



Assignment Project Exam Help

SQL – Part 1

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SQL and Data Definition Language

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What is SQL?

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- SQL stands for Structured Query Language
- SQL was initially developed at IBM (SEQUEL → SQL), as one of the first commercial languages for the relational data model.
- 1986 – SQL was standardised by ANSI and ISO (↪ SQL-86).
- 1989 – SQL was revised (↪ SQL-89).
- 1992 – SQL was strengthened and much expanded (↪ SQL-92).
- 1999 – SQL was expanded and divided into a core specification plus optional specialised packages (↪ SQL:1999).
- 2003 – SQL was further expanded, e.g., XML support (↪ SQL:2003).
- 2011 — SQL was further expanded, e.g., improved support for temporal databases (↪ SQL:2011).

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What is SQL?

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- SQL provides an interface to relational database systems, including:

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- Data Definition Language (DDL);

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- Data Control Language (DCL);

- Transaction Control Language (TCL).



Relational Data Model and SQL

- Unlike the relational data model that is based on **sets**, SQL is based on **multisets**. It means that SQL allows a relation to have duplicate tuples.

Relation name
(Table name)

Attribute (Column)

R

A_1	...	A_n
Value		

Relation
(Table)

Tuple (Row)



Data Definition Language

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StudentID	Name	CourseNo	Semester

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Data Definition Language – Create Table

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- The **CREATE TABLE** statement is used to create a new relation schema by specifying its name, its attributes and, *optionally*, its constraints.

```
CREATE TABLE table_name  
    (attribute_name data_type [attribute constraints],  
    ...,  
    attribute_name data_type [attribute constraints],  
    [table constraints]);
```

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- For each attribute in a relation, we specify its name, its type and, *optionally*, a constraint specific to the attribute (i.e., attribute constraint).

```
attribute_name data_type [attribute_constraint]
```



Create Table – Example

```
CREATE TABLE STUDENT  
(StudentID INT,  
Name VARCHAR(50),  
DoB Date,  
Email VARCHAR(100));
```

StudentID	Name	DoB	Email
-----------	------	-----	-------

```
CREATE TABLE COURSE  
(No VARCHAR(20),  
Cname VARCHAR(50),  
Unit SMALLINT);
```

No	Cname	Unit
----	-------	------

```
CREATE TABLE ENROL  
(StudentID INT,  
CourseNo VARCHAR(20),  
Semester VARCHAR(50),  
Status VARCHAR(50)),
```

StudentID	CourseNo	Semester	Status
-----------	----------	----------	--------

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Attribute Data Types

• Numeric types:

- **TINYINT** and **SMALLINT** provide domains of integer numbers of various sizes.
- **FLOAT** or **REAL**, and **DOUBLE PRECISION** provide floating point numbers of various precision.
- **NUMERIC(*i*)** or **DECIMAL(*i*, *j*)** provide fixed point numbers with parameters *precision i* and *scale j*.
 - **precision** for the total number of digits;
 - **scale** for the number of digits following the decimal point.

• String types

- **CHAR(*n*)** allows character strings of fixed length, where *n* is the number of characters.
- **VARCHAR(*n*)** allows character strings of varying length, where *n* is the maximum number of characters.
- **BIT(*n*)** allows bit strings of fixed length, where *n* is the number of bits.
- **BIT VARYING(*n*)** allows bit strings of varying length, where *n* is the maximum number of bits.

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Attribute Data Types

- **Date and time types:**

- **DATE** provides date values (year, month, day).
- **TIME** provides time values (hour, minute, second).
- **TIMESTAMP** includes the DATE and TIME fields, plus a minimum of six positions for seconds and an optional WITH TIME ZONE qualifier.
- **INTERVAL** specifies a relative value that can be used to increment or decrement a value of a date, time or timestamp.

- **Boolean type:** has the values of TRUE or FALSE.

- The **CREATE DOMAIN** statement is used to create a domain that is essentially a specific data type.

```
CREATE DOMAIN domain_name AS data_type  
[default expression] [constraint,...,constraint];
```

Example: CREATE DOMAIN ssn_type AS CHAR(9);



Attribute Data Types – Example

```
CREATE TABLE STUDENT  
(StudentID INT,  
Name VARCHAR(50),  
DoB Date,  
Email VARCHAR(100));
```

StudentID	Name	DoB	Email
-----------	------	-----	-------

```
CREATE TABLE COURSE  
(No VARCHAR(20),  
Cname VARCHAR(50),  
Unit SMALLINT);
```

No	Cname	Unit
----	-------	------

```
CREATE TABLE ENROL  
(StudentID INT,  
CourseNo VARCHAR(20),  
Semester VARCHAR(50),  
Status VARCHAR(50));
```

StudentID	CourseNo	Semester	Status
-----------	----------	----------	--------

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Attribute Constraints

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The following constraints can be specified in SQL.

NOT NULL: specify that NULL is not allowed for an attribute.

DEFAULT: set a default value for an attribute.

CHECK: limit the values taken from the domain of an attribute.

UNIQUE: ensure that uniqueness of the values for an attribute or a set of attribute in a table.

PRIMARY KEY: uniquely identify each tuple in a table.

FOREIGN KEY: enforce referential integrity between two tables.

INDEX: provides accelerated access to the rows of table.

Attribute Constraints – Not Null, Default and Check

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```
CREATE TABLE COURSE  
(Cname VARCHAR(20) PRIMARY KEY,  
  Cname VARCHAR(50) NOT NULL,  
  Unit SMALLINT NOT NULL Default 6);
```

```
CREATE TABLE ENROL  
(StudentID INT NOT NULL CHECK (StudentID>0),  
  CourseNo VARCHAR(20) NOT NULL,  
  Semester VARCHAR(50) NOT NULL,  
  Status VARCHAR(50),  
  ...);
```

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- If we don't want to have missing and unknown data, we can specify **NOT NULL** for attributes to forbid NULL values.
- Unit of any new tuple in COURSE is set to 6 if no explicit value is provided.
- **CHECK()** for StudentID excludes the student IDs such as 0 and -37.

Attribute Constraints – Unique and Primary Key

```
CREATE TABLE Course
(Cno VARCHAR(20) PRIMARY KEY,
 Cname VARCHAR(50) UNIQUE,
 Unit SMALLINT NOT NULL Default 6);
```

```
CREATE TABLE ENROL
(StudentID INT NOT NULL CHECK (StudentID>0),
 CourseNo VARCHAR(20) NOT NULL,
 Semester VARCHAR(50) NOT NULL,
 Status VARCHAR(50),
 PRIMARY KEY (StudentID, CourseNo, Semester),
 ...);
```

- If a primary key contains only one attribute, **PRIMARY KEY** can be defined as an attribute constraint (e.g., in COURSE); otherwise it is defined as a table constraint (e.g., in ENROL).
- **PRIMARY KEY** specifies a key while **UNIQUE** specifies additional keys.



Attribute Constraints – Foreign Key

```
CREATE TABLE STUDENT
```

```
( StudentID INT PRIMARY KEY,
```

```
  Name VARCHAR(50),
```

```
  DoB Date,
```

```
  Email VARCHAR(100));
```

```
CREATE TABLE COURSE
```

```
( CourseNo VARCHAR(20) PRIMARY KEY,
```

```
  Cname VARCHAR(50),
```

```
  Unit SMALLINT);
```

```
CREATE TABLE ENROL
```

```
( StudentID INT,
```

```
  CourseNo VARCHAR(20),
```

```
  Semester VARCHAR(50),
```

```
  Status VARCHAR(50));
```

- Every StudentID appearing in ENROL must exist in STUDENT.

- Every CourseNo appearing in ENROL must exist in COURSE.

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Attribute Constraints – Foreign Key

```
CREATE TABLE STUDENT
```

```
(StudentID INT PRIMARY KEY,  
Name VARCHAR(50),  
DoB Date,  
Email VARCHAR(100));
```

```
CREATE TABLE COURSE
```

```
(No VARCHAR(20) PRIMARY KEY,  
Cname VARCHAR(50),  
Unit SMALLINT);
```

• StudentID in ENROL
references
StudentID in STUDENT.

```
CREATE TABLE ENROL
```

```
(StudentID INT,  
CourseNo VARCHAR(20),  
Semester VARCHAR(50),  
Status VARCHAR(50),
```

• CourseNo in ENROL
references
No in COURSE.

```
FOREIGN KEY(StudentID) REFERENCES STUDENT(StudentID),  
FOREIGN KEY(CourseNo) REFERENCES COURSE(No));
```

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Attribute Constraints – Foreign Key

```
CREATE TABLE ENROL
```

```
(StudentID INT,  
CourseNo VARCHAR(20),  
Semester VARCHAR(50),  
Status VARCHAR(50),  
FOREIGN KEY (StudentID) REFERENCES STUDENT(StudentID),  
FOREIGN KEY (CourseNo) REFERENCES COURSE(CourseNo));
```

```
CREATE TABLE STUDENT
```

```
(StudentID INT PRIMARY KEY,  
Name VARCHAR(50),  
DoB Date,  
Email VARCHAR(100));
```

```
CREATE TABLE COURSE
```

```
(No VARCHAR(20) PRIMARY KEY,  
Cname VARCHAR(50),  
Unit SMALLINT);
```

- Can we define ENROL before STUDENT and COURSE?

Answer: No. ENROL has the foreign keys that reference STUDENT and COURSE.

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Attribute Constraints – Index

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- Indexes are used for fast retrieval based on columns other than the primary key.

```
CREATE TABLE CUSTOMER
```

```
(CustomerID INT NOT NULL,  
  Name VARCHAR(50) NOT NULL,  
  DOB DATE NOT NULL,  
  Address VARCHAR(80),  
  Phone INT CHECK (Phone>0),  
  PRIMARY KEY (CustomerID));
```

```
CREATE INDEX index1 ON CUSTOMER (Name, DOB);
```

```
CREATE UNIQUE INDEX index2 ON CUSTOMER (Phone);
```

Data Definition Language – Alter and Drop Table

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- The **ALTER TABLE** statement is used to modify an existing relation schema, including:

- changing the name of a table;
- adding or dropping an attribute;
- changing the definition of an attribute;
- adding or dropping table constraints.

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- The **DROP TABLE** statement is used to remove an existing relation schema from a database schema.

Data Definition Language – Alter and Drop Table

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- Add a NOT NULL constraint:

```
ALTER TABLE CUSTOMER ALTER COLUMN Address SET NOT NULL;
```

- Add a UNIQUE constraint:

```
ALTER TABLE CUSTOMER ADD UNIQUE(Phone);
```

- Add a check() constraint:

```
ALTER TABLE CUSTOMER  
ADD CONSTRAINT positive_id CHECK (CustomerID > 0);
```

- Add a Foreign Key constraint:

```
ALTER TABLE ENROL  
ADD FOREIGN KEY(StudentID) REFERENCES Student(StudentID);
```

Data Definition Language – Alter and Drop Table

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- Add an attribute EMAIL into the table CUSTOMER:

```
ALTER TABLE CUSTOMER ADD Email VARCHAR(100);
```

- Drop the attribute EMAIL in the table CUSTOMER:

```
ALTER TABLE CUSTOMER DROP COLUMN Email;
```

- Drop the table ENROL:

```
DROP TABLE ENROL;
```

- Drop the table CUSTOMER (if exists):

```
DROP TABLE IF EXISTS CUSTOMER;
```

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