

实验名称

一、 实验目的

- 掌握数据库应用开发程序设计方法。

二、 系统需求

该系统需要具备的功能如下：

- (多种) 图书查询
- 图书借阅
- 图书归还
- 查看某借书证的借书记录
- 图书入库
- 利用文件实现图书批量入库
- 借书证管理

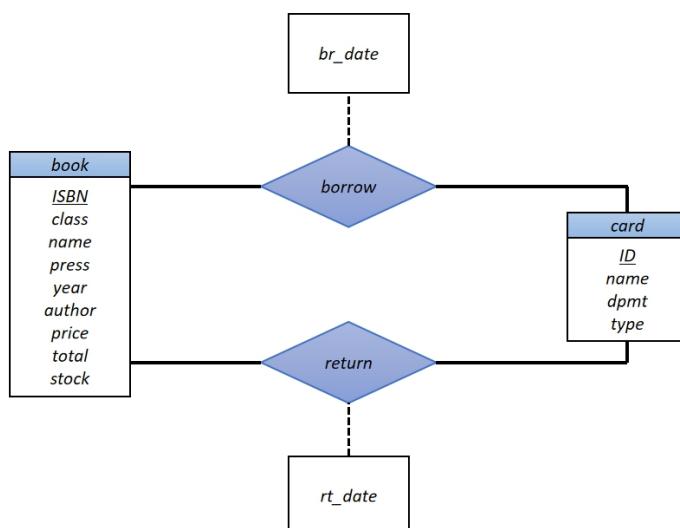
三、 实验环境

- 数据库管理系统：MySQL
- 开发语言：Python
- 开发工具：Visual Studio Code
- 交互页面：字符界面

四、 系统设计及实现

1. 实体之间的关系 E-R 图

E-R 图如下图所示，本次实验中的主体集为图书实体集和借书证实体集。通过借书证，用户可以借阅图书，借阅之后可以归还图书。



2. 数据库逻辑结构设计

考虑到借书与还书的特性，在将 E-R 图转化为 schema 时，将 *rt_date* 和 *br_date* 保存在一个表内。一次借阅由图书的 *ISBN*、借书证的 *ID*、借书日期 *br_date* 共同唯一确认（此处暂不考虑同一本书在一天内被同一个人借了又还并再借，这可以通过更精细的时间戳来解决）。如下：

```
book(ISBN, class, name, press, year, author, price, total, stock)
card(ID, name, dpmt, type)
record(ID, ISBN, br_date, rt_date)
```

用 DDL 语言表示时，注意设置主键与外键，并且需要检查借书证的类型是否为学生 *S* 或教师 *T*。如下：

```
create table book( ISBN      varchar(20),
                   class     varchar(10),
                   name      varchar(30),
                   press     varchar(30),
                   year      int,
                   author    varchar(20),
                   price     decimal(7, 2),
                   total     int,
                   stock     int,
                   primary key(ISBN))
create table card( ID        varchar(10),
                   name      varchar(30),
                   dpmt     varchar(10),
                   type      char(1),
                   primary key(ID),
                   check (type in ('T', 'S')))
create table record(ID       varchar(10),
                    ISBN     varchar(20),
                    br_date  int,
                    rt_date  int,
                    type     char(1),
                    primary key(ID, ISBN),
                    foreign key(ID) references card(ID),
                    foreign key(ISBN) references book(ISBN))
```

3. 程序运行结果场景以及截图说明

本处将结合 MySQL 指令，来更好地观察程序运行的结果。观察运行结果也可以在程序内进行，但可能更为繁琐且不如使用 MySQL 来得简明直观，MySQL 是辅助手段。

演示开始之前，数据表中已经存在一些数据。数据表 *book* 的数据如下：

```
mysql> select * from book;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| ISBN | class | name | press | year | author | price | total | stock |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 9787020164776 | Literature | A Later Bloomer | People | 2020 | Yan Mo | 59.00 | 3 | 3 |
| 9787513311236 | Detective | Roger Ackroyd | SPH | 2013 | Agatha | 50.01 | 2 | 2 |
| 9787513328081 | Literature | Kitano's Tavern | SPH | 2018 | Takeshi Kitano | 45.00 | 3 | 3 |
| 9787515517377 | Physics | The Mamba Mentality | GWP | 2018 | Kobe Bryant | 124.08 | 3 | 3 |
| 9787530210291 | Literature | 1984 | BOLAPH | 2010 | George Orwell | 28.00 | 6 | 5 |
| 9787533941628 | Psychology | Three Theories on Sexology | ZLAPH | 2015 | Sigmund Freud | 32.00 | 3 | 3 |
| 9787535438379 | Science | Wandering Earth | CLAPH | 2008 | Cixin Liu | 28.00 | 3 | 3 |
| 9787536025080 | Literature | Golden Era | FCPH | 1999 | Xiaobo Wang | 19.00 | 9 | 8 |
| 9787536480469 | Science | Killing Algorithm | SSTP | 2015 | Ken Liu | 26.00 | 6 | 6 |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
9 rows in set (0.03 sec)
```

数据表 *card* 的数据如下：

```

mysql> select * from card;
+----+-----+-----+-----+
| ID | name | dpmt | type |
+----+-----+-----+-----+
| 00001 | zpq | CS | s |
| 00002 | LZY | MATH | S |
| T00001 | bk | CS | T |
+----+-----+-----+-----+
3 rows in set (0.01 sec)

```

数据表 *record* 的数据如下：

```

mysql> select * from record;
+----+-----+-----+-----+-----+
| ID | ISBN | br_date | rt_date | type |
+----+-----+-----+-----+-----+
| 00001 | 9787530210291 | 20210414 | 20210414 | s |
| 00002 | 9787536025080 | 20210414 | 20210419 | S |
| T00001 | 9787530210291 | 20210414 | NULL | T |
| t00001 | 9787536025080 | 20210419 | NULL | T |
+----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

```

a. 数据表创建与程序主界面

点击运行程序，程序会首先创建三个相应的数据表；如果数据表已经存在，则输出数据表已存在的提示。主页面会有提示信息，截图如下：

```

D:\Users\lenovo\Desktop\code>python -u "d:\Users\lenovo\Desktop\code\py\python\dbs.py"
Tables already exist!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management   0: Exit
| 

```

此处程序会对输入进行检查，如果输入的是字符串或者非法的数字，系统会提示错误并再次进入主页面。此后的每一次这种输入都会进行检查。截图如下：

```

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management   0: Exit
test
Nonexistent operation!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management   0: Exit
9
Nonexistent operation!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management   0: Exit
| 

```

b. (多种) 图书查询

在主页面输入 1 进入图书查询页面，可以看到程序提示正在进行查询（“*You are trying to search a book...*”），并且给出了基于不同条件的查询的序号。其中年份与价格是**区间查询**。如果需要查阅所有的书籍，则可以选择年份查询，输入 0 与 2022；或者选择价格查询，输入 0 与 10000，实现查询条件的全覆盖。由于其他五种查询皆为**全匹配查询**，这里只演示年份查询。选择年份查询，系统会提示输入何种信息。如果输入的年份非法，系统会给予提示并返回主页面，截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management   0: Exit  
1  
You are trying to search a book...  
Please choose the information you want to search:  
1: Book Name        2: Classification  
3: Press             4: Publication year  
5: Author            6: Price  
7: ISBN              0: Exit  
4  
Please enter the lower bound of the publication year:test  
The publication year should be a number!  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management   0: Exit
```

如果查询条件下没有图书，则系统**提示不存在相应图书并返回主页面**，截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management   0: Exit  
1  
You are trying to search a book...  
Please choose the information you want to search:  
1: Book Name        2: Classification  
3: Press             4: Publication year  
5: Author            6: Price  
7: ISBN              0: Exit  
4  
Please enter the lower bound of the publication year:2022  
Please enter the upper bound of the publication year:2022  
No such books!  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management   0: Exit
```

如果存在符合条件的图书，则**打印这些图书的信息并返回主页面**，截图如下：

```

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit
1
You are trying to search a book...
Please choose the information you want to search:
1: Book Name        2: Classification
3: Press            4: Publication year
5: Author           6: Price
7: ISBN             0: Exit
4
Please enter the lower bound of the publication year:2005
Please enter the upper bound of the publication year:2020
ISBN Classification          Name    Press   Year     Author   Price  Total Stock
0 9787020164776  Literature       A Later Bloomer People 2020 Yan Mo 59.00 3 3
1 9787513311236  Detective        Roger Ackroyd SPH 2013 Agatha 50.01 2 2
2 9787513328081  Literature       Kitano's Tavern SPH 2018 Takeshi Kitano 45.00 3 3
3 9787515517377  Physics          The Mamba Mentality GWP 2018 Kobe Bryant 124.08 3 3
4 9787530216291  Literature       1984 BOLAPH 2010 George Orwell 28.00 6 5
5 9787533941628  Psychology      Three Theories on Sexology ZLAPH 2015 Sigmund Freud 32.00 3 3
6 9787535438379  Science         Wandering Earth CLAPH 2008 Cixin Liu 28.00 3 3
7 9787536480469  Science         Killing Algorithm SSTP 2015 Ken Liu 26.00 6 6

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit

```

c. 图书借阅

在主页面输入 2 进入图书借阅页面，可以看到程序提示正在进行借阅（“*You are trying to borrow a book...*”），系统会提示输入何种信息。如果输入的借书证 ID 不存在，系统会提示借书证不存在并返回主页面，截图如下：

```

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit
2
You are trying to borrow a book...
Please enter your card ID: test
Nonexistent card ID!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit

```

如果输入的图书 ISBN 不存在，系统会提示图书不存在并返回主页面，截图如下：

```

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit
2
You are trying to borrow a book...
Please enter your card ID: 00001
Please enter the ISBN of the book you are to borrow: test
Nonexistent ISBN!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit

```

如果 (ID, ISBN) 已经存在于借书记录中且归还日期为空（说明有一本借了未还），系统会提示已经借阅该书并返回主页面（系统设置为一个人不能同时借阅两本相同的书，想要再借需要先还书）。这种数据可以从数据表的初始数据获得，截图如下：

```

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit
2
You are trying to borrow a book...
Please enter your card ID: T00001
Please enter the ISBN of the book you are to borrow: 9787530210291
You have already borrowed one!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit

```

如果上述情况都没有发生且库存中存在一本书可借，则系统提示**借书成功，显示借阅图书的名字并返回主页面**，截图如下：

```

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit
2
You are trying to borrow a book...
Please enter your card ID: T00001
Please enter the ISBN of the book you are to borrow: 9787513311236
You have successfully borrowed Roger Ackroyd!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management  0: Exit

```

此时，如果利用 MySQL 查看表 *book* 与表 *record*，可以看到两个表都有了相应的改变：库存量减少以及新增借书记录。截图如下：

```

mysql> select * from book;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| ISBN   | class | name        | press  | year | author       | price | total | stock |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 9787020164776 | Literature | A Larter Bloomer | People | 2020 | Yan Mo     | 59.00 | 3    | 3   |
| 9787513311236 | Detective  | Roger Ackroyd    | SPH    | 2013 | Agatha     | 50.01 | 2    | 1   |
| 9787513328081 | Literature | Kitano's Tavern | SPH    | 2018 | Takeshi Kitano | 45.00 | 3    | 3   |
| 9787515517377 | Physics    | The Mamba Mentality | GWP   | 2018 | Kobe Bryant | 124.08 | 3    | 3   |
| 9787530210291 | Literature | 1984            | BOLAPH | 2010 | George Orwell | 28.00 | 6    | 5   |
| 9787533941628 | Psychology | Three Theories on Sexology | ZLAPH | 2015 | Sigmund Freud | 32.00 | 3    | 3   |
| 9787535438379 | Science    | Wandering Earth | CLAPH | 2008 | Cixin Liu    | 28.00 | 3    | 3   |
| 9787536025080 | Literature | Golden Era       | FCPH  | 1999 | Xiaobo Wang  | 19.00 | 9    | 8   |
| 9787536480469 | Science    | Killing Algorithm | SSTP  | 2015 | Ken Liu      | 26.00 | 6    | 6   |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
9 rows in set (0.00 sec)

mysql> select * from record;
+-----+-----+-----+-----+-----+
| ID   | ISBN      | br_date   | rt_date   | type  |
+-----+-----+-----+-----+-----+
| 00001 | 9787530210291 | 20210414 | 20210414 | s    |
| 00002 | 9787536025080 | 20210414 | 20210419 | S    |
| T00001 | 9787513311236 | 20210423 | NULL     | T    |
| T00001 | 9787530210291 | 20210414 | NULL     | T    |
| t00001 | 9787536025080 | 20210419 | NULL     | T    |
+-----+-----+-----+-----+-----+
5 rows in set (0.00 sec)

```

如果图书的库存量为 0，则系统会提示库存里没有可借的图书，给出该图书最早被借阅的时间，最后告知一本图书最多可被借阅三个月。省略将 *Roger Ackroyd* 库存清零的过程，结果截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
2  
You are trying to borrow a book...  
Please enter your card ID: 00002  
Please enter the ISBN of the book you are to borrow: 9787513311236  
No available books now!  
The first one to be borrowed is borrowed on: 2021 - 4 - 23  
A book can be kept for 3 months at most...  
  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit
```

d. 图书归还

在主页面输入 3 进入图书归还页面，可以看到程序提示正在进行归还（“*You are trying to return a book...*”），系统会提示输入何种信息。同样地，系统会对输入的借书证 *ID* 以及图书的 *ISBN* 进行检查，与图书借阅页面一样，不再赘述。

如果系统检查发现用户试图归还一本并没有借阅的书，则会提示**并未借阅此书，显示书名并返回主页面**，截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
3  
You are trying to return a book...  
Please enter your card ID: t00001  
Please enter the ISBN of the book you are to return: 9787533941628  
You haven't borrowed Three Theories on Sexology!  
  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit
```

如果系统发现用户确实借了一本书并且未归还，则会提示**归还成功，显示书名并返回主页面**。截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
3  
You are trying to return a book...  
Please enter your card ID: t00001  
Please enter the ISBN of the book you are to return: 9787536025080  
You just returned Golden Era!  
  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit
```

此时，如果利用 MySQL 查看表 *book* 与表 *record*，可以看到两个表都有了相应的改变：库存量增加以及借书记录改变。截图如下：

```

mysql> select * from book;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| ISBN | class | name | press | year | author | price | total | stock |
+-----+-----+-----+-----+-----+-----+-----+-----+
| 9787020164776 | Literature | A Latent Bloomer | People | 2020 | Yan Mo | 59.00 | 3 | 3 |
| 9787513311236 | Detective | Roger Ackroyd | SPH | 2013 | Agatha | 50.01 | 2 | 0 |
| 9787513328081 | Literature | Kitano's Tavern | SPH | 2018 | Takeshi Kitano | 45.00 | 3 | 3 |
| 9787515517377 | Physics | The Mamba Mentality | GWP | 2018 | Kobe Bryant | 124.08 | 3 | 3 |
| 9787536210291 | Literature | 1984 | BOLAPH | 2010 | George Orwell | 28.00 | 6 | 5 |
| 9787533941628 | Psychology | Three Theories on Sexology | ZLAPH | 2015 | Sigmund Freud | 32.00 | 3 | 3 |
| 9787535438379 | Science | Wandering Earth | CLAPH | 2008 | Cixin Liu | 28.00 | 3 | 3 |
| 9787536025080 | Literature | Golden Era | FCPH | 1999 | Xiaobo Wang | 19.00 | 9 | 9 |
| 9787536480469 | Science | Killing Algorithm | SSTP | 2015 | Ken Liu | 26.00 | 6 | 6 |
+-----+-----+-----+-----+-----+-----+-----+-----+
9 rows in set (0.00 sec)

```

```

mysql> select * from record;
+-----+-----+-----+-----+-----+
| ID | ISBN | br_date | rt_date | type |
+-----+-----+-----+-----+
| 00001 | 9787513311236 | 20210423 | NULL | s |
| 00001 | 9787530210291 | 20210414 | 20210414 | s |
| 00002 | 9787536025080 | 20210414 | 20210419 | S |
| T00001 | 9787513311236 | 20210423 | NULL | T |
| T00001 | 9787530210291 | 20210414 | NULL | T |
| t00001 | 9787536025080 | 20210419 | 20210423 | T |
+-----+-----+-----+-----+
6 rows in set (0.00 sec)

```

e. 查看某借书证的借书记录

在主页面输入 4 进入借书记录查询页面，可以看到程序提示正在进行查询（“*You are trying to view the books you have borrowed...*”），系统会提示输入何种信息。同样地，系统会对输入的借书证 ID 进行检查，与图书借阅页面一样，不再赘述。

这里只显示用户借了但未归还的的借书记录，因为考虑到这一种借书记录对用户有意义。用户很可能并不关心自己所有的借书历史。某用户所有的借书历史可能对管理员来说意义更大，对用户来说很可能是垃圾信息。

如果用户存在但并没有借了未还的书，则系统提示没有借书，并返回主页面，截图如下：

```

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management   0: Exit
4
You are trying to view the books you have borrowed...
Please enter your card ID: 00002
You haven't borrowed any book!

Please choose your operation:
1: Book Search      2: Borrow
3: Return           4: View Borrowed Books
5: Storage          6: Read a File
7: Card Management   0: Exit

```

如果用户存在且有未还的借书记录，则系统打印所有借书记录，并返回主页面，截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
4  
You are trying to view the books you have borrowed...  
Please enter your card ID: 00001  
ISBN             Name        Date  
9787513311236   Roger Ackroyd  2021 - 4 - 23  
  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit
```

f. 图书入库

在主页面输入 5 进入图书入库页面，可以看到程序提示正在进行入库（“*You are trying to add a book to the storage...*”），系统会提示输入何种信息。此处程序会**检查输入**的年份与价格，与前述功能类似，不再赘述。

此处程序被设置为，一本新书被添加入库时，如果已经有同样的书存在于图书库中，则更新价格、总量与库存；否则直接添加新书。图书其他信息的修改，个人认为放在此处是不合适的，可以将借书证管理功能**修改为管理员页面**。在那里，管理员既可以管理借书证，也可以直接修改任意图书的任意信息。

输入重复的 *ISBN* 时，依次输入各种信息，对比之前的截图，可以看出图书 *Roger Ackroyd* 的价格和库存都变了。系统**输出书名并提示存在的图书信息已更新**，截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
5  
You are trying to add a book to the storage...  
Please enter the ISBN:9787513311236  
Please enter the name:Roger Ackroyd  
Please enter the author:Agatha  
Please enter the press:SPH  
Please enter the classification:Detective  
Please enter the publication year:2013  
Please enter the price:66.66  
Existed Roger Ackroyd and the information is updated!  
  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit
```

输入新的 *ISBN* 时，系统**提示新图书成功入库**。截图如下：

```

Please choose your operation:
1: Book Search           2: Borrow
3: Return                 4: View Borrowed Books
5: Storage                6: Read a File
7: Card Management        0: Exit
5
You are trying to add a book to the storage...
Please enter the ISBN:testISBN
Please enter the name:test
Please enter the author:test
Please enter the press:test
Please enter the classification:Nonsense
Please enter the publication year:2021
Please enter the price:66.66
test is successfully added to the storage!

Please choose your operation:
1: Book Search           2: Borrow
3: Return                 4: View Borrowed Books
5: Storage                6: Read a File
7: Card Management        0: Exit

```

此时查看数据表的数据，可以看到相应图书的库存增加、价格改变，并且多出了新的图书。截图如下：

```

mysql> select * from book;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| ISBN      | class    | name          | press   | year  | author        | price | total | stock |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 9787020164776 | Literature | A Later Bloomer | People | 2020 | Yan Mo       | 59.00 | 3     | 3     |
| 9787513311236 | Detective  | Roger Ackroyd   | SPH    | 2013 | Agatha       | 66.66 | 3     | 1     |
| 9787513328081 | Literature  | Kitano's Tavern | SPH    | 2018 | Takeshi Kitano | 45.00 | 3     | 3     |
| 9787515517377 | Physics    | The Mamba Mentality | GWP   | 2018 | Kobe Bryant   | 124.08 | 3     | 3     |
| 9787530210291 | Literature  | 1984            | BOLAPH | 2010 | George Orwell | 28.00 | 6     | 5     |
| 9787533941628 | Psychology  | Three Theories on Sexology | ZLAPH | 2015 | Sigmund Freud | 32.00 | 3     | 3     |
| 9787535438379 | Science    | Wandering Earth  | CLAPH | 2008 | Cixin Liu     | 28.00 | 3     | 3     |
| 9787536025080 | Literature  | Golden Era       | FCPH  | 1999 | Xiaobo Wang   | 19.00 | 9     | 9     |
| 9787536480469 | Science    | Killing Algorithm | SSTP  | 2015 | Ken Liu       | 26.00 | 6     | 6     |
| testISBN      | Nonsense   | test            | test   | 2021 | test         | 66.66 | 1     | 1     |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
10 rows in set (0.01 sec)

```

g. 利用文件实现图书批量入库

在主页面输入 6 进入批量入库页面，可以看到程序提示正在进行读取文件以批量入库（“*You are trying to read a file...*”）。

在这里，利用 Python 的 pandas 包可以很方便地读取 csv 文件或者 xls 文件。将文件中的信息一一对应，调用图书入库的函数即可。此处为了方便测试，手动输入文件路径的方法被修改为了读取固定路径下的固定文件。实际应用中修改为手动输入文件路径，并注意打开文件报错即可。

程序运行截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
6  
You are trying to read a file...  
Existed A Later Bloomer and the information is updated!  
Existed 1984 and the information is updated!  
Existed Wandering Earth and the information is updated!  
Existed Kitano's Tavern and the information is updated!  
Existed Three Theories on Sexology and the information is updated!  
Existed Golden Era and the information is updated!  
Existed Killing Algorithm and the information is updated!  
Existed The Mamba Mentality and the information is updated!  
Existed Golden Era and the information is updated!  
Existed 1984 and the information is updated!  
Existed Killing Algorithm and the information is updated!  
Existed Golden Era and the information is updated!  
  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
[]
```

h. 借书证管理

在主页面输入 7 进入借书证管理页面，可以看到程序提示正在进行管理（“*You are trying to manage the library card...*”），系统会提示输入密码。这里的密码只是一个形式上的区分管理员与普通用户的机制，尚未引入任何加密算法。未来如果要将借书证管理页面修改为管理员页面，引入密码区分二者也是有必要的。

输入的密码如果不是正确密码 *manage*，系统会提示密码错误并返回主页面。截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
7  
You are trying to manage the library card...  
Please enter the password:test  
Wrong password!  
  
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
[]
```

如果密码正确，则进入管理员管理借书证页面。截图如下：

```
Please choose your operation:  
1: Book Search      2: Borrow  
3: Return           4: View Borrowed Books  
5: Storage          6: Read a File  
7: Card Management  0: Exit  
7  
You are trying to manage the library card...  
Please enter the password:manage  
Please choose your operation:  
1: Add one card     2: Delete one card  
0: Exit  
[]
```

同样地，程序会对输入的 *operation* 进行检查，不再赘述。在此页面输入 1，添加借书

证。程序会提示输入何种信息。如果输入的借书证 *ID* 已经存在，程序会提示 *ID* 已存在并返回主页面，截图如下：

```
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit  
7  
You are trying to manage the library card...  
Please enter the password:manage  
Please choose your operation:  
1: Add one card           2: Delete one card  
0: Exit  
1  
Please enter the ID:00001  
Please enter the name:test  
Please enter the department:cs  
Please enter the type('T' or 'S'):s  
00001 already exists!  
  
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit
```

如果输入的借书证类型既非学生也非教师（违背了约束），则会提示检查输入并返回主页面，截图如下：

```
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit  
7  
You are trying to manage the library card...  
Please enter the password:manage  
Please choose your operation:  
1: Add one card           2: Delete one card  
0: Exit  
1  
Please enter the ID:newid  
Please enter the name:test  
Please enter the department:cs  
Please enter the type('T' or 'S'):h  
Error! Please check your input!  
  
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit
```

如果上述情况没有发生，则会打印新加入的借书证 *ID*，提示加入成功并返回主页面，截图如下：

```

You are trying to manage the library card...
Please enter the password:manage
Please choose your operation:
1: Add one card           2: Delete one card
0: Exit
1
Please enter the ID:newid
Please enter the name:test
Please enter the department:cs
Please enter the type('T' or 'S'):s
newid is successfully added!

Please choose your operation:
1: Book Search           2: Borrow
3: Return                 4: View Borrowed Books
5: Storage                6: Read a File
7: Card Management        0: Exit

```

此时查看数据表，可以看到多出了一张借书证，截图如下：

```

mysql> select * from card;
+----+----+----+----+
| ID | name | dpmt | type |
+----+----+----+----+
| 00001 | zpq | CS | s |
| 00002 | LZY | MATH | S |
| newid | test | cs | s |
| T00001 | bk | CS | T |
+----+----+----+----+
4 rows in set (0.00 sec)

```

在管理员管理借书证的页面输入 2，进行删除借书证。如果输入的借书证 ID 不存在，则系统提示借书证不存在并返回主页面，截图如下：

```

Please choose your operation:
1: Book Search           2: Borrow
3: Return                 4: View Borrowed Books
5: Storage                6: Read a File
7: Card Management        0: Exit
7
You are trying to manage the library card...
Please enter the password:manage
Please choose your operation:
1: Add one card           2: Delete one card
0: Exit
2
Please enter the ID:new
Nonexistent card!

Please choose your operation:
1: Book Search           2: Borrow
3: Return                 4: View Borrowed Books
5: Storage                6: Read a File
7: Card Management        0: Exit

```

如果借书证存在，则移除该借书证，显示删除成功并返回主页面，截图如下：

```
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit  
7  
You are trying to manage the library card...  
Please enter the password:manage  
Please choose your operation:  
1: Add one card           2: Delete one card  
0: Exit  
2  
Please enter the ID:newid  
newid is successfully deleted!  
  
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit
```

需要注意的是，新加入的 *newid* 尚未有任何借书记录。为了确保图书不会流失，一个还有书未还的借书证是不能被删除的，例如要删除借书证 *00001*，其还有一本书未还，程序会提示有书未还，删除失败并返回主页面，截图如下：

```
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit  
7  
You are trying to manage the library card...  
Please enter the password:manage  
Please choose your operation:  
1: Add one card           2: Delete one card  
0: Exit  
2  
Please enter the ID:00001  
Some book is kept by this card yet! Deletion fails!  
  
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit
```

如果要删除 *00002*，其没有正在借阅的书，程序会提示删除成功并返回主页面，截图如下：

```
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit  
7  
You are trying to manage the library card...  
Please enter the password:manage  
Please choose your operation:  
1: Add one card           2: Delete one card  
0: Exit  
2  
Please enter the ID:00002  
00002 is successfully deleted!  
  
Please choose your operation:  
1: Book Search           2: Borrow  
3: Return                 4: View Borrowed Books  
5: Storage                6: Read a File  
7: Card Management        0: Exit
```

此时查看相应的数据表，可以看到 00002 的借书记录被全部删除（如果想要保留也很简单），并且借书证里没有 00002 借书证了，截图如下：

```
mysql> select * from card;
+----+-----+-----+-----+
| ID | name | dpmt | type |
+----+-----+-----+-----+
| 00001 | zpq | CS | s |
| T00001 | bk | CS | T |
+----+-----+-----+
2 rows in set (0.00 sec)

mysql> select * from record;
+-----+-----+-----+-----+-----+
| ID | ISBN | br_date | rt_date | type |
+-----+-----+-----+-----+-----+
| 00001 | 9787513311236 | 20210423 | NULL | s |
| 00001 | 9787530210291 | 20210414 | 20210414 | s |
| T00001 | 9787513311236 | 20210423 | NULL | T |
| T00001 | 9787530210291 | 20210414 | NULL | T |
| t00001 | 9787536025080 | 20210419 | 20210423 | T |
+-----+-----+-----+-----+
5 rows in set (0.00 sec)
```

五、遇到的问题及解决方法

1. 程序无法连接到数据库

初次编写时，程序出现了连接不上数据库的问题。后来检查发现，用户名应该填写 `user='root'` 而不是 `user='local@host'`。并且最好指明字符集，防止后续的显示出现问题。

2. 文件的路径问题

在读取文件进行批量入库时，程序也出现过数次找不到文件的错误。检查后发现是，Visual Studio Code 进入的路径变化了，导致**设定的相对路径也要变化**，否则就会找不到文件。当然，这一问题也可以通过**指定绝对路径**来解决。

3. 判断归还日期为 `NULL`

这一判断用于判断某本被借阅的书是否已经被归还，在查看借书记录以及删除借书证等处需要用到。同时将借书日期和还书日期放在一个表内，节省了空间、减少了信息冗余。

4. 如何处理 SQL 指令的结果

不同的 SQL 指令执行结果在 Python 有着截然不同的返回值。如 `select` 语句在返回空集时，会得到一个 `None` 对象，否则会得到一个数组；`delete` 语句的返回值则是删除元组的数量。编写程序时，需要对不同的返回值加以判断与利用。

除此之外，SQL 指令引发的错误也是可以利用的。如 `insert` 语句在插入一个主键重复的元组时，会引发 `pymysql.err.IntegrityError`，意为一致性错误；在插入的属性违反了 `check` 约束时，会引发 `pymysql.err.OperationalError`，意为操作性错误。由于系统的自动提交默认为假，在执行显示提交 `commit()` 指令提交修改之前，程序对数据库的修改不会被保存，可以使用 `try` 语句来利用这些错误，帮助编写程序。

六、 总结

此次实验让我学会了如何将数据库管理与编程语言结合起来，了解了开发的一般步骤，深刻体会到了许多上课讲到的开发细节是如何帮助开发的。