

# Chapter 3 Application

## Unit 3.1 Relational Database

备课时间：2019/10/19~2019/10/24

### 词汇与词组

1. A **relational database** is a database that conforms to the relational model, and refers to a database's data and schema (the database's structure of how that data is arranged).

- **relational database** 关系数据库
- **confirm to** 符合，遵照
- **relational model** 关系模型
- **refer to** 涉及
- **Schema** /'ski: mə/ 模式

2. Common usage of the term “**Relational database management system**” (**RDBMS**) technically refers to the software used to create a relational database, but sometimes mistakenly refers to a relational database.

- **Relational database management system** 关系数据库管理系统 RDBMS
- **mistakenly** 错误地

3. Frequency, the term “RDBMS” is **inaccurately** used as a **generic label** for the relational database concept.

- **generic label** 通用标签

## 后缀-el 有四种含义

### (1) 表示“小”

**runnel** /'rʌnl/ [runn = run 跑→ 流动 + -el 后缀表示小→ 流动的小股流水→] n. 小河, 小溪

**model** [mod = mode 样式 + -el 后缀表示小→] n. 模型

**parcel** /'pɑ:sl/ [parc 部分 + -el 后缀→把某东西, 分成一份一份的→] n. 小包裹

**novel** /'nɔ:vl/ [nov 新的 + -el 后缀, 表示小→] n. [长篇]小说  
adj. 新奇的, 新颖的

### (2) 表示“人”

**wastrel** /'weɪstrəl/ [astr=waste 浪费 + -el 后缀表示人 →]  
n. 浪费者; 败家子

**personnel** /,pɜ:sə'nel/ [personn = person 人 + -el 后缀]  
n. 全体人员

**colonel** /'kɜ:nl/ [colon=column 柱子 + -el 后缀表示人 →  
像柱子一样站着的人→此人起到顶梁柱作用 →]  
n. 陆军上校

### (3) 表示“物”

**funnel** /'fʌnl/ [funn 管道 + -el 后缀, 表示物→ 通过管理倒东西的物→] n. 漏斗

**chisel** /'tʃɪzəl/ [chis 挖 + -el 后缀, 表示物→] n. 凿子

**quadrel** /'kwadrəl/ [quadr 四 -el 后缀, 表示物 →四方形的东西→] n. 方砖, 方瓦, 方形石

#### (4) 表示“场所、地点”

**hotel** /həʊ'tel/ [hot=host 客人 + -el 后缀→旅客住地] n. 旅馆

**tunnel** /'tʌnl/ [tunn 桶, 管道 + -el 后缀→] n. 隧道

**kennel** /'kenl/ [kenn=can 容器, 管道 + -el 后缀→能让小动物住进去的小地方→] n. 狗窝

这个单词是不是和 kernel 很像?

#### 后缀-le

**bottle** /'bɔ:təl/ [bott=拉丁文 butta 桶 + -le 后缀表示小] n. 瓶

**bundle** /'bʌndl/ [bund = bind 绑 + -le 后缀] n. 捆; 束

**pebble** /'pebl/ [pebb =cobble 圆石子 + -le 后缀表示小] n. 小圆石

**riddle** /'rɪdl/ [ridd = read 阅读 + -le 后缀 →应该能读的东西→] n. 谜; 难以捉摸的人 Tom Marvolo Riddle



4. Most current RDBMSs (for example: Oracle, Microsoft SQL Server, Ingres, MySQL, PostgreSQL) **deviate** significantly from the relational model and are more accurately called SQL database management products.

➤ **Ingres**: interactive graphics and retrieval system

➤ **Deviate from** 偏离 /'di: viet/

But sometimes you have to **deviate from** your plans.

但有时你不得不偏离你的计划。

➤ **SQL** 结构化查询语言 (Structured Query Language)

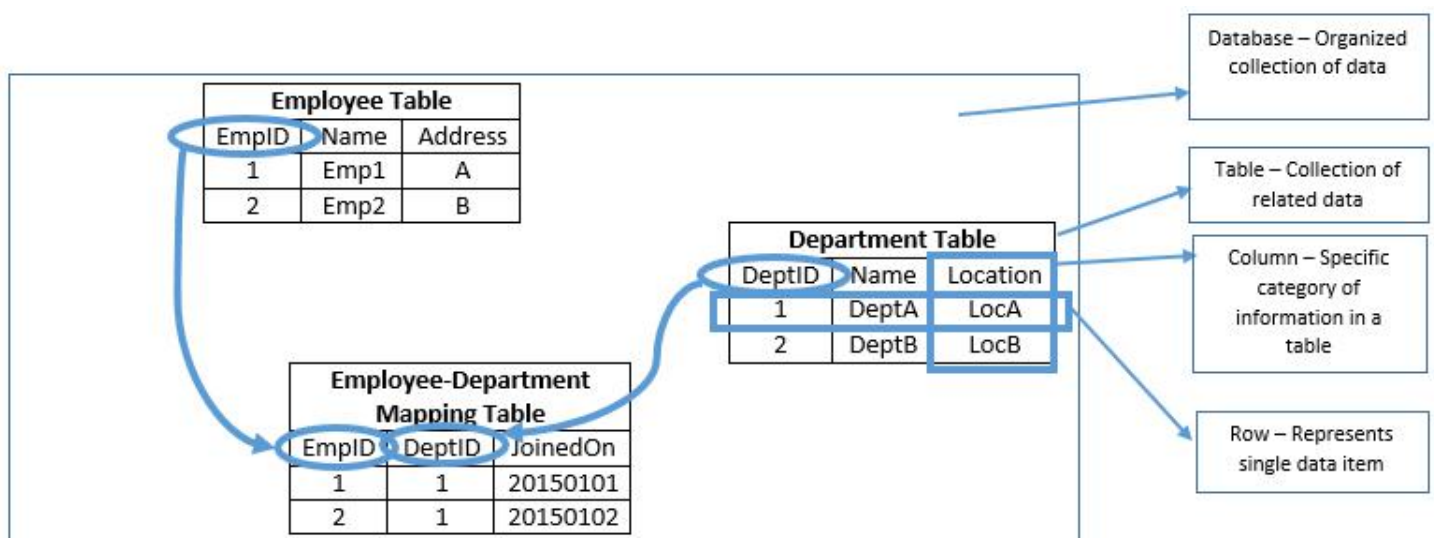
5. Strictly, a relational database is a collection of **relations** (frequently called **tables**).

➤ **Relation** 关系 binary relation 二元关系

The number of binary relations on a set A, where  $|A|=n$  is  $2^{n^2}$ .

**笛卡尔积 (Cartesian Product)  $D1 \times D2 \times \dots \times Dn$  的任一子集称为定义域  $D1, D2, \dots, Dn$  上的 n 元关系**

➤ **Table** 表



6. A relation is defined as a set of **tuples** that all have the same attributes.

➤ **Tuple** /'tʌpəl/ 元组（不是元祖），数组

如：(1, 2, 3, 4), <1, 2, 3, 4>

**A deterministic finite automaton (DFA) is described by a five-element tuple: (Q,Σ,δ,q0,F).**

**n-元组：**

**0 Empty tuple**

**1 Single**

**2 Double**

**3 Triple or triplet**

**4 Quadruple /kwɑ'drupl/**

**5 Quintuple /kwɪn'tu:pl/**

**6 Sextuple /'sɛkstjʊpl/**

**7 Septuple /sɛp'tjʊpl/**

**8 Octuple /'ɔktjʊpl/**

**9 Nonuple /'nanjəpəl/**

**10 Decuple /'dekjʊpl/**

<https://www.cosmosdawn.net/forum/threads/if-1-single-2-double-n-tuple-n-tuples.2735/>

➤ **Attribute 属性（字段）**

Id_P	LastName	FirstName	Address	City

7. That is usually represented by a table, which is data organized in **rows** and **columns**.

➤ **Row** 行                      **Column** 列

8. In a relational database, all of the data stored in a column should be in the same **domain** (i.e. data type).

➤ **Domain** 值域，数据类型，**一组**具有相同数据类型的**值的集合**，例如整数、实数、字符串的集合

数据类型	说明
integer(size) int(size) smallint(size) tinyint(size)	仅容纳整数。在括号内规定数字的最大位数。
decimal(size,d) numeric(size,d)	容纳带有小数的数字。 "size" 规定数字的最大位数。"d" 规定小数点右侧的最大位数。
char(size)	容纳固定长度的字符串（可容纳字母、数字以及特殊字符）。 在括号中规定字符串的长度。
varchar(size)	容纳可变长度的字符串（可容纳字母、数字以及特殊的字符）。 在括号中规定字符串的最大长度。
date(yyymmdd)	容纳日期。

9. In the relational model, the tuples should not have any **ordering**.

➤ **Ordering** 次序

10. **While** this is the **desired** result, it is not **universally achieved**.

➤ **While** 虽然，尽管

➤ **desired** 渴望的，想要的，期望的

➤ **universally** 普遍的

➤ **achieve** 实现，达到

11. All data stored in a computer has to have an order, **as** the memory of a computer is **linear**.

➤ **as = because**

➤ **Linear** 线性的

12. Because all transfer protocols are linear, and **coincidentally** enough, humans read in a linear **fashion**.

➤ **Coincidentally** 巧合地，无独有偶

You use **coincidentally** when you want to draw attention to a coincidence.

➤ **Fashion = way** 方式

13. **Constraints** are a way of providing **restrictions** on the kinds of data that can be stored in the relations.

➤ **Constraint** 约束

➤ **Restriction** 限制, 约束

例子: 关系中不允许出现相同的元组; 关系中每一个分量必须是不可分的数据项

14. Because of the **integral** role which they play in organizing data, they are usually considered part of the database.

➤ **integral** /'ɪntɪgrəl/ 构成整体所必须的, 不可或缺的

1) Rituals, celebrations, and festivals form an **integral** part of every human society. 仪式、庆典和节日是每个人类社会不可缺少的组成部分。

2) As an **integral** part of the contract, the inspection of goods have its special importance. 作为合同里不可或缺的组成部分, 商品检验有特殊的重要性。

➤ **integral** 积分

15. A **key** is a kind of constraint which requires that the object, or critical information about the object, isn't **duplicated**.

➤ **Key** 键

➤ **duplicated** 重复的



16. For example, a family might like to have a constraint such that no two people in the **immediate family** have the same name.

➤ **immediate family** 直系亲属

➤ **immediate** 立即的，直接的，前缀 im-, 表示：不，非

The **immediate value** is limited to 8 bits (rather than 12 bits) giving an offset of 0-255 bytes.

➤ **intermediate** 中间的

**intermediate language** 中间语言

17. Each student is typically assigned a Student ID, which are used as keys for individual students stored in the school database.

➤ **assign** /ə'saɪn/ 分配

**Assignment** 赋值；作业

➤ **individual** 个人的

**individual students** 每一个学生

18. A key over more than one attribute is called a compound key.

➤ **Compound key** 组合键

## 19. Cardinality (关系的) 基数

关系所含元组的个数即为该关系的基数，例如，关系 T 包括如下 3 个元组：

姓名	性别
胡歌	男
张译	男
赵丽颖	女

则关系 T 的基数是 3.

再如关系 S:

姓名	作品
陈红	水云间
陈红	常回家看看

S 的基数是 2，如果我们选的键是姓名，则 S 中两个元组的姓名都是“陈红”，这两个元组无法从键上做区别，则基数变成  $1 \neq 2$ .

20. A key, in this context, refers to any set of attributes which uniquely **span** the relation.

- **span** 横跨（在关系中的）
- HTML `<span>` 标签被用来组合文档中的行内元素。
- S 为一向量空间 V 的子集。所有 S 的线性组合构成的集合，称为 S 所张成(生成)的空间，记作  $\text{span}(S)$ 。

The "span" of  $a$  and  $b$  is the set of all their linear combinations.

向量  $a$  和向量  $b$  的生成空间为它们线性组合和所有集合

### 2.5 Definition *span*

The set of all linear combinations of a list of vectors  $v_1, \dots, v_m$  in  $V$  is called the *span* of  $v_1, \dots, v_m$ , denoted  $\text{span}(v_1, \dots, v_m)$ . In other words,

$$\text{span}(v_1, \dots, v_m) = \{a_1v_1 + \dots + a_mv_m : a_1, \dots, a_m \in \mathbf{F}\}.$$

The span of the empty list  $()$  is defined to be  $\{0\}$ .

#### ➤ **aeroplane span** 飞机翼展

翼展 (wing span) 指固定翼飞行器的机翼左右翼尖之间的距离，是衡量机翼气动外形的主要几何参数之一。

21. In particular, this is called a superkey.

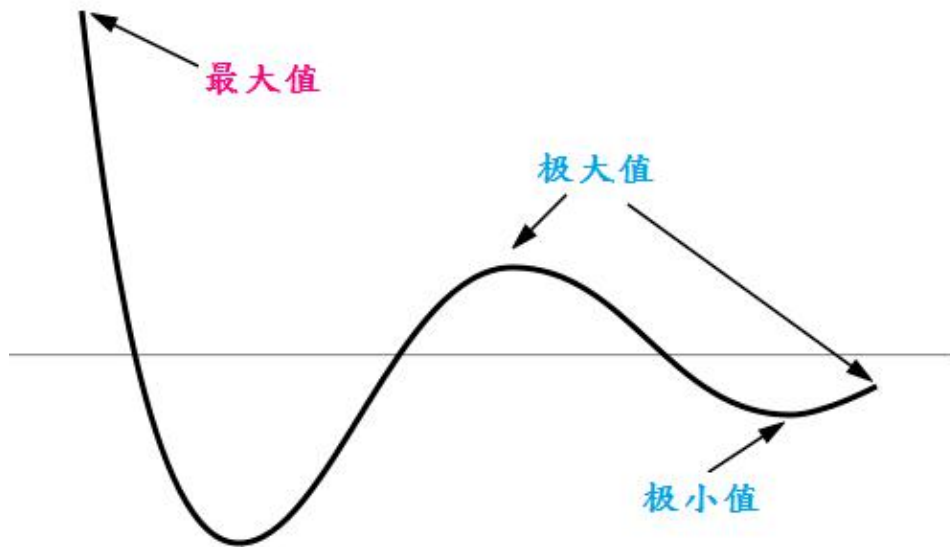
#### ➤ **Superkey** 在关系中能唯一标识元组的属性集称为超键

22. A **candidate key** is a **minimal** superkey, meaning that, **none** of the attributes in the key could be removed from the key, and still has that attribute set be a key.

#### ➤ **Candidate key** 不含多余属性的超键称为候选键

➤ **Minimal** 最小的                      **minimum** 最小

➤ **Maximal** 最大的                      **maximum** 最大



- 最大值是 absolute maximum, global maximum
- 极大值是 local maximum, relative maximum



23. Many DBMSs have a concept of a **primary key**. The primary key (usually a candidate key) is the key most often used to identify a tuple.

➤ **primary key** 主键

24. If the value of the primary key is actual interesting data with logical ties to the data (like a name) for the tuple, it is called a **natural key**.

➤ **natural key** 自然键

25. If the key is generated and doesn't have any logical connection to the rest of the data in the tuple, it is called a **surrogate key**.

➤ **surrogate key** 代理键

➤ **Surrogate** /'sərə, get/ 替代的，代理的

➤ **Surrogacy** /'sɜ: rəgəsi/ 替身代孕；代孕行为

**Surrogacy will continue to be banned in China, and violations will be punished, China's top health authority announced last Wednesday.**

上周三，中国最高卫生部门回应，代孕在中国依然被禁止，违反规定将受到处罚。

26. A **foreign key** is not a key by the previous definition. Rather, a foreign key is a **reference to a key in another table**, meaning that the **referencing** tuple has, as part of its attributes, the values of a key in the **referenced** tuple that corresponds to the relationship.

➤ **foreign key** 外键

➤ **referencing vs referenced**

**商品：**

product_no	name	price
100	美新系列 H1801 水笔	2

**订单：**

order_id	product_no	quantity
520	100	300

```
CREATE TABLE products (  
    product_no integer PRIMARY KEY,  
    name text,  
    price numeric  
);
```

```
CREATE TABLE orders (  
    order_id integer PRIMARY KEY,  
    product_no integer REFERENCES products (product_no),  
    quantity integer  
);
```

● The **orders** table is the **referencing** table and

● The **products** table is the **referenced** table

➤ **Employee (员工) vs Employer (老板)**

## 27. Transition constraints 转换（迁移）约束

It shouldn't be possible for a person to change from being "married" to being "single, never married".

The only valid states after "married" might be "**divorced**", "**widowed**" or "**deceased**".

- **Divorced** /dɪ'vɔː st/ 离异
- **Widowed** /'wɪdəʊd/ 丧偶
- **Deceased** /dɪ'siː st/ 已故
- transition

- 1) CSS **transitions** allows you to change property values smoothly, over a given duration.
- 2) In deterministic finite state automaton, a **transition** function takes as arguments a state and an input symbol and returns a state.
- 3) In theoretical computer science, a **transition** system is used to describe the potential behavior of discrete systems.

28. A **stored procedure** is an **executable code** that is associated with the database.

- **stored procedure** 存储过程
- **executable code** 可执行代码

29. Frequently, they are used as an **application programming interface (API)** for security or simplicity.

➤ **application programming interface** 应用编程接口

30. These are usually written as **Imperative programming** code extending the **Data Definition Language** and/or the **Data Manipulation Language** for the DBMS.

➤ **Imperative programming** 命令式编程，关注计算机执行的步骤，告诉计算机先做什么再做什么，C, Java, Python

➤ **Declarative programming** 声明式编程，主要思想是告诉计算机应该做什么，但不指定具体要怎么做，SQL, HTML, CSS

➤ **Functional programming** 函数式编程关心数据的映射 Erlang, Scala, Haskell, Java Stream API

➤ **Data Definition/Description Language (DDL)** 数据定义语言，主要的命令有 CREATE、ALTER、DROP 等，DDL 主要是用来创建，删除，修改数据库和表对象

➤ **Data Manipulation Language (DML)** 数据操作语言，SELECT、UPDATE、INSERT、DELETE

➤ **Data Control Language (DCL)** 数据控制语言，用来设置或更改数据库用户或角色权限



31. An **index** is a way of providing quicker access to the data in a relational database.

➤ **Index 索引,常使用的数据结构是 B+Tree**

➤ The internal nodes of B+ tree are often called **index** nodes.

➤ The leaf nodes of a B+ tree are linked together in the form of a singly linked lists to make the search queries more efficient.

➤ In B+ tree, records (data) can only be stored on the leaf nodes while internal nodes can only store the key values.