CHAPTER 3A :
Basic SQL

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Outline

- SQL Data Definition and Data Types
- Specifying Constraints in SQL
- Basic Retrieval Queries in SQL

Basic SQL

Structured Query Language

Considered one of the major reasons for the commercial success of relational databases

Statements for data definitions, queries, and updates

- Both DDL and DML
- Core specification plus specialized extensions

Terminology:

Relational Model	SQL
relation	table
tuple	row
attribute	column

- *Syntax notes*:
  - Some interfaces require each statement to end with a semicolon.

CREATE TABLE Command

Specify a new relation

- Provide name
- Specify attributes and initial constraints
- **Base tables** (**base relations**)
  - Relation and its tuples are physically stored and managed by DBMS

Can optionally specify schema:

- `CREATE TABLE COMPANY.EMPLOYEE ...`

  or

- `CREATE TABLE EMPLOYEE ...`

Include information for each column (attribute) plus constraints

- **Column name**
- **Column type (domain)**
- **Key, uniqueness, and null constraints**

Data Types

Numeric data types

- Integer numbers: `INT`, `INTEGER`, `SMALLINT`, `BIGINT`
- Floating-point (real) numbers: `REAL`, `DOUBLE`, `FLOAT`
- Fixed-point numbers: `DECIMAL(n,m)`, `DEC(n,m)`, `NUMERIC(n,m)`, `NUM(n,m)`

Character-string data types

- Fixed length: `CHAR(n)`, `CHARACTER(n)`
- Varying length: `VARCHAR(n)`, `CHAR VARYING(n)`, `CHARACTER VARYING(n)`, `LONG VARCHAR`

Large object data types

- Characters: `CLOB`, `CHAR LARGE OBJECT`, `CHARACTER LARGE OBJECT`
- Bits: `BLOB`, `BINARY LARGE OBJECT`

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

Scenario : Library Management System

users

id	full_name	enabled	last_login
1	John Smith	f	2017-10-25 10:26:10.015152
2	Alice Walker	t	2017-10-25 10:26:50.295461
3	Harry Potter	t	2017-10-25 10:26:50.295461
5	Jane Smith	t	2017-10-25 10:36:43.324015

checkouts

id	user_id	book_id	checkout_date	return_date
1	1	1	2017-10-15 14:43:18.095143-07	
2	1	2	2017-10-05 16:22:44.593188-07	2017-10-13 13:05:12.673382-05
3	2	2	2017-10-15 11:11:24.994973-07	2017-10-22 17:47:10.407569-07
4	5	3	2017-10-15 09:27:07.215217-07	

books

id	title	author	published_date	isbn
1	My First SQL book	Mary Parker	2012-02-22 12:08:17.320053-03	981483029127
2	My Second SQL book	John Mayer	1972-07-03 09:22:45.050088-07	857300923713
3	My Third SQL book	Cary Flint	2015-10-18 14:05:44.547516-07	523120967812

addresses

user_id	street	city	state
1	1 Market Street	San Francisco	CA
2	2 Elm Street	San Francisco	CA
3	3 Main Street	Boston	MA

reviews

id	book_id	reviewer_name	content	rating	published_date
1	1	'John Smith'	'My first review'	4	2017-12-10 05:50:11.127281-02
2	2	'John Smith'	'My second review'	5	2017-10-13 15:05:12.673382-05
3	2	'Alice Walker'	'Another review'	1	2017-10-22 23:47:10.407569-07

SQL Create Table (1)

```
CREATE TABLE USERS
(
ID INT NOT NULL,
FULL_NAME VARCHAR (50) NOT NULL,
ENABLED CHAR (1) NOT NULL,
LAST_LOGIN DATETIME NOT NULL,
PRIMARY KEY (ID)
);
```

```
CREATE TABLE ADDRESSES
(
USER_ID int,
STREET VARCHAR (30) NOT NULL,
CITY VARCHAR (30) NOT NULL,
STATE VARCHAR (30) NOT NULL,
PRIMARY KEY (USER_ID)
);
```

```
CREATE TABLE REVIEWS
(
ID SERIAL,
BOOK_ID INTEGER NOT NULL,
REVIEWER_NAME VARCHAR (255),
CONTENT VARCHAR (255),
RATING INTEGER,
PUBLISHED_DATE TIMESTAMP DEFAULT CURRENT_TIMESTAMP,
PRIMARY KEY (ID),
FOREIGN KEY (BOOK_ID) REFERENCES BOOKS (ID)
);
```

SQL Create Table (2)

```
CREATE TABLE CHECKOUTS
(
ID SERIAL,
USER_ID INT NOT NULL,
BOOK_ID INT NOT NULL,
CHECKOUT_DATE TIMESTAMP,
RETURN_DATE TIMESTAMP,
PRIMARY KEY (ID),
FOREIGN KEY (USER_ID) REFERENCES USERS(ID),
FOREIGN KEY (BOOK_ID) REFERENCES BOOKS(ID)
);
```

```
CREATE TABLE BOOKS
(
ID SERIAL,
TITLE VARCHAR (100) NOT NULL,
AUTHOR VARCHAR (100) NOT NULL,
PUBLISHED_DATE TIMESTAMP NOT NULL,
ISBN CHAR (12),
PRIMARY KEY (ID),
UNIQUE (ISBN)
);
```

Specifying Key Constraints

`PRIMARY KEY` clause

- Specifies the **attributes that make up the primary key** of a relation

```
Dnumber INT NOT NULL PRIMARY KEY,
```

- **Primary key attributes must be declared `NOT NULL`**

`UNIQUE` clause

- Specifies **alternate (candidate) keys**

```
Dname VARCHAR(15) UNIQUE;
```

- **May or may not allow null values**, depending on declaration

Referential Constraints

FOREIGN KEY clause

```
FOREIGN KEY (Dept) REFERENCES
DEPARTMENT (Dnum
```

- Default operation: reject update on violation
- Attach **referential triggered action** clause in case referenced tuple is deleted
  - Options include `SET NULL`, `CASCADE`, and `SET DEFAULT`

*** **Foreign key declaration must refer to a table already created**

Specifying Tuple Constraints

Some constraints involve several columns,

`CHECK` clause at the end of a `CREATE TABLE` statement

- Apply to each tuple individually

Example:

```
Dnumber INT NOT NULL CHECK (Dnumber > 0 AND Dnumber < 21);
```

Default value of an attribute

- **DEFAULT**<value>
- NULL is not permitted for a particular attribute (**NOT NULL**)

SELECT – FROM – WHERE statement

Basic form of the `SELECT` statement:

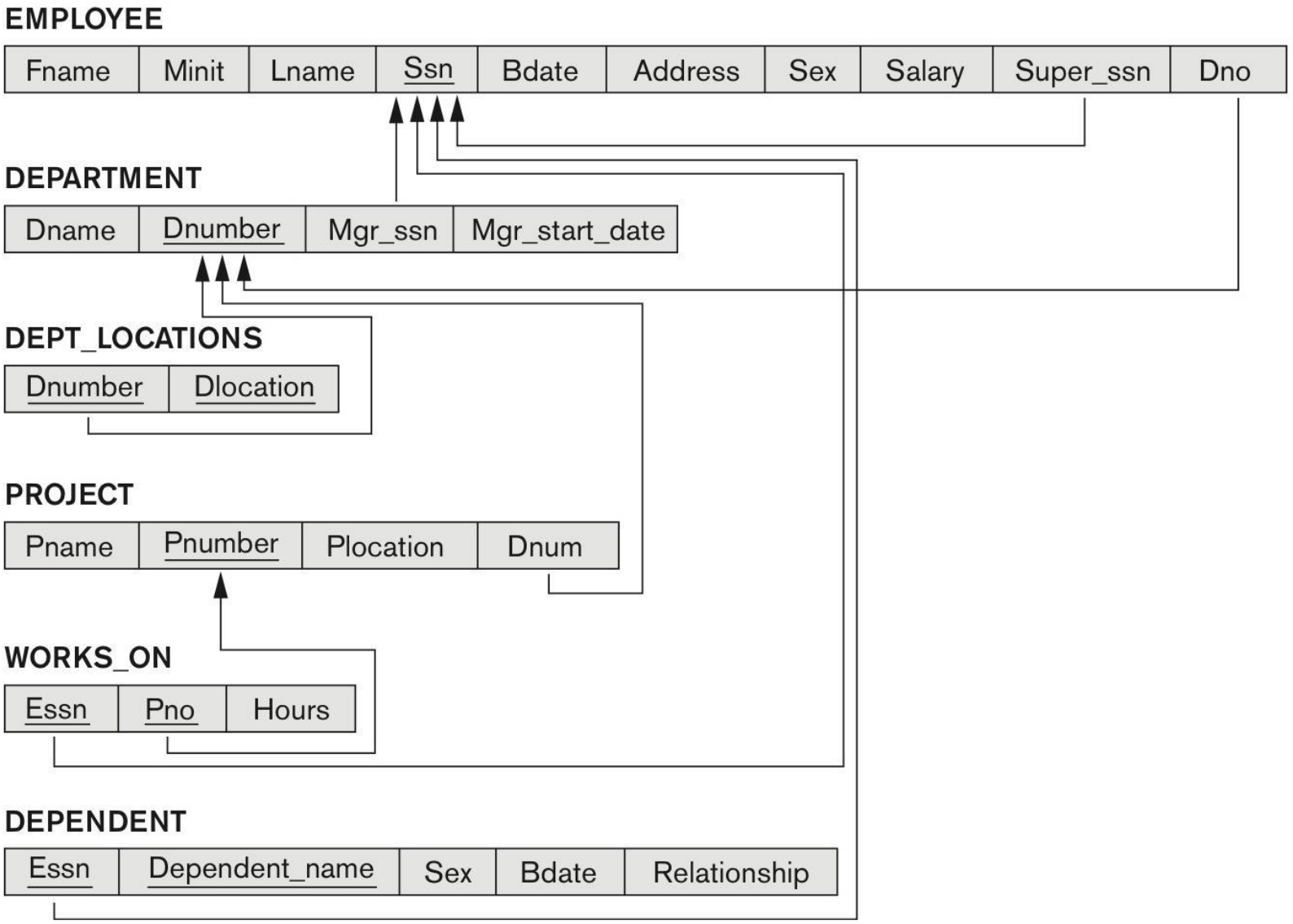
SELECT <attribute list>
FROM <table list>
WHERE <condition>;

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.

Logical comparison operators
=, <, <=, >, >=, and <>

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
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
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James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

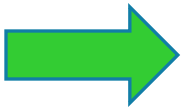
Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

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

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';
```



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

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
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DEPARTMENT

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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

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;
```

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

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
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DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
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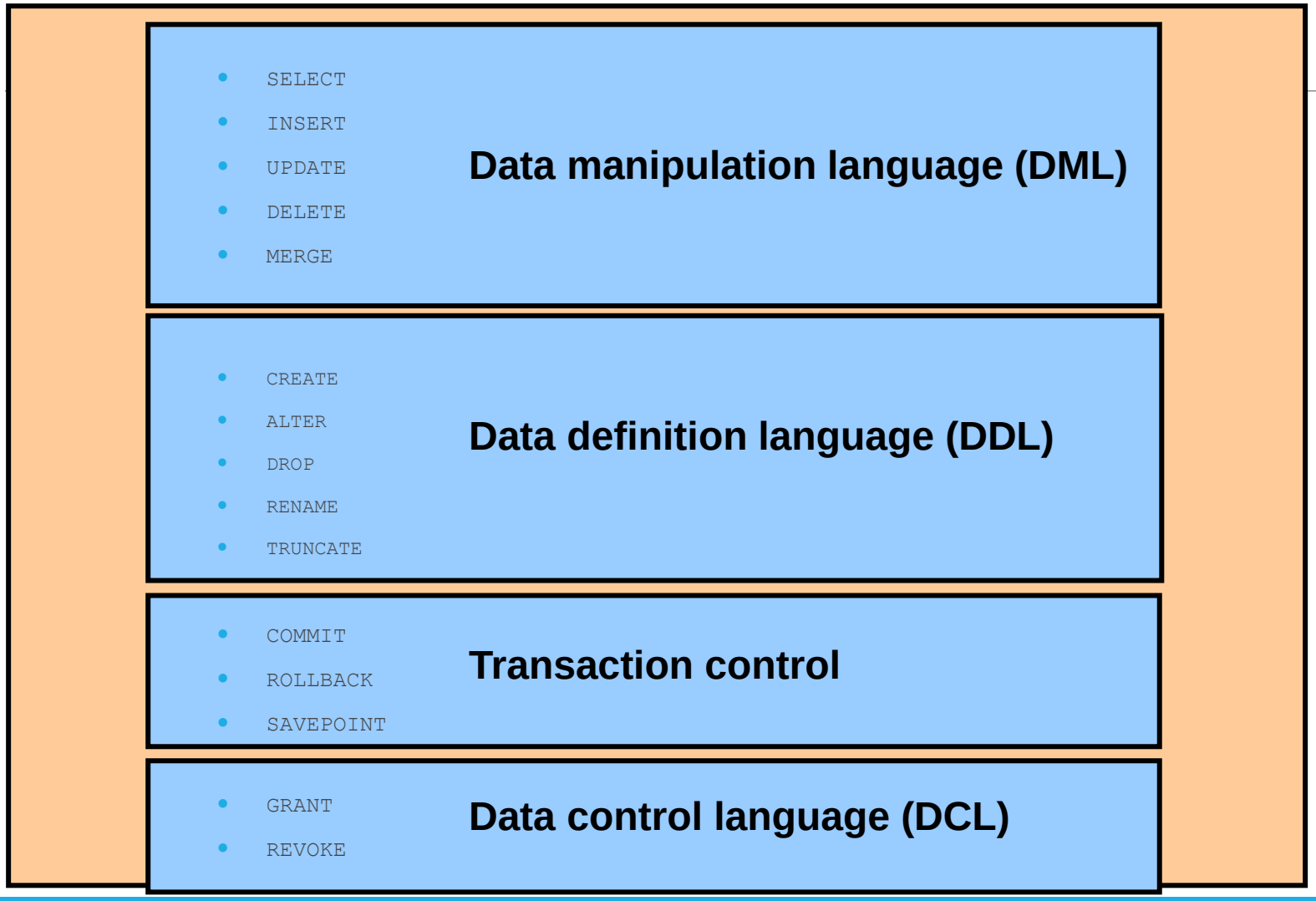
PROJECT

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

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';
```

(c)

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

SQL Statements