Database Management Systems

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Data Definition Language (DDL)

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- Specification notation for defining the database schema
  - E.g.

    create table *account* (
    account-number **char**(10),
    balance **integer**)
- DDL compiler generates a set of tables stored in a *data dictionary*
- Data dictionary contains metadata (i.e., data about data)
  - database schema
  - Data *storage and definition* language
    - language in which the storage structure and access methods used by the database system are specified
    - Usually an extension of the data definition language

Data Manipulation Language (DML)

Data Manipulation Language (DML)

- Language for accessing and manipulating the data organized by the appropriate data model
  - DML also known as query language
- Two classes of languages
  - Procedural – user specifies what data is required and how to get those data
  - Nonprocedural – user specifies what data is required without specifying how to get those data
- SQL is the most widely used query language


MySQL
TM

Type	Description	Example Values
INT	Integer (whole number)	1, 42, -100
TINYINT	Very small integer (-128 to 127)	0, 127
SMALLINT	Small integer	-32,768 to 32,767
MEDIUMINT	Medium integer	-8M to 8M approx.
BIGINT	Large integer	-2^{63} to $2^{63}-1$
DECIMAL(p,s)	Fixed-point number (precision, scale)	DECIMAL(5,2): 123.45
FLOAT	Single-precision floating point	3.14
DOUBLE	Double-precision floating point	3.14159265359
BIT	Stores bit-field values	BIT(1) = 0 or 1
BOOLEAN	Alias for TINYINT(1) (0 = false, 1 = true)	0, 1

Type	Description	Example
DATE	Date (YYYY-MM-DD)	'2025-08-02'
DATETIME	Date and time	'2025-08-02 13:45:00'
TIMESTAMP	Date and time (with auto update)	'2025-08-02 13:45:00'
TIME	Time only	'13:45:00'
YEAR	Year (4 digits)	2025

Type	Description	Example
CHAR(n)	Fixed-length string (padded)	'Hello '
VARCHAR(n)	Variable-length string	'Hello'
TEXT	Large text (up to 64 KB)	Article, paragraph
TINYTEXT	Up to 255 characters	Short description
MEDIUMTEXT	Up to 16 MB	Medium documents
LONGTEXT	Up to 4 GB	Books, large logs
ENUM(...)	One value from a list	'Male', 'Female'
SET(...)	Multiple values from a list	'Reading, Swimming'
BLOB types	Binary data (e.g., images/files)	Binary files

CREATE DATABASE university;

```
CREATE TABLE students (
    student_id INT AUTO_INCREMENT PRIMARY KEY,
    name VARCHAR(100),
    birth_date DATE,
    email VARCHAR(100) UNIQUE,
    gpa DECIMAL(3,2)
);
```

Add a new column

ALTER TABLE students **ADD COLUMN** phone **VARCHAR(**15);

Modify a column

ALTER TABLE students **MODIFY COLUMN** gpa **DECIMA**L(4,2);

Drop a column

ALTER TABLE students **DROP COLUMN** phone;

SQL

- SQL: widely used non-procedural language
  - E.g. find the name of the customer with customer-id 192-83-7465

    select *customer.customer-name*
    from *customer*
    where *customer.customer-id* = '192-83-7465'
  - E.g. find the balances of all accounts held by the customer with customer-id 192-83-7465

    select *account.balance*
    from *depositor*, *account*
    where *depositor.customer-id* = '192-83-7465' **and**
    depositor.account-number = *account.account-number*
- Application programs generally access databases through one of
  - Language extensions to allow embedded SQL
  - Application program interface (e.g. ODBC/JDBC) which allow SQL queries to be sent to a database


MySQL
TM

Id	Name	Department	Salary	Gender	Age	City
1001	John Doe	IT	35000	Male	25	London
1002	Mary Smith	HR	45000	Female	27	Mumbai
1003	James Brown	Finance	50000	Male	28	Delhi
1004	Mike Walker	Finance	50000	Male	28	London
1005	Linda Jones	HR	75000	Female	26	Mumbai
1006	Anurag Mohanty	IT	35000	Male	25	London
1007	Priyanla Dewangan	HR	45000	Female	27	Mumbai
1008	Sambit Mohanty	IT	50000	Male	28	London
1009	Pranaya Kumar	IT	50000	Male	28	London
1010	Hina Sharma	HR	75000	Female	26	Mumbai

```sql
CREATE DATABASE company;
USE company;

CREATE TABLE employee (
   Id INT PRIMARY KEY,
   Name VARCHAR(45) NOT NULL,
   Department VARCHAR(45) NOT NULL,
   Salary FLOAT NOT NULL,
   Gender VARCHAR(45) NOT NULL,
   Age INT NOT NULL,
   City VARCHAR(45) NOT NULL
);
```

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1009	Pranaya Kumar	IT	50000	Male	28	London
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SELECT Name, Department, Gender, City FROM employee;

Name	Department	Gender	City
John Doe	IT	Male	London
Mary Smith	HR	Female	Mumbai
James Brown	Finance	Male	Delhi
Mike Walker	Finance	Male	London
Linda Jones	HR	Female	Mumbai
Anurag Mohanty	IT	Male	London
Priyanla Dewangan	HR	Female	Mumbai
Sambit Mohanty	IT	Male	London
Pranaya Kumar	IT	Male	London
Hina Sharma	HR	Female	Mumbai

SELECT * FROM employee WHERE Department = 'IT';

SELECT Id, Name, Department, Salary, Gender, Age, City
FROM employee;

Id	Name	Department	Salary	Gender	Age	City
1001	John Doe	IT	35000	Male	25	London
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