

数据库实验二 用户自定义完整性约束

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实验环境

操作系统	Windows 10 20H2
数据库版本	mysql Ver 8.0.21
代码编辑器	vscode

实验过程

1 建数据库

1.1 建表

```
1  # 1.1 建表
2  CREATE TABLE IF NOT EXISTS Project (
3      `id` INT,
4      `name` CHAR(20),
5      `dept_id` INT
6  );
7  CREATE TABLE IF NOT EXISTS Worker (
8      id INT,
9      name CHAR(20),
10     age INT,
11     salary INT,
12     dept_id INT
13 );
14 CREATE TABLE IF NOT EXISTS WP (
15     worker_id INT,
16     project_id INT,
17     time INT
18 );
19 CREATE TABLE IF NOT EXISTS Department (
20     id INT,
21     name CHAR(20),
22     chairman_id INT
23 );
```

1.2 插入数据

数据生成过程使用了自己编写的python脚本

```
1  # 1.2 插入数据
2  INSERT INTO Department
3  VALUES
4  (0, '公关', 181860000),
5  (1, '开发', 181860001),
6  (2, '运营', 181860002),
7  (3, '产品', 181860003);
8
9  INSERT INTO Worker
10 VALUES
11 (181860000, '尚忠霞', 34, 918368, 0),
12 (181860001, '孙江', 30, 911016, 1),
13 (181860002, '殷梅', 35, 391053, 2),
14 (181860003, '骆月', 29, 862730, 3),
15 (181860004, '史瑶', 29, 406307, 3),
16 (181860005, '殷芳', 26, 712941, 2),
17 (181860006, '南宫毅', 31, 767097, 0),
18 (181860007, '郎都艺', 31, 147451, 0),
19 (181860008, '史新', 39, 959588, 3),
20 (181860009, '满雅', 36, 452839, 3);
21
22 INSERT INTO Project
23 VALUES
24 (0, 'Office', 2),
25 (1, 'SQL', 2),
26 (2, 'VSCode', 1),
27 (3, 'Visual Studio', 2),
28 (4, 'Edge', 0);
29
30 INSERT INTO WP
31 VALUES
32 (181860000, 0, 8),
33 (181860000, 1, 10),
34 (181860000, 3, 7),
35 (181860001, 0, 3),
36 (181860002, 2, 10),
37 (181860003, 2, 1),
38 (181860004, 0, 3),
39 (181860004, 1, 7),
40 (181860004, 2, 9),
41 (181860004, 3, 5),
42 (181860005, 3, 9),
43 (181860005, 4, 3),
44 (181860006, 0, 3),
45 (181860006, 1, 9),
46 (181860006, 2, 1),
47 (181860006, 3, 4),
48 (181860006, 4, 5),
49 (181860007, 1, 5),
50 (181860007, 2, 9),
51 (181860008, 0, 7),
52 (181860008, 1, 8),
53 (181860008, 4, 7),
```

54 (181860009,0,7),
55 (181860009,4,10);

插入数据后的各表截图为：

ex2.sql exp2-manual.pdf department X

```
SELECT * FROM ex2.department LIMIT 100;
```

Input To Search Data

#	id	name	chairman_id
1	0	公关	181860000
2	1	开发	181860001
3	2	运营	181860002
4	3	产品	181860003

ex2.sql exp2-manual.pdf project X

```
SELECT * FROM ex2.project LIMIT 100;
```

Input To Search Data

#	id	name	dept_
1	0	Office	2
2	1	SQL	2
3	2	VSCode	1
4	3	Visual Studio	2
5	4	Edge	0

ex2.sql exp2-manual.pdf worker X

```
SELECT * FROM ex2.worker LIMIT 100;
```

Input To Search Data

#	id	name	age	salary	dept_
1	181860000	尚忠霞	34	918368	0
2	181860001	孙江	30	911016	1
3	181860002	殷梅	35	391053	2
4	181860003	骆月	29	862730	3
5	181860004	史瑶	29	406307	3
6	181860005	殷芳	26	712941	2
7	181860006	南宫毅	31	767097	0
8	181860007	郎都艺	31	147451	0
9	181860008	史新	39	959588	3
10	181860009	满雅	36	452839	3

ex2.sqlexp2-manual.pdfwp

SELECT * FROM ex2.wp LIMIT 100;

Input To Search Data

	#	worker_i	project_id	time
		Filter	Filter	Filter
	1	181860000	0	8
	2	181860000	1	10
	3	181860000	3	7
	4	181860001	0	3
	5	181860002	2	10
	6	181860003	2	1
	7	181860004	0	3
	8	181860004	1	7
	9	181860004	2	9
	10	181860004	3	5
	11	181860005	3	9
	12	181860005	4	3
	13	181860006	0	3
	14	181860006	1	9
	15	181860006	2	1
	16	181860006	3	4
	17	181860006	4	5
	18	181860007	1	5
	19	181860007	2	9
	20	181860008	0	7
	21	181860008	1	8
	22	181860008	4	7
	23	181860009	0	7
	24	181860009	4	10

2 添加约束

2.1 添加主键约束

```
1 ALTER TABLE Project ADD PRIMARY KEY(id);
2 ALTER TABLE Worker ADD PRIMARY KEY (id);
3 ALTER TABLE Department ADD PRIMARY KEY(id);
4 ALTER TABLE WP ADD PRIMARY KEY (worker_id,project_id);
```

2.2 添加非空约束

```
1 ALTER TABLE Project CHANGE COLUMN id id INT NOT NULL;
2 ALTER TABLE Project CHANGE COLUMN dept_id dept_id INT NOT NULL;
3 ALTER TABLE Project CHANGE COLUMN name name CHAR(20) NOT NULL;
4
5 ALTER TABLE worker CHANGE COLUMN id id INT NOT NULL;
6 # ALTER TABLE worker CHANGE COLUMN dept_id dept_id INT NOT NULL;
7 ALTER TABLE worker CHANGE COLUMN name name CHAR(20) NOT NULL;
8 ALTER TABLE worker CHANGE COLUMN age age INT NOT NULL;
9 ALTER TABLE worker CHANGE COLUMN salary salary INT NOT NULL;
10
11 ALTER TABLE Department CHANGE COLUMN id id INT NOT NULL;
12 ALTER TABLE Department CHANGE COLUMN chairman_id chairman_id INT NOT NULL;
13 ALTER TABLE Department CHANGE COLUMN name name CHAR(20) NOT NULL;
14
15 ALTER TABLE WP CHANGE COLUMN worker_id worker_id INT NOT NULL;
16 ALTER TABLE WP CHANGE COLUMN project_id project_id INT NOT NULL;
17 # ALTER TABLE WP CHANGE COLUMN time time INT NOT NULL;
```

2.3 添加外键约束

```
1 ALTER TABLE WP
2 ADD CONSTRAINT fk_worker_id
3 FOREIGN KEY (worker_id)
4 REFERENCES Worker(id)
5 ON UPDATE CASCADE;
6
7 ALTER TABLE WP
8 ADD CONSTRAINT fk_project_id
9 FOREIGN KEY (project_id)
10 REFERENCES Project(id)
11 ON UPDATE CASCADE;;
12
13 ALTER TABLE Worker
14 ADD CONSTRAINT fk_dept_id_in_worker
15 FOREIGN KEY (dept_id)
16 REFERENCES Department(id)
17 ON UPDATE CASCADE;
18
19 ALTER TABLE Project
20 ADD CONSTRAINT fk_dept_id_in_project
21 FOREIGN KEY (dept_id)
22 REFERENCES Department(id)
23 ON UPDATE CASCADE;
```

2.4 update和delete验证外键约束

```
1 ### update验证 : 修改表Project中的id, 期望WP中的project_id同步修改
2 SELECT * FROM WP
3 WHERE project_id = 0 OR project_id = 100;
4
5 UPDATE Project
6 SET id = 100
7 WHERE id = 0;
8
9 SELECT * FROM WP
```

```

10 WHERE project_id = 0 OR project_id = 100;
11
12 ### delete验证 : 删除Project中的一条记录(已被WP使用), 期望被阻止
13 DELETE FROM Project
14 WHERE id = 100 ;

```

```

mysql> ## 2.4 update和delete验证外键约束
mysql>
mysql> ### update验证 : 修改表Project中的id, 期望WP中的project_id同步修改
mysql> SELECT * FROM WP

```

```

-> WHERE project_id = 0 OR project_id = 100;

```

worker_id	project_id	time
181860000	0	8
181860001	0	3
181860004	0	3
181860006	0	3
181860008	0	7
181860009	0	7

```

6 rows in set (0.00 sec)

```

```

mysql>
mysql> UPDATE Project
-> SET id = 100
-> WHERE id = 0;
Query OK, 1 row affected (0.01 sec)
Rows matched: 1 Changed: 1 Warnings: 0

```

```

mysql>
mysql> SELECT * FROM WP
-> WHERE project_id = 0 OR project_id = 100;

```

worker_id	project_id	time
181860000	100	8
181860001	100	3
181860004	100	3
181860006	100	3
181860008	100	7
181860009	100	7

```

6 rows in set (0.00 sec)

```

```

mysql> ### delete验证 : 删除Project中的一条记录(已被WP使用), 期望被阻止
mysql> DELETE FROM Project
-> WHERE id = 100 ;
ERROR 1451 (23000): Cannot delete or update a parent row: a foreign key constraint fails (`ex2`.`wp`, CONSTRAINT `fk_project_id` FOREIGN KEY (`project_id`) REFERENCES `project` (`id`) ON UPDATE CASCADE)
mysql>

```

3 执行违反约束的操作

3.1 违反主键约束

```

1 INSERT INTO Worker
2 VALUES
3 (181860001, "孙大海", 30, 999999, 1);
4
5 INSERT INTO WP
6 VALUES
7 (181860000, 2, 12);

```

3.2 违反非空约束

```
1  INSERT INTO Project
2  VALUES
3  (20, NULL, NULL);
```

3.3 违反外键约束

```
1  INSERT INTO Project
2  VALUES
3  (20, "Github Desktop", 100);
4
5  DELETE FROM Worker
6  WHERE id in (
7      SELECT DISTINCT worker_id FROM WP
8  );
```

```
mysql> # 3 执行违反约束的操作
mysql>
mysql> ## 3.1 违反主键约束
mysql> INSERT INTO Worker
-> VALUES
-> (181860001, "孙大海", 30, 999999, 1);
ERROR 1062 (23000): Duplicate entry '181860001' for key 'worker.PRIMARY'
mysql>
mysql> INSERT INTO WP
-> VALUES
-> (181860000, 2, 12);
Query OK, 1 row affected (0.01 sec)

mysql>
mysql> ## 3.2 违反非空约束
mysql> INSERT INTO Project
-> VALUES
-> (20, NULL, NULL);
ERROR 1048 (23000): Column 'name' cannot be null
mysql>
mysql> ## 3.3 违反外键约束
mysql> INSERT INTO Project
-> VALUES
-> (20, "Github Desktop", 100);
ERROR 1452 (23000): Cannot add or update a child row: a foreign key constraint fails (`ex2`.`project`, CONSTRAINT `fk_dept_id_in_project` FOREIGN KEY (`dept_id`) REFERENCES `department` (`id`) ON UPDATE CASCADE)
mysql>
mysql> DELETE FROM Worker
-> WHERE id in (
-> SELECT DISTINCT worker_id FROM WP
-> );
ERROR 1451 (23000): Cannot delete or update a parent row: a foreign key constraint fails (`ex2`.`wp`, CONSTRAINT `fk_worker_id` FOREIGN KEY (`worker_id`) REFERENCES `worker` (`id`) ON UPDATE CASCADE)
mysql>
mysql>
```

4 触发器

4.1 创建触发器

```
1  DELIMITER $
2  CREATE TRIGGER work_time_inspector
3  BEFORE INSERT ON WP
4  FOR EACH ROW
5  BEGIN
6      if NEW.time > 24 then
7          SET NEW.time = 24;
8      end if;
9  END$
10 DELIMITER ;
11
12 DELIMITER $
13 CREATE TRIGGER worker_salary_increaser
14 AFTER INSERT ON WP
15 FOR EACH ROW
16 BEGIN
17     declare is_chairman boolean;
18     set is_chairman = (EXISTS (SELECT chairman_id FROM Department d WHERE
NEW.worker_id = d.chairman_id));
19     if is_chairman = true then
20         UPDATE Worker
```

```

21     SET salary = salary * 1.05 * 1.03
22     WHERE NEW.worker_id = id;
23 else
24     UPDATE Worker
25     SET salary = salary * 1.05
26     WHERE NEW.worker_id = id;
27 end if;
28 END$
29 DELIMITER ;

```

mysql> # 4 触发器

mysql>

mysql> ## 4.1 创建触发器

mysql> DELIMITER \$

mysql> CREATE TRIGGER work_time_inspector

-> BEFORE INSERT ON WP

-> FOR EACH ROW

-> BEGIN

-> if NEW.time > 24 then

-> SET NEW.time = 24;

-> end if;

-> END\$

Query OK, 0 rows affected (0.02 sec)

mysql> DELIMITER ;

mysql>

mysql>

mysql> DELIMITER \$

mysql> CREATE TRIGGER worker_salary_increaser

-> AFTER INSERT ON WP

-> FOR EACH ROW

-> BEGIN

-> declare is_chairman boolean;

-> set is_chairman = (EXISTS (SELECT chairman_id FROM Department d WHERE NEW.worker_id = d.chairman_id));

-> if is_chairman = true then

-> UPDATE Worker

-> SET salary = salary * 1.05 * 1.03

-> WHERE NEW.worker_id = id;

-> else

-> UPDATE Worker

-> SET salary = salary * 1.05

-> WHERE NEW.worker_id = id;

-> end if;

-> END\$

Query OK, 0 rows affected (0.01 sec)

mysql> DELIMITER ;

mysql>

4.2 验证触发器

```

1  INSERT INTO Project
2  VALUES
3  (5, 'new project', 1);
4
5  SELECT id, salary FROM Worker
6  WHERE id = 181860000 OR id = 181860007;
7
8  INSERT INTO WP
9  VALUES
10 (181860000, 5, 25),
11 (181860007, 5, 30);
12
13 ### expected: 1、 salary of 181860000 should be s * 1.05 * 1.03
14 ###                (181860000, 5, 25) should be modified to (181860055, 5, 24)
15 ###                2、 salary of 181860007 should be s * 1.05
16 ###                (181860007, 5, 30) should be modified to (181860007, 5, 24)
17
18 SELECT id, salary FROM Worker
19 WHERE id = 181860000 OR id = 181860007;
20
21 SELECT * FROM WP

```



```
22 WHERE project_id = 5;
```

```
mysql> ## 4.2 验证触发器
```

```
mysql>
```

```
mysql> INSERT INTO Project
```

```
-> VALUES
```

```
-> (5, 'new project', 1);
```

```
Query OK, 1 row affected (0.01 sec)
```

```
mysql>
```

```
mysql> SELECT id, salary FROM Worker
```

```
-> WHERE id = 181860000 OR id = 181860007;
```

```
+-----+-----+  
| id      | salary |
```

```
+-----+-----+  
| 181860000 | 918368 |
```

```
| 181860007 | 147451 |
```

```
+-----+-----+
```

```
2 rows in set (0.00 sec)
```

```
mysql>
```

```
mysql> INSERT INTO WP
```

```
-> VALUES
```

```
-> (181860000, 5, 25),
```

```
-> (181860007, 5, 30);
```

```
Query OK, 2 rows affected (0.01 sec)
```

```
Records: 2 Duplicates: 0 Warnings: 0
```

```
mysql>
```

```
mysql> ### expected: 1、 salary of 181860000 should be s * 1.05 * 1.03
```

```
mysql> ### (181860000, 5, 25) should be modified to (181860055, 5, 24)
```

```
mysql> ### 2、 salary of 181860007 should be s * 1.05
```

```
mysql> ### (181860007, 5, 30) should be modified to (181860007, 5, 24)
```

```
mysql>
```

```
mysql> SELECT id, salary FROM Worker
```

```
-> WHERE id = 181860000 OR id = 181860007;
```

```
+-----+-----+  
| id      | salary |
```

```
+-----+-----+  
| 181860000 | 993215 |
```

```
| 181860007 | 154824 |
```

```
+-----+-----+
```

```
2 rows in set (0.00 sec)
```

```
mysql>
```

```
mysql> SELECT * FROM WP
```

```
-> WHERE project_id = 5;
```

```
+-----+-----+-----+  
| worker_id | project_id | time |
```

```
+-----+-----+-----+  
| 181860000 | 5 | 24 |
```

```
| 181860007 | 5 | 24 |
```

```
+-----+-----+-----+
```

```
2 rows in set (0.00 sec)
```

5 用户权限

5.1 创建用户并授权

```
1 CREATE USER IF NOT EXISTS 'worker1'@'localhost'  
2 IDENTIFIED BY '123123';  
3  
4 GRANT SELECT ON ex2.Worker TO 'worker1'@'localhost';  
5 GRANT UPDATE(age) ON ex2.Worker TO 'worker1'@'localhost';
```

5.2 用户登录并修改

先通过

```
1  mysql -uworker1 -p123123
```

登录worker1账号

```
1  use ex2
2
3  UPDATE Worker
4  SET age = age + 20;
5
6  UPDATE Worker
7  SET salary = salary + 20000;
```

```
mysql> use ex2
Database changed
mysql>
mysql> UPDATE Worker
-> SET age = age + 20;
Query OK, 10 rows affected (0.01 sec)
Rows matched: 10  Changed: 10  Warnings: 0

mysql>
mysql> UPDATE Worker
-> SET salary = salary + 20000;
ERROR 1143 (42000): UPDATE command denied to user 'worker1'@'localhost' for column 'salary' in table 'worker'
mysql> █
```

5.3 删除用户

```
1  DROP USER 'worker1'@'localhost';
```

```
mysql> DROP USER 'worker1'@'localhost';
Query OK, 0 rows affected (0.01 sec)

mysql> █
```

实验中遇到的麻烦及解决方法

1、本次实验要生成符合要求的学生数据、课程数据、选课数据和教室数据较为麻烦

我通过修改上一次实验中的数据生成脚本，完成了本次实验的python数据生成脚本

2、创建触发器和用户授权的语法不了解

我通过查阅资料自学了实验中需要用到的mysql语法

致谢

1、MySQL教程

