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Databases - Tutorial 06
Structured Query Language (sql)

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Contents

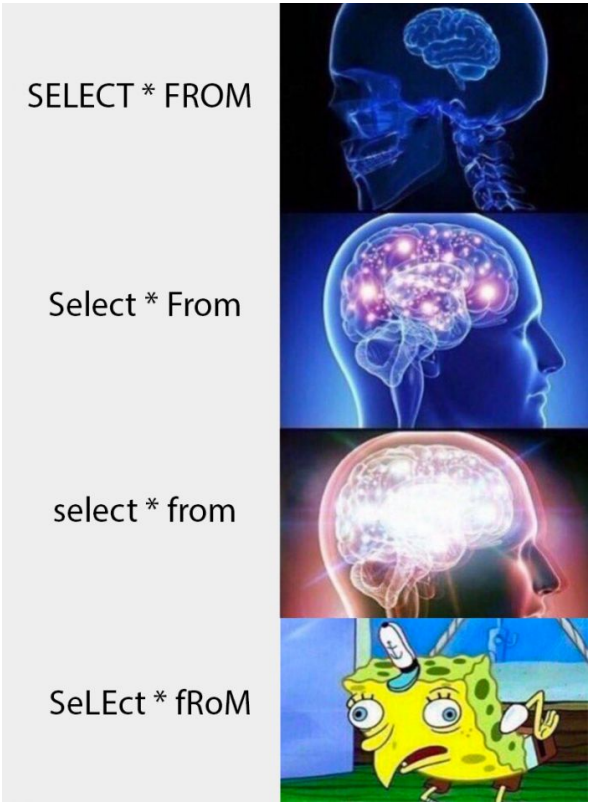
- SQL (structured query language)

What is SQL?

- SQL stands for Structured Query Language
- SQL lets you access and manipulate databases
- SQL became a standard of the American National Standards Institute (ANSI) in 1986, and of the International Organization for Standardization (ISO) in 1987
- SQL can execute queries against a database
- SQL can retrieve data from a database
- SQL can insert records in a database
- SQL can update records in a database
- SQL can delete records from a database
- SQL can create new databases
- SQL can create new tables in a database
- SQL can create stored procedures in a database
- SQL can create views in a database
- SQL can set permissions on tables, procedures, and views

SQL Commands

- **CREATE DATABASE testdb - Create testdb database**
- **SELECT - extracts data from a database**
- **UPDATE - updates data in a database**
- **DELETE - deletes data from a database**
- **INSERT INTO - inserts new data into a database**
- **CREATE DATABASE - creates a new database**
- **ALTER DATABASE - modifies a database**
- **CREATE TABLE - creates a new table**
- **ALTER TABLE - modifies a table**
- **DROP TABLE - deletes a table**
- CREATE INDEX - creates an index (search key)
- DROP INDEX - deletes an index



- https://www.postgresqltutorial.com/postgresql-cheat-sheet/

Operators

OPERATOR	DESCRIPTION
=	equal
<	less than
>	greater than
<=	less than or equal
>=	greater than or equal
!=	not equal
<>	not equal (yup, there are two ways)

Aggregate Functions

FUNCTION	DESCRIPTION
MAX	returns the largest (maximum) number in a sets
MIN	described
COUNT	returns a count of the # of values in a set
COUNT DISTINCT	returns a count of the # of unique (distinct) values in a set
EVERY	returns true if all data inside is true (same as bool_and)
AVG	returns the average (mean) of the set of numbers
SUM	returns the sum of all the values in the set

Joins

JOIN VISUAL	TYPE	DESCRIPTION
	INNER	DEFAULT: returns only the rows where matches were found
	LEFT OUTER	returns matches and all rows from the left listed table
	RIGHT OUTER	returns matches and all rows from the right listed table
	FULL OUTER	returns matches and all rows from both tables

Dates

DATA TYPE	DESCRIPTION	EXAMPLE	OUTPUT
TIMESTAMP	date and time	`TIMESTAMP '2021-08-09 13:57:40'`	2021-08-09T13:57:40
DATE	date (no time)	`DATE '2021-08-09 13:57:40'`	2021-08-09
TIME	time (no day)	`TIME '2021-08-09 13:57:40'`	13:57:40
INTERVAL	interval between two date/times	`INTERVAL '1 day 2 hours 10 seconds'`	1 day, 2:00:10

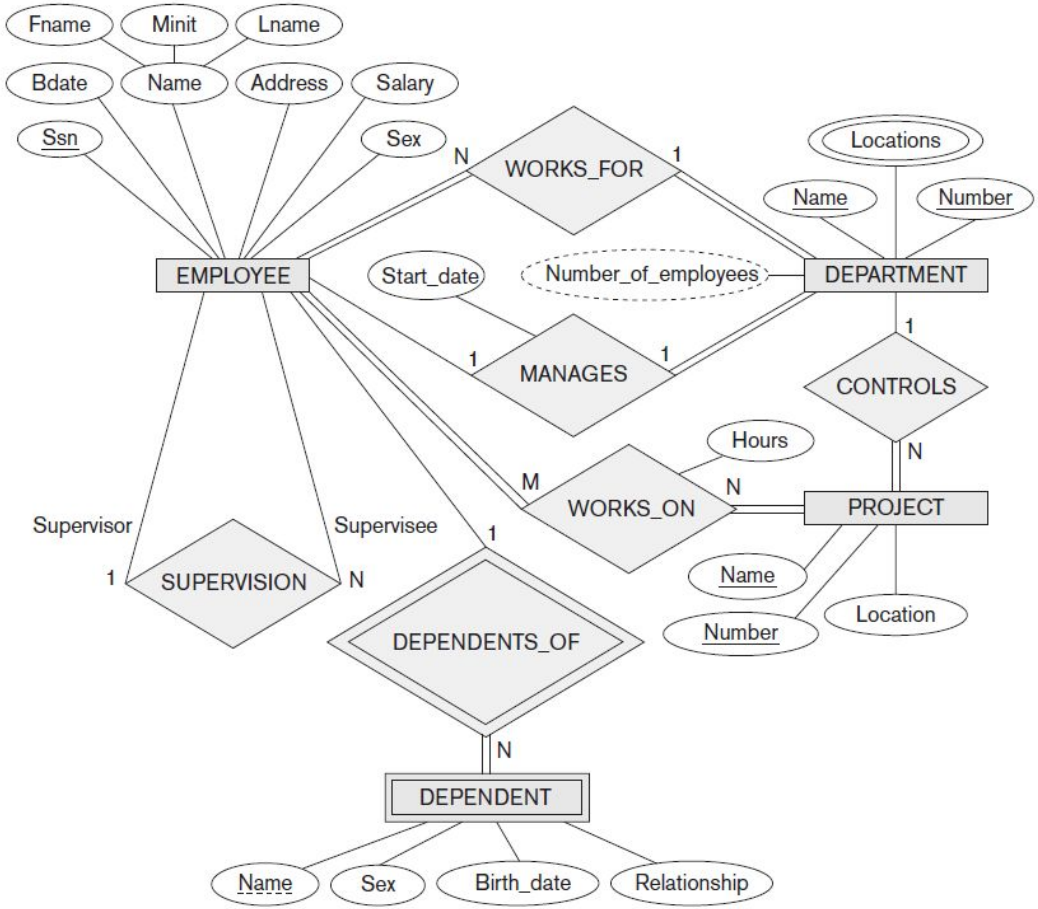


Figure 3.2
An ER schema diagram for the COMPANY database. The diagrammatic notation is introduced gradually throughout this chapter and is summarized in Figure 3.14.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

Figure 5.5
Schema diagram for the COMPANY relational database schema.

ERD of Company database

```
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),
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) );
```

Example of the syntax in PostgreSQL

```
CREATE TABLE staff(
   staff_id SERIAL PRIMARY KEY,
   first_name VARCHAR(45) NOT NULL,
   last_name VARCHAR(45) NOT NULL,
   email VARCHAR(100) NOT NULL UNIQUE
);
```

Example of the syntax in PostgreSQL

```
DROP TABLE IF EXISTS `city`;
CREATE TABLE `city` (
  `ID` INT(11) NOT NULL AUTO_INCREMENT,
  `Name` CHAR(35) NOT NULL DEFAULT '',
  `CountryCode` CHAR(3) NOT NULL DEFAULT '',
  `District` CHAR(20) NOT NULL DEFAULT '',
  `Population` INT(11) NOT NULL DEFAULT '0',
  PRIMARY KEY (`ID`),
  KEY `CountryCode` (`CountryCode`),
  CONSTRAINT `city_ibfk_1` FOREIGN KEY
(`CountryCode`)
            REFERENCES `country` (`Code`)
);
```

ERD of Company database

Figure 5.6
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

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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

Q0:

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

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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;
```

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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.

Query 8. For each employee, retrieve the employee's first and last name and the first and last name of his or her immediate supervisor.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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'
```

Query 8. For each employee, retrieve the employee's first and last name and the first and last name of his or her immediate supervisor.

```
Q8:   SELECT   E.Fname, E.Lname, S.Fname, S.Lname
      FROM     EMPLOYEE AS E, EMPLOYEE AS S
      WHERE    E.Super_ssn = S.Ssn;
```

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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

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

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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;
```

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;
```

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

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' );
```

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

Query 12. Retrieve all employees whose address is in Houston, Texas.

Query 13. Show the resulting salaries if every employee working on the 'ProductX' project is given a 10% raise.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

Query 12. Retrieve all employees whose address is in Houston, Texas.

```
Q12:  SELECT   Fname, Lname
      FROM     EMPLOYEE
      WHERE    Address LIKE '%Houston,TX%';
```

Query 13. Show the resulting salaries if every employee working on the 'ProductX' project is given a 10% raise.

```
Q13:  SELECT   E.Fname, E.Lname, 1.1 * E.Salary AS Increased_sal
      FROM     EMPLOYEE AS E, WORKS_ON AS W, PROJECT AS P
      WHERE    E.Ssn = W.Essn AND W.Pno = P.Pnumber AND
               P.Pname = 'ProductX';
```

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

Query 14. Retrieve all employees in department 5 whose salary is between $30,000 and $40,000.

Query 15. Retrieve a list of employees and the projects they are working on, ordered by department and, within each department, ordered alphabetically by last name, then first name.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

Query 14. Retrieve 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;
```

Query 15. Retrieve a list of employees and the projects they are working on, ordered by department and, within each department, ordered alphabetically by last name, then first name.

```
Q15:  SELECT      D.Dname, E.Lname, E.Fname, P.Pname
      FROM        DEPARTMENT AS D, EMPLOYEE AS E, WORKS_ON AS W,
                  PROJECT AS P
      WHERE       D.Dnumber = E.Dno AND E.Ssn = W.Essn AND W.Pno =
                  P.Pnumber
      ORDER BY    D.Dname, E.Lname, E.Fname;
```

Useful links

- https://www.postgresqltutorial.com/postgresql-cheat-sheet/
- https://www.postgresqltutorial.com/
- https://dataschool.com/learn-sql/sql-cheat-sheet/
- https://gist.github.com/Kartones/dd3ff5ec5ea238d4c546
- https://pgexercises.com/questions/basic/