

《数据库原理与设计》实验报告

年级、专业、班级	2024 级软件工程 01		姓名	
实验题目	实验 6 数据完整性控制			
实验时间	2024/10/22	实验地点	DS1501	
实验成绩		实验性质	<input checked="" type="checkbox"/> 验证性 <input type="checkbox"/> 设计性 <input type="checkbox"/> 综合性	
教师评价： <input type="checkbox"/> 算法/实验过程正确; <input type="checkbox"/> 源程序/实验内容提交 <input type="checkbox"/> 程序结构/实验步骤合理; <input type="checkbox"/> 实验结果正确; <input type="checkbox"/> 语法、语义正确; <input type="checkbox"/> 报告规范; 其他： 评价教师签名：				
一、实验目的 [1] 掌握实体完整性的创建和修改方法; [2] 掌握参照完整性的创建和修改方法; [3] 掌握用户定义的完整性的创建和修改方法; [4] 掌握触发器的创建和修改。				
二、实验项目内容 针对数据库 Library 进行下面的实验： 1. 对各个表实现实体完整性并验证； 2. 实现表之间的参照完整性并验证； 3. 实现下列约束并验证： (1) 姓名不能为空值。 (2) 性别应该为“男”或“女”。 (3) 年龄必须在 0 到 100 之间。 (4) 价格必须大于 0。 (5) 借阅日期默认为当前日期。 4. 创建触发器，当删除 Reader 表中读者的信息时，同时删除 Borrow 表中该读者的记录。 5. 创建一个表 Book_Count，用来记录每本书被借阅的次数，关系模式为 (Bno, BorrowTimes)，其中 Bno 表示图书编号，BorrowTimes 表示借阅次数。现要求在 Borrow 表上创建一个触发器，当有新的借阅记录时，更新 Book_Count 表的信息，将被借图书的借阅次数加 1。				

报告创建时间：

三、实验过程或算法（源程序）

1.

```
alter table test1 add primary key (bno);
```

验证： insert into test1 values('B07','计算机','王小明','88.8'); ×

 insert into test1 values('B08','计算机','王小明','88.8'); √

```
alter table book add unique (bno);
```

验证： insert into book values('B11','计算机','王小明','88.8'); ×

 insert into book values('B02','计算机','王小明','88.8'); √

2.

```
alter table library.borrow
```

```
add constraint bno foreign key (bno)
```

```
references library.book(bno)
```

```
on delete no action
```

```
on update no action;
```

验证： insert into borrow(borrcode, bno) values('10','b11'); √

 insert into borrow(borrcode, bno) values('11','b12'); ×

3.

```
alter table reader
```

```
add constraint sex_check check(rsex='男' or rsex='女') enforced;
```

```
alter table reader
```

```
add constraint age_check check(rage>=0 and rage<=100) enforced;
```

```
alter table book
```

```
add constraint price_check check(bprice>0) enforced;
```

```
ALTER TABLE borrow MODIFY borrowdate TIMESTAMP DEFAULT CURRENT_TIMESTAMP;
```

验证：

insert into reader(rno,rname,rsex,rage) values ('r07',null,'沃尔玛塑料袋','107');

×

insert into reader(rno,rname,rsex,rage) values ('r07','余里','沃尔玛塑料袋','107'); ×

insert into reader(rno,rname,rsex,rage) values ('r07','余里','男','107'); ×

insert into reader(rno,rname,rsex,rage) values ('r07','余里','男','17'); √

insert into book(bno,bprice) values ('b12','11'); √

insert into book(bno,bprice) values ('b13','-11'); ×

insert into borrow(borrcode,bno) values ('10','B06')

4.

```
delete from reader where rno='R01';
```

5.

```
create table book_count(
```

```
bno char(10),borrowtimes int(4)
);
```

```
Insert          into      book_count(bno,borrowtimes)
values('b01','0'),('b02','0'),('b03','0'),('b04','0'),('b05','0'),('b06','0'),('b11','0'),('b12'
,'0')
insert into borrow(borrnum,bno) values('13','b02')
```

四、实验结果及分析和（或）源程序调试过程

1. 设置主键

The screenshot shows the MySQL Workbench interface for creating a table named 'test1'. In the 'Columns' tab, there are three columns defined:

Column Name	Datatype	PK	NN	UQ	B	UN	ZF	AI	G	Default/Expression
borrnum	INT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>						
rno	CHAR(10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	NULL
bno	CHAR(10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	NULL

For the 'borrnum' column, the 'PK' and 'NN' checkboxes are checked. Below the table definition, the 'Storage' section is shown with the 'Primary Key' checkbox checked.

At the bottom of the interface, the SQL command `alter table test1 add primary key (bno);` is visible in the query editor.

当插入主键相同是元组时将被拒绝

1 • SELECT * FROM library.test1;

Result Grid | Filter Rows: Ed

bno	btitle	bauthor	bprice
B02	计算机网络基础	孙河	40.00
B03	操作系统概论	林东	52.00
B04	C++程序设计	刘伟	43.00
B05	数据库基础	陈宏伟	39.00
B06	英语世界	王大海	24.00

1 insert into test1 values('B02','计算机','王小明','88.8');
2

Output

Action Output

#	Time	Action
1	19:22:07	insert into test1 values('B02','计算机','王小明','88.8')

Message
Error Code: 1062. Duplicate entry 'B02' for key test1.PRIMARY'

但是主键不一致则可以插入

1 insert into test1 values('B08','计算机','王小明','88.8');
2

Output

Action Output

#	Time	Action
1	19:23:56	insert into test1 values('B08','计算机','王小明','88.8')

Message
1 row(s) affected

或者设置 unique 约束:

Table Name: book Schema: library

Column Name Datatype PK NN UQ B UN ZF AI G Default/Expression

bno	CHAR(10)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	NULL							
btitle	VARCHAR(100)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	NULL
bauthor	VARCHAR(50)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	NULL
bprice	DECIMAL(5,2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	NULL

Column Name: bno Data Type: CHAR(10)
Charset/Collation: Default Charset Default Collation
Comments:
Storage: Virtual Stored
Primary Key Not Null Unique
Binary Unsigned Zero Fill
Auto Increment Generated

Columns Indexes ForeignKeys Triggers Partitioning Options

1 • alter table book add unique (bno);
2

Output

Action Output

#	Time	Action
1	19:29:47	alter table book add unique (bno)

Message
0 row(s) affected Records: 0 Duplicates: 0 Warnings: 0

当插入值与 unique 列已有数据一样时不能成功, 反之可以成功

```
1 • insert into book values('B11','计算机','王小明','88.8');
2 • insert into book values('B02','计算机','王小明','88.8');
3
```

Output

#	Time	Action	Message
1	19:34:29	insert into book values('B11','计算机','王小明','88.8')	1 row(s) affected
2	19:34:29	insert into book values('B02','计算机','王小明','88.8')	Error Code: 1062. Duplicate entry 'B02' for key 'book.PRIMARY'

2. (参照完整性)
现在为 borrow 表中的 bno 设置外键，参照 book 表中的 bno

The screenshot shows the 'Create Table' dialog in MySQL Workbench. The 'Table Name' is set to 'borrow' and the 'Schema' is 'library'. The 'Charset/Collation' is 'utf8mb4'. The 'Comments:' field is empty. In the 'Foreign Key Name' section, 'bno' is selected. In the 'Referenced Table' section, 'library`.`book`' is chosen. In the 'Column' section, 'bno' is checked and mapped to 'bno' in the 'Referenced Column' section. Other columns like 'borrnum', 'rno', 'borrowdate', and 'returndate' are listed but not selected.

Foreign Key Name	Referenced Table	Column	Referenced Column
bno	'library`.`book`'	<input type="checkbox"/> borrnum	
		<input type="checkbox"/> rno	
		<input checked="" type="checkbox"/> bno	bno
		<input type="checkbox"/> borrowdate	
		<input type="checkbox"/> returndate	

Tables

- ▶ book
- ▶ bookcopy
- ▼ borrow
 - ▶ Columns
 - ▶ Indexes
 - ▼ Foreign Keys
 - bno**
 - ▶ Triggers
 - ▶ readcopy
 - ▶ reader
 - ▶ test1
 - ▶ test2
- ▶ Views
- ▶ Stored Procedures
- ▶ Functions

▶ library_2

▶ sales

▶ sys

▶ test1

Administration Schemas

Information

Foreign Key: bno

Definition:

```

Target      book (bno
           → bno)
On          RESTRICT
Update     RESTRICT
On Delete   RESTRICT
  
```

也可以使用 SQL 语句

```

alter table library.borrow add constraint bno foreign key (bno) references library.book(bno) on delete no action on update no action;
  
```

验证参照完整性

The screenshot shows the MySQL Workbench interface. In the SQL editor, two statements are run:

```

1 • insert into borrow(borrrnum, bno) values('10','b11');
2 • insert into borrow(borrrnum, bno) values('11','b12');
  
```

In the Output pane, the first statement is successful:

Action	Output
1	insert into borrow(borrrnum, bno) values('10','b11');

The second statement fails with an error message:

Action	Output	Message
2	insert into borrow(borrrnum, bno) values('11','b12');	Error Code: 1452. Cannot add or update a child row: a foreign key constraint fails (library.borrow: CONSTRAINT `bno` FOREIGN KEY (`bno`) REFERENCES `library`.`book`(`bno`))

3.

Output

#	Time	Action	Message
1	19:56:33	insert into borrow(borrowid, bno) values('10',b11)	1 row(s) affected
2	19:56:33	insert into borrow(borrowid, bno) values('11',b12)	Error Code: 1452. Cannot add or update a child row: a foreign key constraint fails (<i>test</i> .borrow: CONSTRAINT `fk_borrow` FOREIGN KEY(`borrowid`) REFERENCES `reader`(`rno`))
3	20:01:10	Apply changes to reader	Changes applied
4	20:09:31	alter table reader add constraint sex_check check(rsex='男' or rsex='女') enforced	6 row(s) affected Records: 6 Duplicates: 0 Warnings: 0
5	20:09:31	alter table reader add constraint age_check check(age>=0 and age<=100) enforced	6 row(s) affected Records: 6 Duplicates: 0 Warnings: 0
6	20:09:31	alter table book add constraint price_check check(bprice>0) enforced	7 row(s) affected Records: 7 Duplicates: 0 Warnings: 0

ALTER TABLE borrow

MODIFY borrowdate TIMESTAMP DEFAULT CURRENT_TIMESTAMP;

验证：

关于 reader 表

#	Time	Action	Message
1	20:15:50	insert into reader(rno,rname,rsex,rage) values ('r07',null,'沃尔玛塑料袋','107');	Error Code: 1048. Column 'rname' cannot be null
2	20:16:02	insert into reader(rno,rname,rsex,rage) values ('r07','余里','沃尔玛塑料袋','107')	Error Code: 1406. Data too long for column 'rsex' at row 1
3	20:17:17	insert into reader(rno,rname,rsex,rage) values ('r07','余里','男','107')	Error Code: 3819. Check constraint 'age_check' is violated.
4	20:17:21	insert into reader(rno,rname,rsex,rage) values ('r07','余里','男','17')	1 row(s) affected

关于 book 表（新插入行默认实验时的时间为借阅时间）

#	Time	Action	Message
1	20:20:24	insert into book(bno,bprice) values ('b12','11');	1 row(s) affected
2	20:20:24	insert into book(bno,bprice) values ('b13','-11');	Error Code: 3819. Check constraint 'price_check' is violated.

1 • insert into borrow(borrnum,bno) values ('10','B06')
 2

Output

Action Output

#	Time	Action
1	20:25:06	insert into borrow(borrnum,bno) values ('10','B06')

1 row(s)

Result Grid

	borrnum	rno	bno	borrowdate	returndate
5	R03	b01	2015-06-12 00:00:00	2015-07-26	
6	R04	b03	2015-05-08 00:00:00	2015-07-02	
7	R04	b02	2015-06-05 00:00:00	2015-08-02	
8	R05	b04	2015-07-20 00:00:00	NULL	
9	R06	b05	2015-08-01 00:00:00	NULL	
10	NULL	B06	2024-10-22 20:25:06	NULL	
*	NULL	NULL	NULL	NULL	

borrow 2

4.
使用图形界面:

BEFORE INSERT
 AFTER INSERT
 BEFORE UPDATE
 AFTER UPDATE
 BEFORE DELETE
 AFTER DELETE

```

  1 • CREATE DEFINER='root'@'localhost' TRIGGER 'reader_AFTER_DELETE' AFTER DELETE ON 'reader' FOR EACH ROW BEGIN
  2   delete from borrow b where old.rno=b.rno;
  3 END
  
```

reader_AFTER_DELETE

当删除 reader 中的 r01 时, borrow 也会删除 r01 的借阅记录

	borrnum	rno	bno	borrowdate	returndate
3	R02	b01	2014-12-20 00:00:00	2015-01-10	
4	R03	b02	2014-11-25 00:00:00	2015-01-15	
5	R03	b01	2015-06-12 00:00:00	2015-07-26	
6	R04	b03	2015-05-08 00:00:00	2015-07-02	
7	R04	b02	2015-06-05 00:00:00	2015-08-02	
8	R05	b04	2015-07-20 00:00:00	NULL	
9	R06	b05	2015-08-01 00:00:00	NULL	
10	NULL	B06	2024-10-22 20:25:06	NULL	
*	NULL	NULL	NULL	NULL	

borrow 2

5. 图形界面：

Comments:

```
BEFORE INSERT
▼ AFTER INSERT
borrow_AFTER_INSERT
1 • CREATE DEFINER='root'@'localhost' TRIGGER `borrow_AFTER_INSERT` AFTER INSERT ON `borrow` FOR EACH ROW BEGIN
2     update book_count b set borrowtimes=borrowtimes+1 where new.bno=b.bno;
3     END
```

Algorithm: Default Lock Type: Default

```
1      DROP TRIGGER IF EXISTS `library`.`borrow_AFTER_INSERT`;
2
3      DELIMITER $$;
4      USE `library`$$;
5      CREATE DEFINER = CURRENT_USER TRIGGER `library`.`borrow_AFTER_INSERT` A
6      BEGIN
7          update book_count b set borrowtimes=borrowtimes+1 where new.bno=b.bno;
8      END$$;
9      DELIMITER ;
10
```

验证：

新添加一条 borrow 记录，b02 的次数加一

insert into borrow(borrnum,bno) values('13','b02')

bno	borrowtimes
b01	0
b02	1
b03	0
b04	0
b05	0
b06	0
b11	0
b12	0

book_count 3 ×