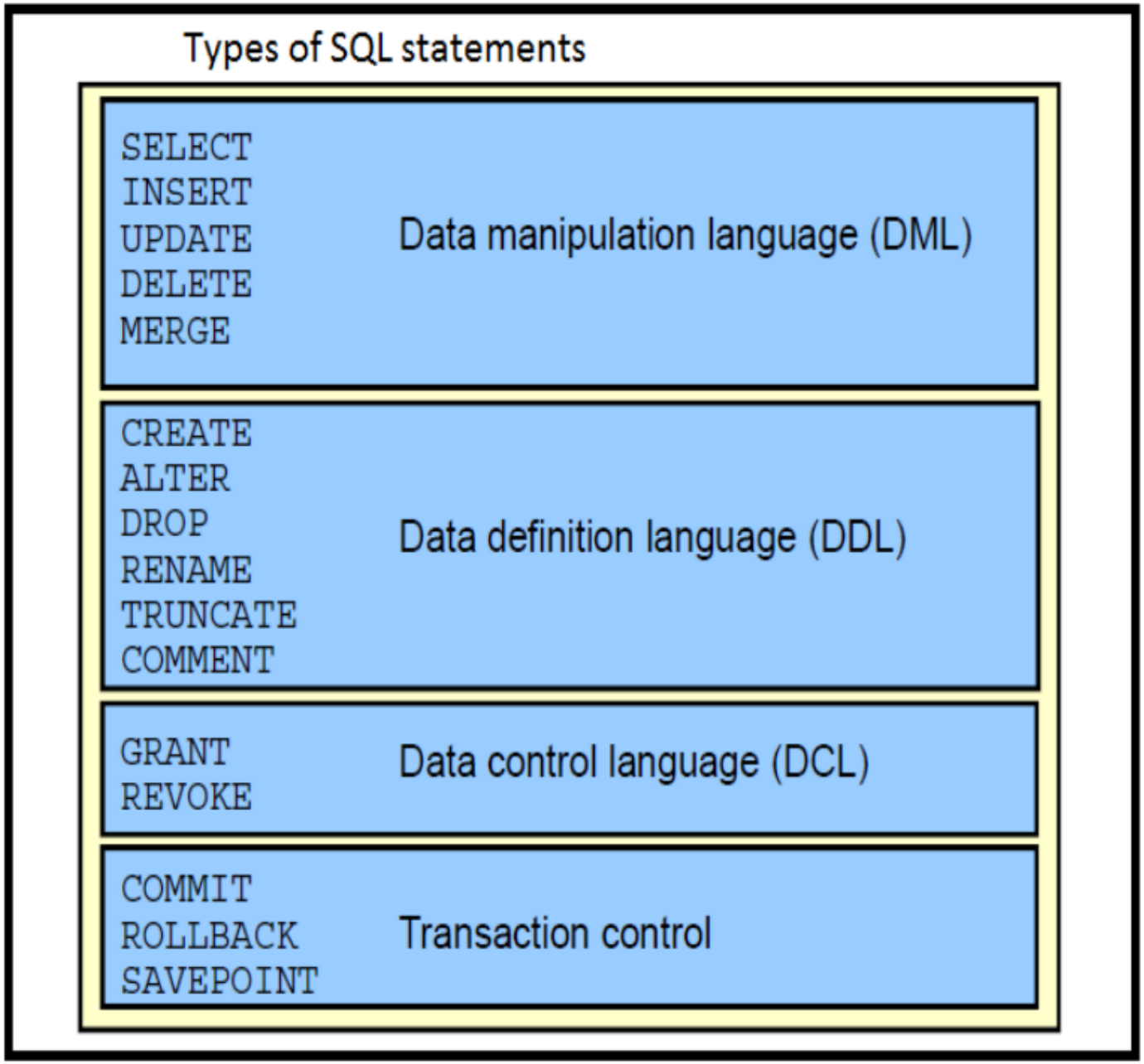
- **Outlines:**
  - **SQL Definition.**
  - **Types of SQL Statements.**
  - **Characteristics of SQL Statements.**
  - **Data Types**
  - **Database Schema Example (HR).**
  - **Connecting to the Database.**
    - **As a system administrator**
    - **As a system user**
  - **Data Types**
  - **DML**
  - **DDL**

SQL Definition

- SQL (Structured Query Language) is a standard programming language specifically designed for managing and manipulating relational databases.
- SQL is widely used in database management systems like MySQL, Microsoft SQL Server, and Oracle.
- To access Oracle database you need SQL
- To write SQL statements you need development environments:
  - SQL*PLUS
  - Oracle SQL developer (the primary tool)
  - Toad for SQL Server/Oracle

SQL Definition




Types of SQL statements
SELECT
INSERT
UPDATE
DELETE
MERGE
Data manipulation language (DML)
CREATE
ALTER
DROP
RENAME
TRUNCATE
COMMENT
Data definition language (DDL)
GRANT
REVOKE
Data control language (DCL)
COMMIT
ROLLBACK
SAVEPOINT
Transaction control

SQL STATEMENT CHARACTERISTICS

DDL

- **Auto-commit: DDL commands are automatically committed in most database systems, meaning the changes are permanent and cannot be rolled back.**
- **Schema Changes: DDL commands alter the schema (structure) of the database, rather than the data itself.**

DML

- **Affecting Data Only: DML commands are used to manipulate the data within the tables, not the structure of the tables.**
- **Transaction Control: Unlike DDL, DML commands are not automatically committed. You can use transaction control commands like COMMIT, ROLLBACK, and SAVEPOINT to manage transactions.**

DCL

- **Security Management**: DCL commands play a crucial role in securing the database by controlling who can access or modify the data and database objects.
- **Transaction Control:** Like DML, changes made using DCL commands are usually committed automatically, which means they cannot be rolled back in most database systems.

Transaction Control

- **Atomicity:** Transactions ensure that a set of SQL operations either all succeed or all fail, maintaining data consistency.
- **Consistency:** The database is always in a consistent state before and after a transaction.
- **Isolation:** Transactions are isolated from each other, preventing unintended interactions between concurrent transactions.
- **Durability:** Once a transaction is committed, its changes are permanent, even if the system fails.

Data Types

Data Type	Description
VARCHAR2(*size*)	Variable-length character data
CHAR(*size*)	Fixed-length character data
NUMBER(*p*,*s*)	Variable-length numeric data
DATE	Date and time values
LONG	Variable-length character data (up to 2 GB)
CLOB	Character data (up to 4 GB)
RAW and LONG RAW	Raw binary data
BLOB	Binary data (up to 4 GB)
BFILE	Binary data stored in an external file (up to 4 GB)
ROWID	A base-64 number system representing the unique address of a row in its table

Human Resources (HR) Schema