6-Basic SQL

Outline

- SQL Data Definition and Data Types
- Specifying Constraints in SQL
- Basic Retrieval Queries in SQL
- `INSERT`, `DELETE`, and `UPDATE` Statements in SQL
- Additional Features of SQL

Basic SQL

- SQL language
  - Considered one of the major reasons for the commercial success of relational databases
- **SQL**
  - **Structured Query Language**
  - Statements for data definitions, queries, and updates (both DDL and DML)
  - **Core specification**
  - Plus specialized **extensions**

SQL Data Definition and Data Types

- Terminology:
  - **Table**, **row**, and **column** used for relational model terms relation, tuple, and attribute
- `CREATE` statement
  - Main SQL command for data definition

Schema and Catalog Concepts in SQL

- **SQL schema**
  - Identified by a **schema name**
  - Includes an **authorization identifier** and **descriptors** for each element
- Schema **elements** include
  - Tables, constraints, views, domains, and other constructs
- Each statement in SQL ends with a semicolon

Schema and Catalog Concepts in SQL (cont'd.)

- `CREATE SCHEMA` statement
  - `CREATE SCHEMA COMPANY AUTHORIZATION 'Jsmith';`
- **Catalog**
  - Named collection of schemas in an SQL environment
- SQL **environment**
  - Installation of an SQL-compliant RDBMS on a computer system

The CREATE TABLE Command in SQL

- Specify a new relation
  - Provide name
  - Specify attributes and initial constraints
- Can optionally specify schema:
  - `CREATE TABLE COMPANY.EMPLOYEE ...`

    or
  - `CREATE TABLE EMPLOYEE ...`

The CREATE TABLE Command in SQL (cont'd.)

- **Base tables** (**base relations**)
  - Relation and its tuples are actually created and stored as a file by the DBMS
- **Virtual relations**
  - Created through the `CREATE VIEW` statement

```
CREATE TABLE EMPLOYEE
        ( Fname          VARCHAR(15)          NOT NULL,
          Minit          CHAR,
          Lname          VARCHAR(15)          NOT NULL,
          Ssn            CHAR(9)              NOT NULL,
          Bdate          DATE,
          Address        VARCHAR(30),
          Sex            CHAR,
          Salary         DECIMAL(10,2),
          Super_ssn      CHAR(9),
          Dno            INT                  NOT NULL,
        PRIMARY KEY (Ssn),
        FOREIGN KEY (Super_ssn) REFERENCES EMPLOYEE(Ssn),
        FOREIGN KEY (Dno) REFERENCES DEPARTMENT(Dnumber) );
CREATE TABLE DEPARTMENT
        ( Dname          VARCHAR(15)          NOT NULL,
          Dnumber        INT                  NOT NULL,
          Mgr_ssn        CHAR(9)              NOT NULL,
          Mgr_start_date DATE,
        PRIMARY KEY (Dnumber),
        UNIQUE (Dname),
        FOREIGN KEY (Mgr_ssn) REFERENCES EMPLOYEE(Ssn) );
```

Figure 4.1
SQL CREATE TABLE data definition statements for defining the COMPANY schema from Figure 3.7.

```
CREATE TABLE DEPT_LOCATIONS
        ( Dnumber           INT             NOT NULL,
          Dlocation         VARCHAR(15)     NOT NULL,
        PRIMARY KEY (Dnumber, Dlocation),
        FOREIGN KEY (Dnumber) REFERENCES DEPARTMENT(Dnumber) );
CREATE TABLE PROJECT
        ( Pname             VARCHAR(15)     NOT NULL,
          Pnumber           INT             NOT NULL,
          Plocation         VARCHAR(15),
          Dnum              INT             NOT NULL,
        PRIMARY KEY (Pnumber),
        UNIQUE (Pname),
        FOREIGN KEY (Dnum) REFERENCES DEPARTMENT(Dnumber) );
CREATE TABLE WORKS_ON
        ( Essn              CHAR(9)         NOT NULL,
          Pno               INT             NOT NULL,
          Hours             DECIMAL(3,1)    NOT NULL,
        PRIMARY KEY (Essn, Pno),
        FOREIGN KEY (Essn) REFERENCES EMPLOYEE(Ssn),
        FOREIGN KEY (Pno) REFERENCES PROJECT(Pnumber) );
CREATE TABLE DEPENDENT
        ( Essn              CHAR(9)         NOT NULL,
          Dependent_name    VARCHAR(15)     NOT NULL,
          Sex               CHAR,
          Bdate             DATE,
          Relationship      VARCHAR(8),
        PRIMARY KEY (Essn, Dependent_name),
        FOREIGN KEY (Essn) REFERENCES EMPLOYEE(Ssn) );
```

Figure 4.1
SQL CREATE TABLE data definition statements for defining the COMPANY schema from Figure 3.7.

The CREATE TABLE Command in SQL (cont'd.)

- Some foreign keys may cause errors
  - Specified either via:
    - Circular references
    - Or because they refer to a table that has not yet been created

Attribute Data Types and Domains in SQL

- Basic **data types**
  - **Numeric** data types
    - Integer numbers: `INTEGER`, `INT`, and `SMALLINT`
    - Floating-point (real) numbers: `FLOAT` or `REAL`, and `DOUBLE PRECISION`
  - **Character-string** data types
    - Fixed length: `CHAR(`*n*`)`, `CHARACTER(`*n*`)`
    - Varying length: `VARCHAR(`*n*`)`, `CHAR VARYING(`*n*`)`, `CHARACTER VARYING(`*n*`)`

Attribute Data Types and Domains in SQL (cont'd.)

- **Bit-string** data types
  - Fixed length: `BIT(`*n*`)`
  - Varying length: `BIT VARYING(`*n*`)`
- **Boolean** data type
  - Values of `TRUE` or `FALSE` or `NULL`
- **DATE** data type
  - Ten positions
  - Components are `YEAR`, `MONTH`, and `DAY` in the form YYYY-MM-DD

Attribute Data Types and Domains in SQL (cont'd.)

- Additional data types
  - **Timestamp** data type (`TIMESTAMP`)
    - Includes the `DATE` and `TIME` fields
    - Plus a minimum of six positions for decimal fractions of seconds
    - Optional `WITH TIME ZONE` qualifier
  - **`INTERVAL`** data type
    - Specifies a relative value that can be used to increment or decrement an absolute value of a date, time, or timestamp

Attribute Data Types and Domains in SQL (cont'd.)

- Domain
  - Name used with the attribute specification
  - Makes it easier to change the data type for a domain that is used by numerous attributes
  - Improves schema readability
  - Example:
    - `CREATE DOMAIN SSN_TYPE AS CHAR(9);`

Specifying Constraints in SQL

- Basic constraints:
  - Key and referential integrity constraints
  - Restrictions on attribute domains and NULLs
  - Constraints on individual tuples within a relation

Specifying Attribute Constraints and Attribute Defaults

- `NOT NULL`
  - `NULL` is not permitted for a particular attribute
- Default value
  - **`DEFAULT`** `<value>`
- **`CHECK`** clause
  - `Dnumber INT NOT NULL CHECK (Dnumber > 0 AND Dnumber < 21);`

```
CREATE TABLE EMPLOYEE
    ( . . . ,
      Dno        INT          NOT NULL        DEFAULT 1,
    CONSTRAINT EMPPK
      PRIMARY KEY (Ssn),
    CONSTRAINT EMPSUPERFK
      FOREIGN KEY (Super_ssn) REFERENCES EMPLOYEE(Ssn)
                  ON DELETE SET NULL          ON UPDATE CASCADE,
    CONSTRAINT EMPDEPTFK
      FOREIGN KEY(Dno) REFERENCES DEPARTMENT(Dnumber)
                  ON DELETE SET DEFAULT       ON UPDATE CASCADE);
CREATE TABLE DEPARTMENT
    ( . . . ,
      Mgr_ssn    CHAR(9)      NOT NULL        DEFAULT '888665555',
      . . . ,
    CONSTRAINT DEPTPK
      PRIMARY KEY(Dnumber),
    CONSTRAINT DEPTSK
      UNIQUE (Dname),
    CONSTRAINT DEPTMGRFK
      FOREIGN KEY (Mgr_ssn) REFERENCES EMPLOYEE(Ssn)
                  ON DELETE SET DEFAULT   ON UPDATE CASCADE);
CREATE TABLE DEPT_LOCATIONS
    ( . . . ,
    PRIMARY KEY (Dnumber, Dlocation),
    FOREIGN KEY (Dnumber) REFERENCES DEPARTMENT(Dnumber)
                  ON DELETE CASCADE           ON UPDATE CASCADE);
```

Figure 4.2
Example illustrating how default attribute values and referential integrity triggered actions are specified in SQL.

Specifying Key and Referential Integrity Constraints

- **`PRIMARY KEY`** clause
  - Specifies one or more attributes that make up the primary key of a relation
  - `Dnumber INT PRIMARY KEY;`
- **`UNIQUE`** clause
  - Specifies alternate (secondary) keys
  - `Dname VARCHAR(15) UNIQUE;`

Specifying Key and Referential Integrity Constraints (cont'd.)

- **`FOREIGN KEY`** clause
  - Default operation: reject update on violation
  - Attach **referential triggered action** clause
    - Options include `SET NULL`, `CASCADE`, and `SET DEFAULT`
    - Action taken by the DBMS for `SET NULL` or `SET DEFAULT` is the same for both `ON DELETE` and `ON UPDATE`
    - `CASCADE` option suitable for "relationship" relations

Giving Names to Constraints

- Keyword **`CONSTRAINT`**
  - Name a constraint
  - Useful for later altering

Specifying Constraints on Tuples Using CHECK

- `CHECK` clauses at the end of a `CREATE TABLE` statement
  - Apply to each tuple individually
  - `CHECK (Dept_create_date <= Mgr_start_date);`

Basic Retrieval Queries in SQL

- `SELECT` statement
  - One basic statement for retrieving information from a database
- SQL allows a table to have two or more tuples that are identical in all their attribute values
  - Unlike relational model
  - Multiset or bag behavior

The SELECT-FROM-WHERE Structure of Basic SQL Queries

- Basic form of the `SELECT` statement:

SELECT <attribute list>
FROM <table list>
WHERE <condition>;

where

- <attribute list> is a list of attribute names whose values are to be retrieved by the query.
- <table list> is a list of the relation names required to process the query.
- <condition> is a conditional (Boolean) expression that identifies the tuples to be retrieved by the query.

The SELECT-FROM-WHERE Structure of Basic SQL Queries (cont'd.)

- Logical comparison operators
  - =, <, <=, >, >=, and <>
- **Projection attributes**
  - Attributes whose values are to be retrieved
- **Selection condition**
  - Boolean condition that must be true for any retrieved tuple

Figure 3.6
One possible database state for the COMPANY relational database schema.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

Figure 4.3
Results of SQL queries when applied to the COMPANY database state shown in Figure 3.6. (a) Q0. (b) Q1. (c) Q2. (d) Q8. (e) Q9. (f) Q10. (g) Q1C.

(a)

Bdate	Address
1965-01-09	731Fondren, Houston, TX

(b)

Fname	Lname	Address
John	Smith	731 Fondren, Houston, TX
Franklin	Wong	638 Voss, Houston, TX
Ramesh	Narayan	975 Fire Oak, Humble, TX
Joyce	English	5631 Rice, Houston, TX

Query 0. Retrieve the birth date and address of the employee(s) whose name is 'John B. Smith'.

```
Q0:   SELECT   Bdate, Address
      FROM     EMPLOYEE
      WHERE    Fname='John' AND Minit='B' AND Lname='Smith';
```

Query 1. Retrieve the name and address of all employees who work for the 'Research' department.

```
Q1:   SELECT   Fname, Lname, Address
      FROM     EMPLOYEE, DEPARTMENT
      WHERE    Dname='Research' AND Dnumber=Dno;
```

Figure 4.3
Results of SQL queries when applied to the COMPANY database state shown in Figure 3.6. (a) Q0. (b) Q1. (c) Q2. (d) Q8. (e) Q9. (f) Q10. (g) Q1C.

(c)

Pnumber	Dnum	Lname	Address	Bdate
10	4	Wallace	291Berry, Bellaire, TX	1941-06-20
30	4	Wallace	291Berry, Bellaire, TX	1941-06-20

Query 2. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birth date.

```
Q2:   SELECT   Pnumber, Dnum, Lname, Address, Bdate
      FROM     PROJECT, DEPARTMENT, EMPLOYEE
      WHERE    Dnum=Dnumber AND Mgr_ssn=Ssn AND
               Plocation='Stafford';
```

Ambiguous Attribute Names

- Same name can be used for two (or more) attributes
  - As long as the attributes are in different relations
  - Must **qualify** the attribute name with the relation name to prevent ambiguity

```
Q1A:  SELECT  Fname, EMPLOYEE.Name, Address
      FROM    EMPLOYEE, DEPARTMENT
      WHERE   DEPARTMENT.Name='Research' AND
              DEPARTMENT.Dnumber=EMPLOYEE.Dnumber;
```

Aliasing, Renaming, and Tuple Variables

- **Aliases** or **tuple variables**
  - Declare alternative relation names E and S
  - `EMPLOYEE AS E(Fn, Mi, Ln, Ssn, Bd, Addr, Sex, Sal, Sssn, Dno)`

Unspecified WHERE Clause and Use of the Asterisk

- Missing `WHERE` clause
  - Indicates no condition on tuple selection
- `CROSS PRODUCT`
  - All possible tuple combinations

Queries 9 and 10. Select all EMPLOYEE Ssns (Q9) and all combinations of EMPLOYEE Ssn and DEPARTMENT Dname (Q10) in the database.

```
Q9:     SELECT    Ssn
        FROM      EMPLOYEE;

Q10:    SELECT    Ssn, Dname
        FROM      EMPLOYEE, DEPARTMENT;
```

Unspecified WHERE Clause and Use of the Asterisk (cont'd.)

- Specify an asterisk (*)
  - Retrieve all the attribute values of the selected tuples

```
Q1C:    SELECT    *
        FROM      EMPLOYEE
        WHERE     Dno=5;

Q1D:    SELECT    *
        FROM      EMPLOYEE, DEPARTMENT
        WHERE     Dname='Research' AND Dno=Dnumber;

Q10A:   SELECT    *
        FROM      EMPLOYEE, DEPARTMENT;
```

Tables as Sets in SQL

- SQL does not automatically eliminate duplicate tuples in query results
- Use the keyword **`DISTINCT`** in the `SELECT` clause
  - Only distinct tuples should remain in the result

Query 11. Retrieve the salary of every employee (Q11) and all distinct salary values (Q11A).

```
Q11:    SELECT    ALL Salary
        FROM      EMPLOYEE;

Q11A:   SELECT    DISTINCT Salary
        FROM      EMPLOYEE;
```

Tables as Sets in SQL (cont'd.)

- Set operations
  - UNION, **EXCEPT** (difference), **INTERSECT**
  - Corresponding multiset operations: UNION ALL, EXCEPT ALL, INTERSECT ALL)

Query 4. Make a list of all project numbers for projects that involve an employee whose last name is 'Smith', either as a worker or as a manager of the department that controls the project.

```
Q4A:  (SELECT    DISTINCT Pnumber
       FROM      PROJECT, DEPARTMENT, EMPLOYEE
       WHERE     Dnum=Dnumber AND Mgr_ssn=Ssn
                 AND Lname='Smith' )
       UNION
      ( SELECT   DISTINCT Pnumber
       FROM      PROJECT, WORKS_ON, EMPLOYEE
       WHERE     Pnumber=Pno AND Essn=Ssn
                 AND Lname='Smith' );
```

Substring Pattern Matching and Arithmetic Operators

- **`LIKE`** comparison operator
  - Used for string **pattern matching**
  - % replaces an arbitrary number of zero or more characters
  - underscore (_) replaces a single character
- Standard arithmetic operators:
  - Addition (+), subtraction (–), multiplication (*), and division (/)
- **`BETWEEN`** comparison operator

- Query 12. Retrieve all employees whose address is in Houston, Texas
- Q12: SELECT Fname, Lname

  FROM EMPLOYEE

  WHERE Address LIKE ‘%Houston, TX%’;
- Query 12A. Find all employees who were born during the 1950s
- Q12A: SELECT Fname, Lname

  FROM EMPLOYEE

  WHERE Bdate LIKE ‘_ _5 _ _ _ ___’ ;
  ‘%Houston, TX%’;

- Query 13. Show the resulting salaries if every employee working on the ‘ProductX’ project is given a 10 percent raise.
- Q13: SELECT Fname, Lname, 1,1 * Salary

  AS Increased_Sal

  FROM EMPLOYEE, WORKS_ON, PROJECT

  WHERE Ssn=Essn AND Pno=Pnumber AND

  Pname=‘ProductX’;
- Query 14. Retrive all employees in department 5 whose salary is between $30,000 and $40,000
- Q14: SELECT *

  FROM EMPLOYEE

  WHERE (Salary BETWEEN 30000 AND 40000)

  AND Dno=5;

Ordering of Query Results

- Use **`ORDER BY`** clause
  - Keyword **`DESC`** to see result in a descending order of values
  - Keyword **`ASC`** to specify ascending order explicitly
  - `ORDER BY D.Dname DESC, E.Lname ASC, E.Fname ASC`

Discussion and Summary of Basic SQL Retrieval Queries

```
SELECT      <attribute list>
FROM        <table list>
[ WHERE     <condition> ]
[ ORDER BY <attribute list> ];
```

INSERT, DELETE, and UPDATE Statements in SQL

- Three commands used to modify the database:
  - `INSERT`, `DELETE`, and `UPDATE`

The INSERT Command

- Specify the relation name and a list of values for the tuple

```
U1:   INSERT INTO   EMPLOYEE
      VALUES        ( 'Richard', 'K', 'Marini', '653298653', '1962-12-30', '98
                      Oak Forest, Katy, TX', 'M', 37000, '653298653', 4 );
```

```
U3B:  INSERT INTO   WORKS_ON_INFO ( Emp_name, Proj_name,
                    Hours_per_week )
      SELECT        E.Lname, P.Pname, W.Hours
      FROM          PROJECT P, WORKS_ON W, EMPLOYEE E
      WHERE         P.Pnumber=W.Pno AND W.Essn=E.Ssn;
```

The DELETE Command

- Removes tuples from a relation
  - Includes a `WHERE` clause to select the tuples to be deleted

```
U4A:  DELETE FROM   EMPLOYEE
      WHERE         Lname='Brown';

U4B:  DELETE FROM   EMPLOYEE
      WHERE         Ssn='123456789';

U4C:  DELETE FROM   EMPLOYEE
      WHERE         Dno=5;

U4D:  DELETE FROM   EMPLOYEE;
```

The UPDATE Command

- Modify attribute values of one or more selected tuples
- Additional **`SET`** clause in the `UPDATE` command
  - Specifies attributes to be modified and new values

```
U5:   UPDATE   PROJECT
      SET      Plocation = 'Bellaire', Dnum = 5
      WHERE    Pnumber=10;
```

Additional Features of SQL

- Techniques for specifying complex retrieval queries
- Writing programs in various programming languages that include SQL statements
- Set of commands for specifying physical database design parameters, file structures for relations, and access paths
- Transaction control commands

Additional Features of SQL (cont'd.)

- Specifying the granting and revoking of privileges to users
- Constructs for creating triggers
- Enhanced relational systems known as object-relational
- New technologies such as XML and OLAP

Summary

- SQL
  - Comprehensive language
  - Data definition, queries, updates, constraint specification, and view definition

  - Data definition commands for creating tables
  - Commands for constraint specification
  - Simple retrieval queries
  - Database update commands

Ex-1

- Consider the database shown below
  - What are the referential integrity constraints that should hold on the schema?
  - Write appropriate SQL DDL statements to define the database.

STUDENT

Name	Student_number	Class	Major
Smith	17	1	CS
Brown	8	2	CS

COURSE

Course_name	Course_number	Credit_hours	Department
Intro to Computer Science	CS1310	4	CS
Data Structures	CS3320	4	CS
Discrete Mathematics	MATH2410	3	MATH
Database	CS3380	3	CS

SECTION

Section_identifier	Course_number	Semester	Year	Instructor
85	MATH2410	Fall	07	King
92	CS1310	Fall	07	Anderson
102	CS3320	Spring	08	Knuth
112	MATH2410	Fall	08	Chang
119	CS1310	Fall	08	Anderson
135	CS3380	Fall	08	Stone

GRADE_REPORT

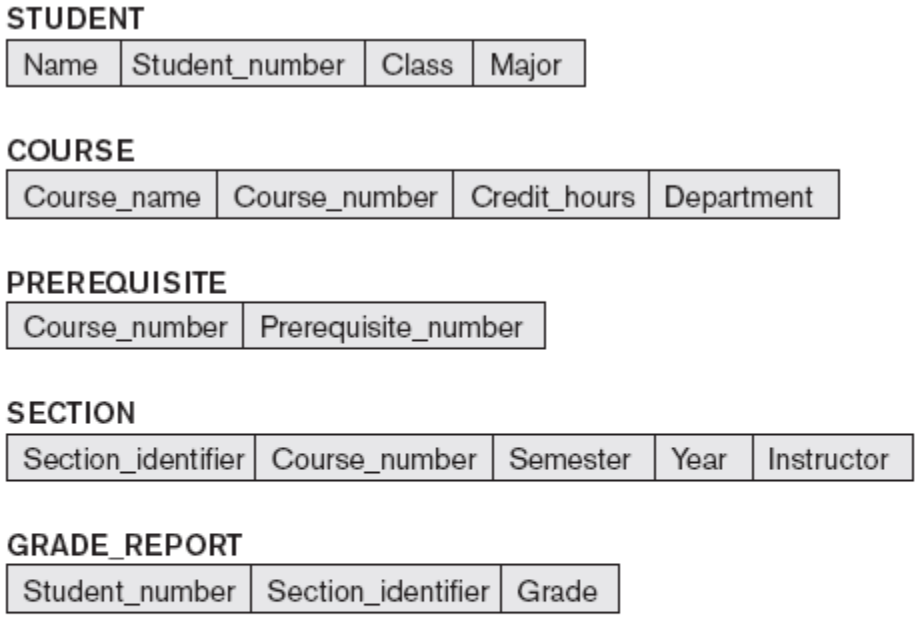
Student_number	Section_identifier	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

PREREQUISITE

Course_number	Prerequisite_number
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310

Figure 1.2
A database that stores student and course information.

Figure 2.1
Schema diagram for the database in Figure 1.2.



[6]Schema changes are usually needed as the requirements of the database applications change. Newer database systems include operations for allowing schema changes, although the schema change process is more involved than simple database updates.

[7]It is customary in database parlance to use *schemas* as the plural for *schema*, even though *schemata* is the proper plural form. The word *scheme* is also sometimes used to refer to a schema.

- PREREQUISITE.(CourseNumber) --> COURSE.(CourseNumber)
- PREREQUISITE.(PrerequisiteNumber) --> COURSE.(CourseNumber)
- SECTION.(CourseNumber) --> COURSE.(CourseNumber)
- GRADE_REPORT.(StudentNumber) --> STUDENT.(StudentNumber)
- GRADE_REPORT.(SectionIdentifier) --> SECTION.(SectionIdentifier)

```
CREATE TABLE STUDENT ( Name VARCHAR(30) NOT NULL,
StudentNumber INTEGER NOT NULL, Class CHAR NOT NULL, Major CHAR(4),
PRIMARY KEY (StudentNumber) );

CREATE TABLE COURSE ( CourseName VARCHAR(30) NOT NULL,
CourseNumber CHAR(8) NOT NULL,CreditHours INTEGER, Department CHAR(4),
PRIMARY KEY (CourseNumber), UNIQUE (CourseName) );

CREATE TABLE PREREQUISITE ( CourseNumber CHAR(8) NOT NULL,
PrerequisiteNumber CHAR(8) NOT NULL, PRIMARY KEY (CourseNumber,
    PrerequisiteNumber),
FOREIGN KEY (CourseNumber) REFERENCES COURSE (CourseNumber),
FOREIGN KEY (PrerequisiteNumber) REFERENCES COURSE (CourseNumber) );

CREATE TABLE SECTION ( SectionIdentifier INTEGER NOT NULL, CourseNumber
    CHAR(8) NOT NULL, Semester VARCHAR(6) NOT NULL, Year CHAR(4) NOT NULL,
Instructor VARCHAR(15), PRIMARY KEY (SectionIdentifier), FOREIGN KEY
    (CourseNumber) REFERENCES COURSE (CourseNumber) );
```

```
CREATE TABLE GRADE_REPORT ( StudentNumber INTEGER NOT NULL,
SectionIdentifier INTEGER NOT NULL,  Grade CHAR, PRIMARY KEY (StudentNumber,
    SectionIdentifier), FOREIGN KEY (StudentNumber) REFERENCES
STUDENT (StudentNumber), FOREIGN KEY (SectionIdentifier) REFERENCES
SECTION (SectionIdentifier) );
```

Ex-2

Write SQL update statements to do the following on the database schema shown in Figure1.2.

(a) Insert a new student <'Johnson', 25, 1, 'MATH'> in the database.

(b) Change the class of student 'Smith' to 2.

(c) Insert a new course <'Knowledge Engineering','COSC4390', 3,'COSC'>.

(d) Delete the record for the student whose name is 'Smith' and student number is 17.

- (a) INSERT INTO STUDENT
- VALUES ('Johnson', 25, 1, 'MATH')
-
- (b) UPDATE STUDENT
- SET CLASS = 2
- WHERE Name='Smith'
-
- (c) INSERT INTO COURSE
- VALUES ('Knowledge Engineering','COSC4390', 3,'COSC')
-
- (d) DELETE FROM STUDENT
- WHERE Name='Smith' AND StudentNumber=17

Ex-3

Specify the following queries in SQL on the database schema of Figure 1.2.

(a) Retrieve the names of all senior students majoring in 'COSC' (computer science).

(b) Retrieve the names of all courses taught by professor King in 85 and 86.

(c) For each section taught by professor King, retrieve the course number, semester, year, and number of students who took the section.

(d) Retrieve the name and transcript of each senior student (Class=5) majoring in COSC. Transcript includes course name, course number, credit hours, semester, year, and grade for each course completed by the student.

(e) Retrieve the names and major departments of all straight A students (students who have a grade of A in all their courses).

(f) Retrieve the names and major departments of all students who do not have any grade of A in any of their courses.

(a) SELECT Name

FROM STUDENT

WHERE Major='COSC'

(b) SELECT CourseName

FROM COURSE, SECTION

WHERE COURSE.CourseNumber=SECTION.CourseNumber AND Instructor='King'

AND (Year='85' OR Year='86')

Another possible SQL query uses nesting as follows:

SELECT CourseName

FROM COURSE

WHERE CourseNumber IN (SELECT CourseNumber

FROM SECTION

WHERE Instructor='King' AND (Year='85' OR Year='86'))

(c) SELECT CourseNumber, Semester, Year, COUNT(*)

FROM SECTION, GRADE_REPORT

WHERE Instructor='King' AND
SECTION.SectionIdentifier=GRADE_REPORT.SectionIdentifier

GROUP BY CourseNumber, Semester, Year

(d) SELECT Name, CourseName, C.CourseNumber, CreditHours, Semester, Year, Grade

FROM STUDENT ST, COURSE C, SECTION S, GRADE_REPORT G

WHERE Class=5 AND Major='COSC' AND ST.StudentNumber=G.StudentNumber AND

G.SectionIdentifier=S.SectionIdentifier AND S.CourseNumber=C.CourseNumber

(e) SELECT Name, Major

FROM STUDENT

WHERE NOT EXISTS (SELECT *

FROM GRADE_REPORT

WHERE StudentNumber= STUDENT.StudentNumber AND NOT(Grade='A'))

(f) SELECT Name, Major

FROM STUDENT

WHERE NOT EXISTS (SELECT *

FROM GRADE_REPORT

WHERE StudentNumber= STUDENT.StudentNumber AND Grade='A')