

# 银行业务管理系统—系统设计与实现报告

## 银行业务管理系统—系统设计与实现报告

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# 1 概述

## 1.1 系统目标

某银行准备开发一个银行业务管理系统。我们的目标是为了该银行的业务管理，开发一个银行业务管理系统

## 1.2 需求说明

要求实现的主要功能需求：

- 客户管理：提供客户所有信息的增、删、改、查功能；如果客户存在着关联账户或者贷款记录，则不允许删除；
- 账户管理：提供账户开户、销户、修改、查询功能，包括储蓄账户和支票账户；账户号不允许修改；
- 贷款管理：提供贷款信息的增、删、查功能，提供贷款发放功能；贷款信息一旦添加成功后不允许修改；要求能查询每笔贷款的当前状态（未开始发放、发放中、已全部发放）；处于

- 发放中状态的贷款记录不允许删除；
- **业务统计：**按业务分类（储蓄、贷款）和时间（月、季、年）统计各个支行的业务总金额和用户数，统计的结果以表格形式展示。

其他说明：

1. 支行、部门和员工的信息需要预先插入到数据库中，本项目假设这三类数据已经在数据库中了，并且本实验不要求实现这三类数据的维护。
2. 后台DBMS 使用MySQL；
3. 前端开发工具不限，可以是 C/S 架构也可以是 B/S 架构；
4. 查询功能允许自行设计，但要求尽可能灵活设计，考虑用户多样化的查询需求；
5. 各类数据的类型可自行根据实际情况设计；
6. 测试数据自行设计；
7. 系统实现时要保证数据之间的一致性；
8. 程序须有一定的出错处理，要求自己先做好测试，能够处理可以预见的一些错误，例如输入的客户姓名带单引号（类似O'Neil）、输入数据不合法等等；
9. 其余功能可以自行添加，例如登录管理、权限管理等等，但不做强制要求。如果做了添加，请在实验报告中加以描述；
10. 本实验要求单独完成。

## 1.3 本报告的主要贡献

使用 `flask + vue` 的BS架构，完成了银行业务管理系统的初步模型，实现了老师要求的所有功能。

介绍了整个系统的架构和运行流程，可以使读者对整个系统的实现有个初步了解。

演示了系统执行功能的过程和结果，可以直观体会到系统的正确性。

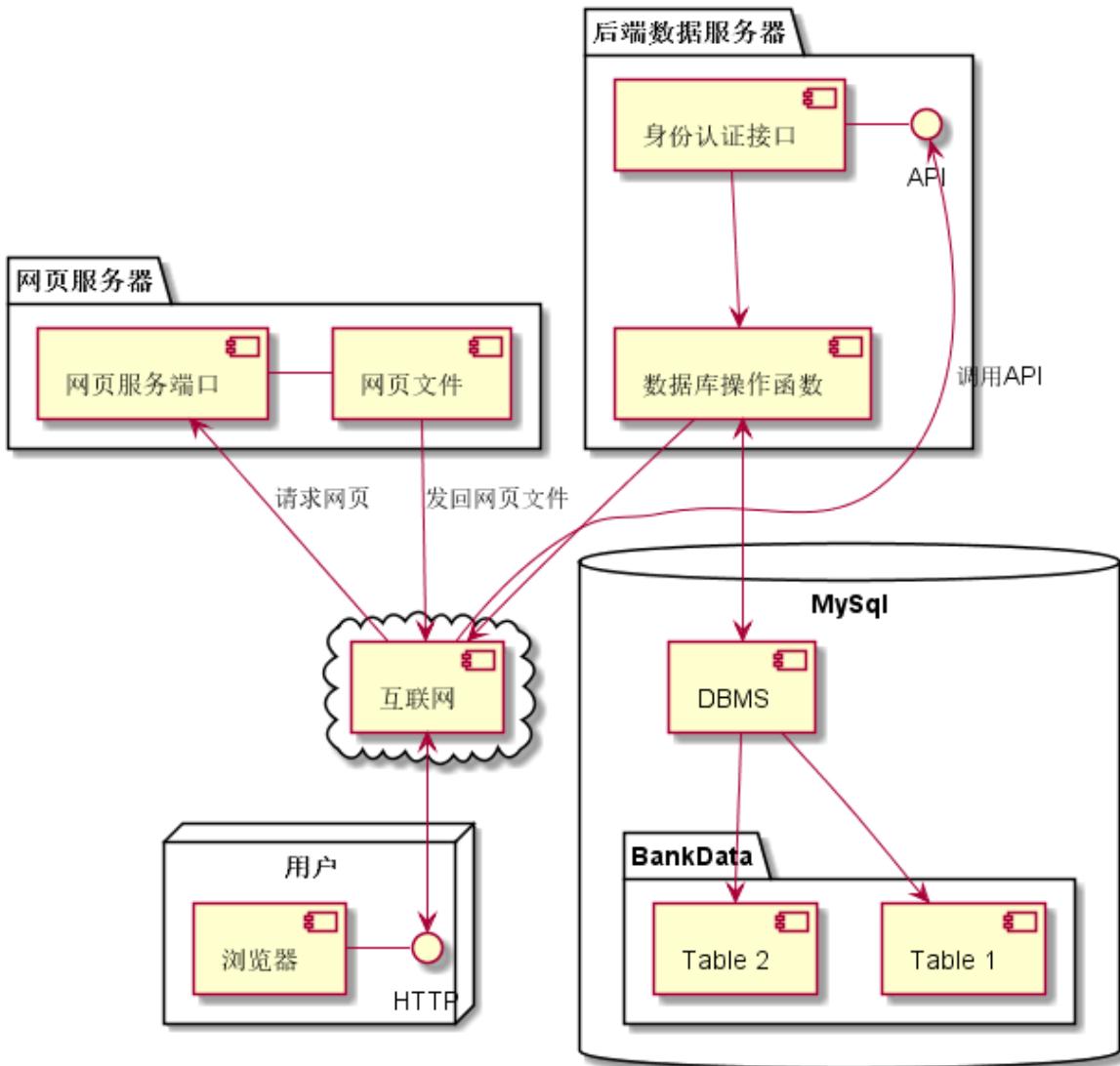
总结了实验中遇到的各种困难和解决方案。

## 2 总体设计

### 2.1 系统模块结构

#### 系统整体结构

用户向网页服务器请求网页，之后通过网页和后端数据服务器进行交互，并使用数据服务器和 `mysql` 数据库进行交互，以保证用户和数据库的隔离，并且所有对数据库的操作都需要通过身份认证接口进行验证，以防用户恶意操作数据库。

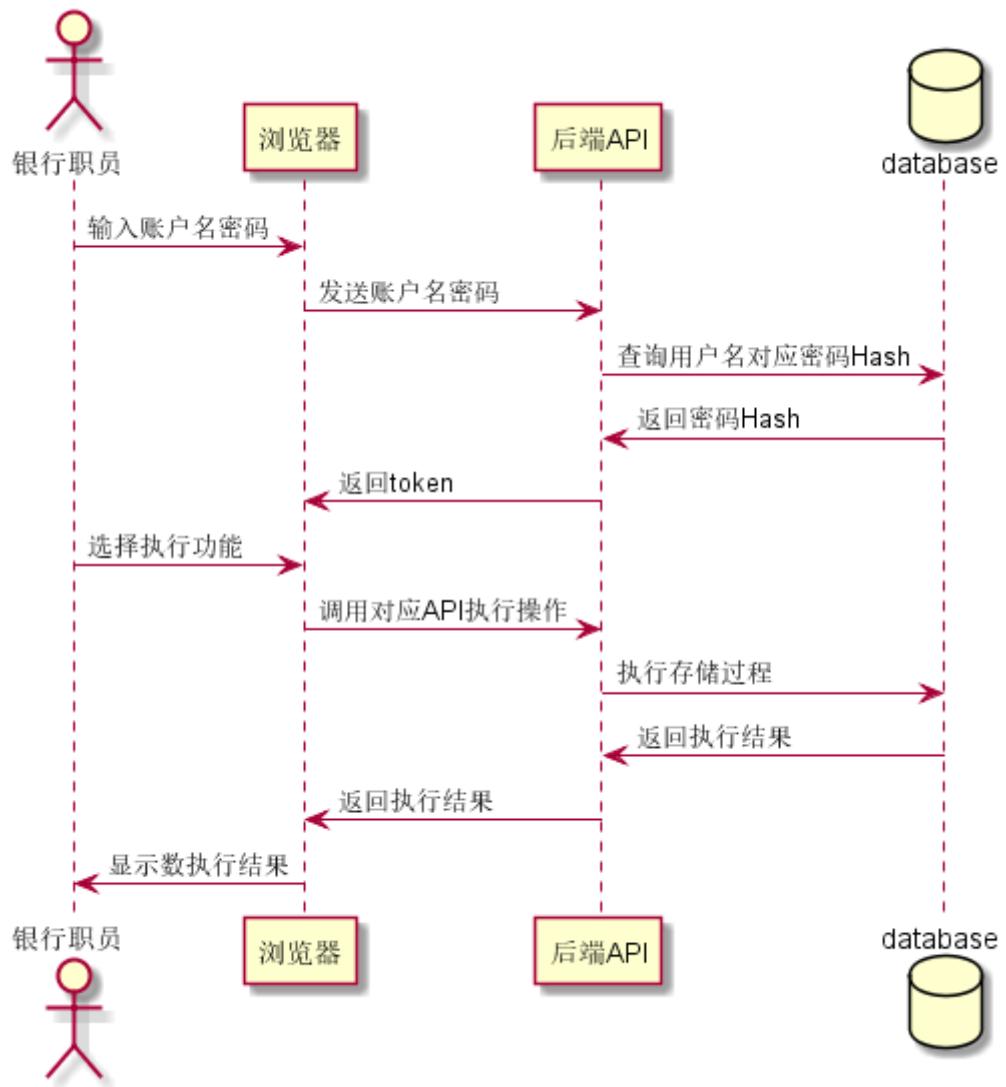


## 模块基本功能

- 网页服务器
  - 接受用户的请求网页信息
  - 将用户请求的网页发回给用户
- 后端数据服务器
  - 用户通过对 `ip:5000/<router> [GET, POST]` 的请求，调用后端特定的API，并将结果发送给用户
  - 验证用户的身份，身份不符则拒绝提供数据
- 数据库操作函数
  - 使用 `sqlalchemy` 对数据库进行ORM建模，并通过ORM模型对数据库进行访问
  - 提供输入检查，确保错误数据能够被及时发现
  - 提供错误处理，使用 `raise` 方式向上层模块发送具体错误信息

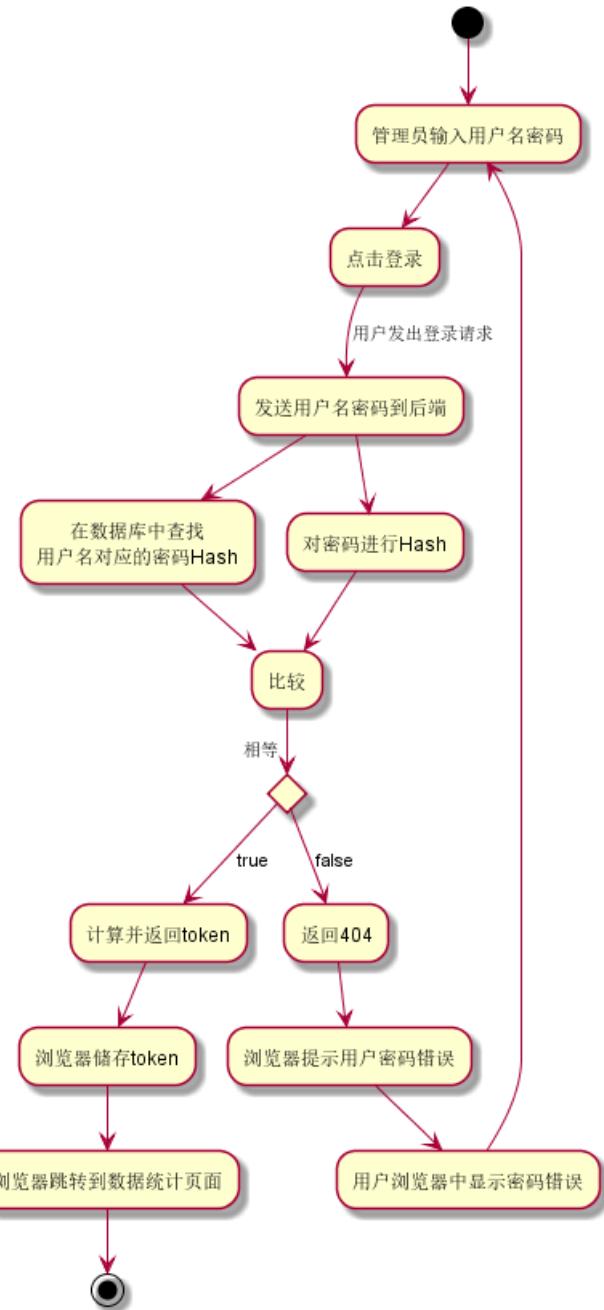
## 2.2 系统工作流程

### 整体交互流程

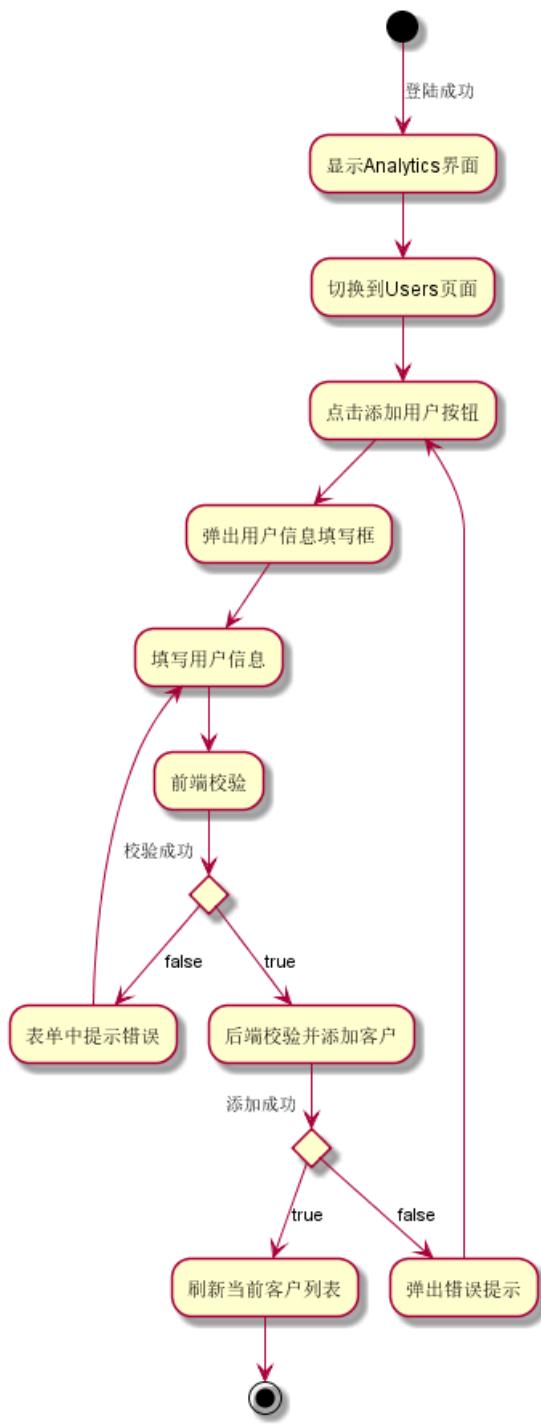


## 银行职员流程

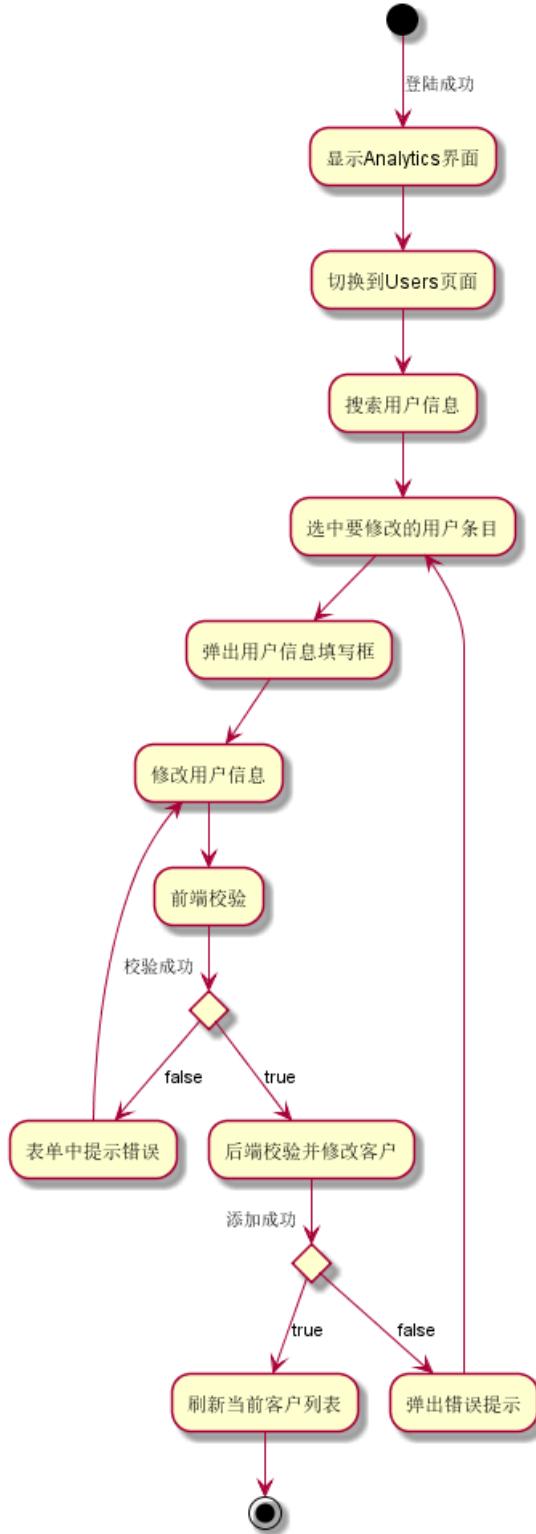
登录



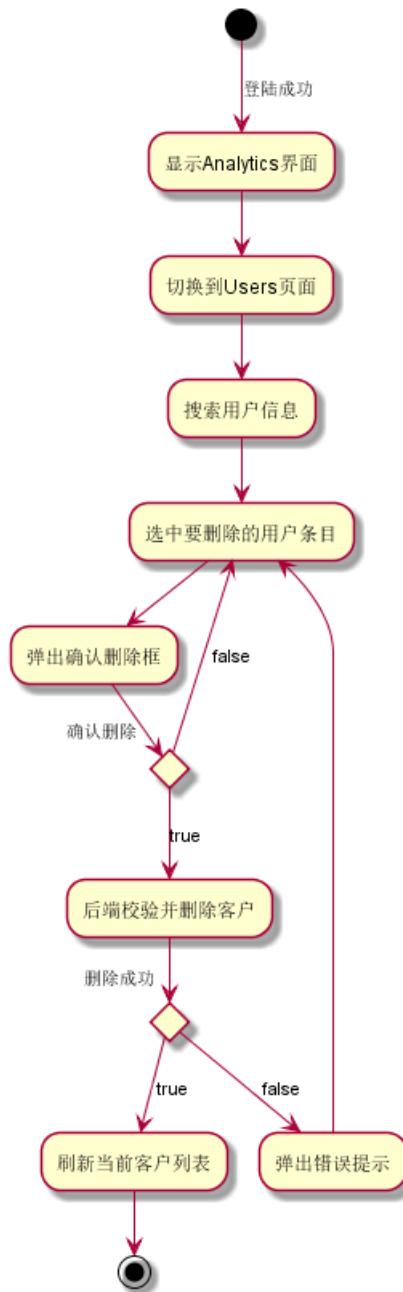
添加客户



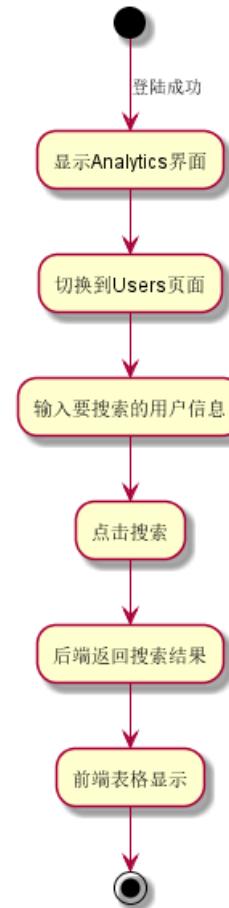
修改客户



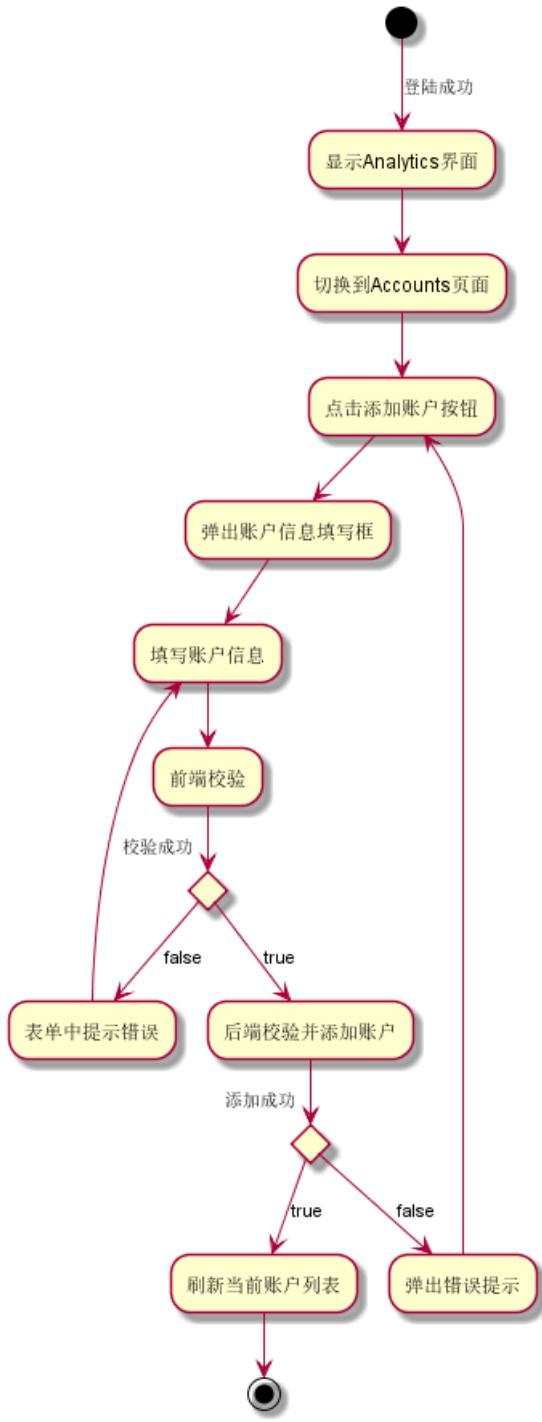
删除客户



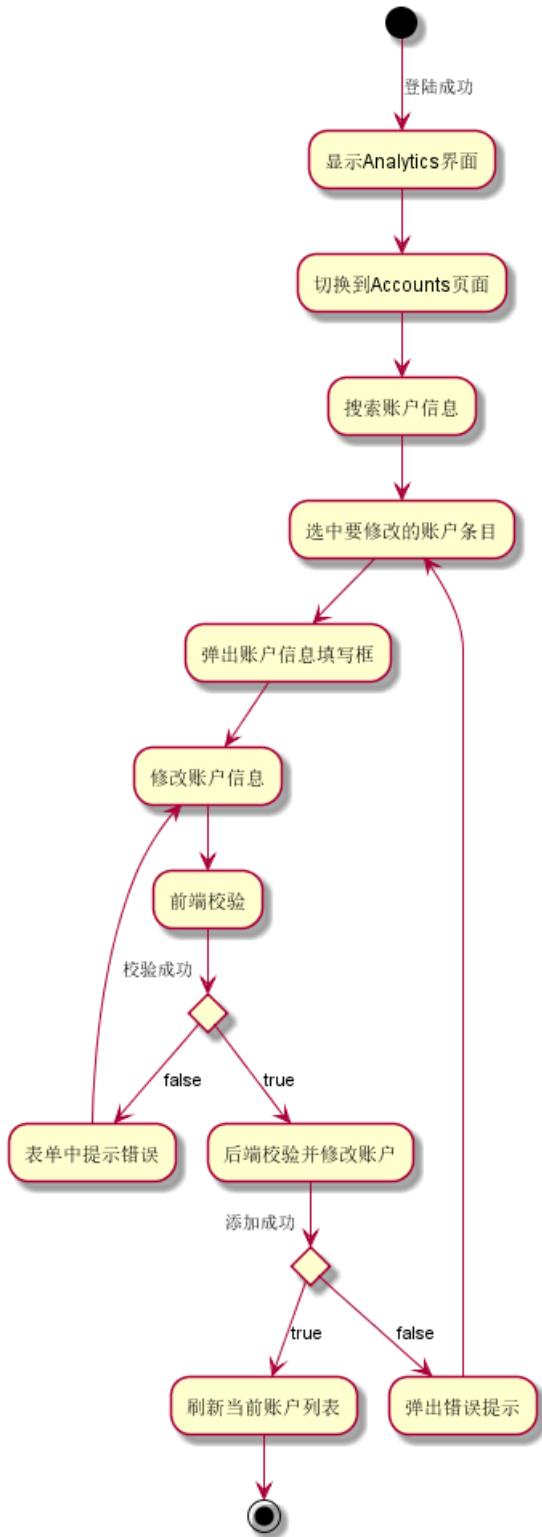
查询客户



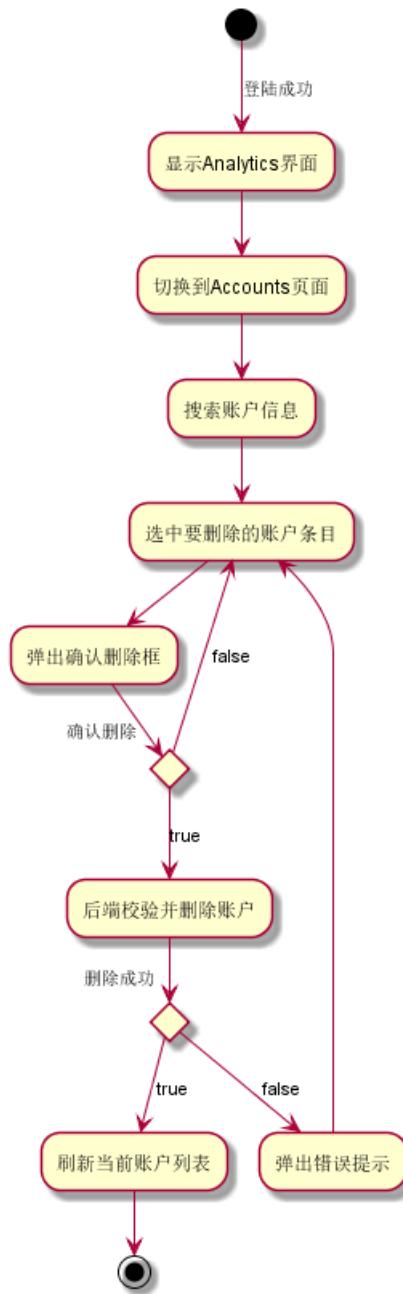
开户



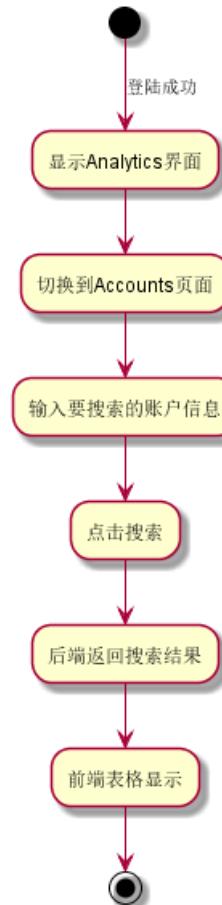
修改账户



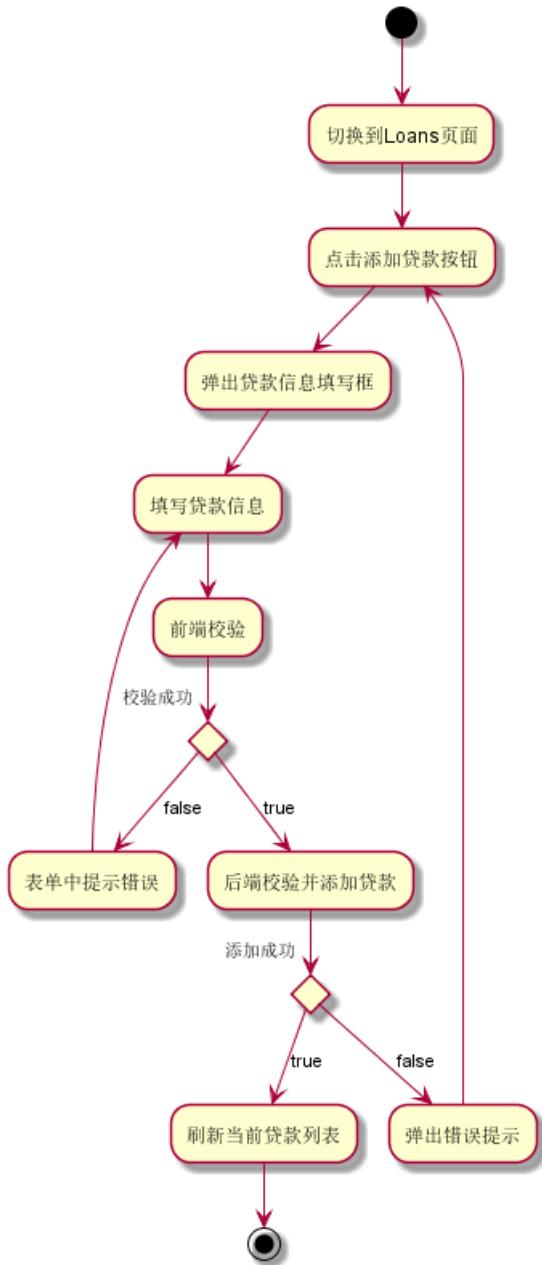
删除账户



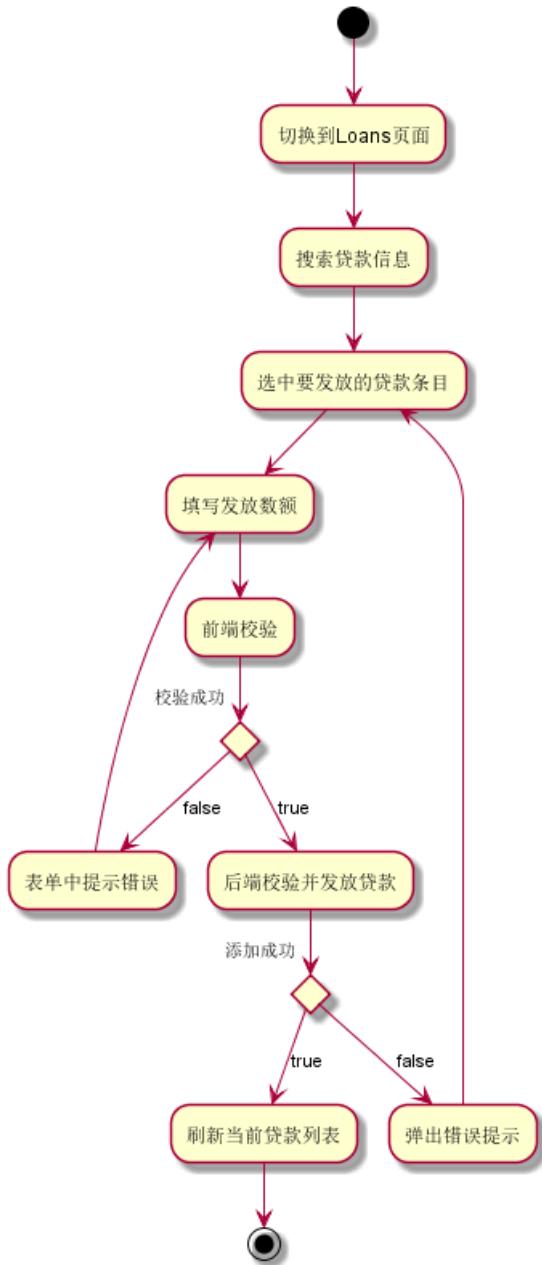
查询账户



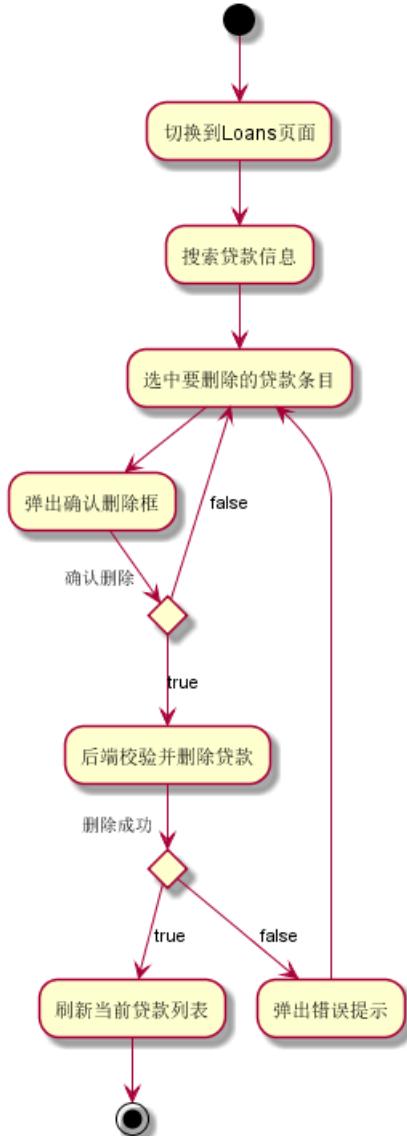
添加贷款



发放贷款



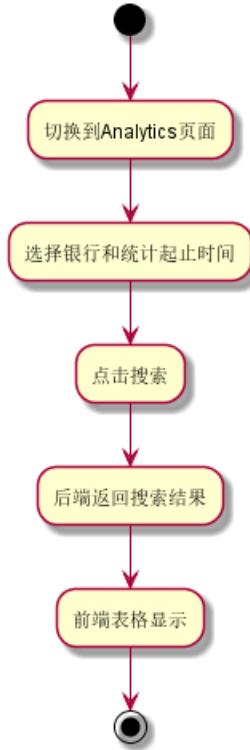
删除贷款



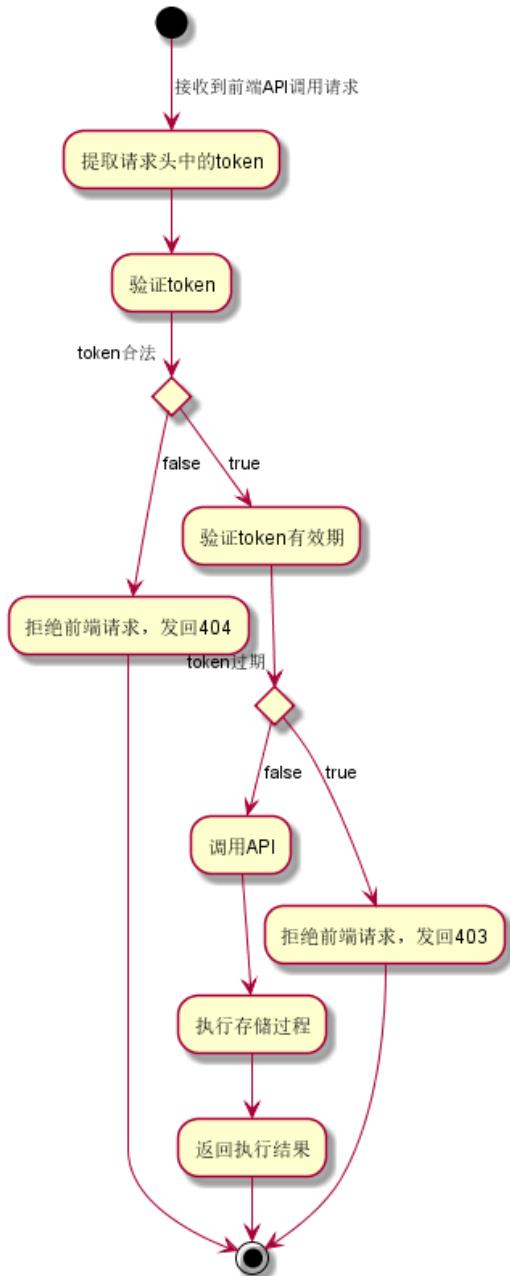
查询贷款



查看统计信息



后端流程

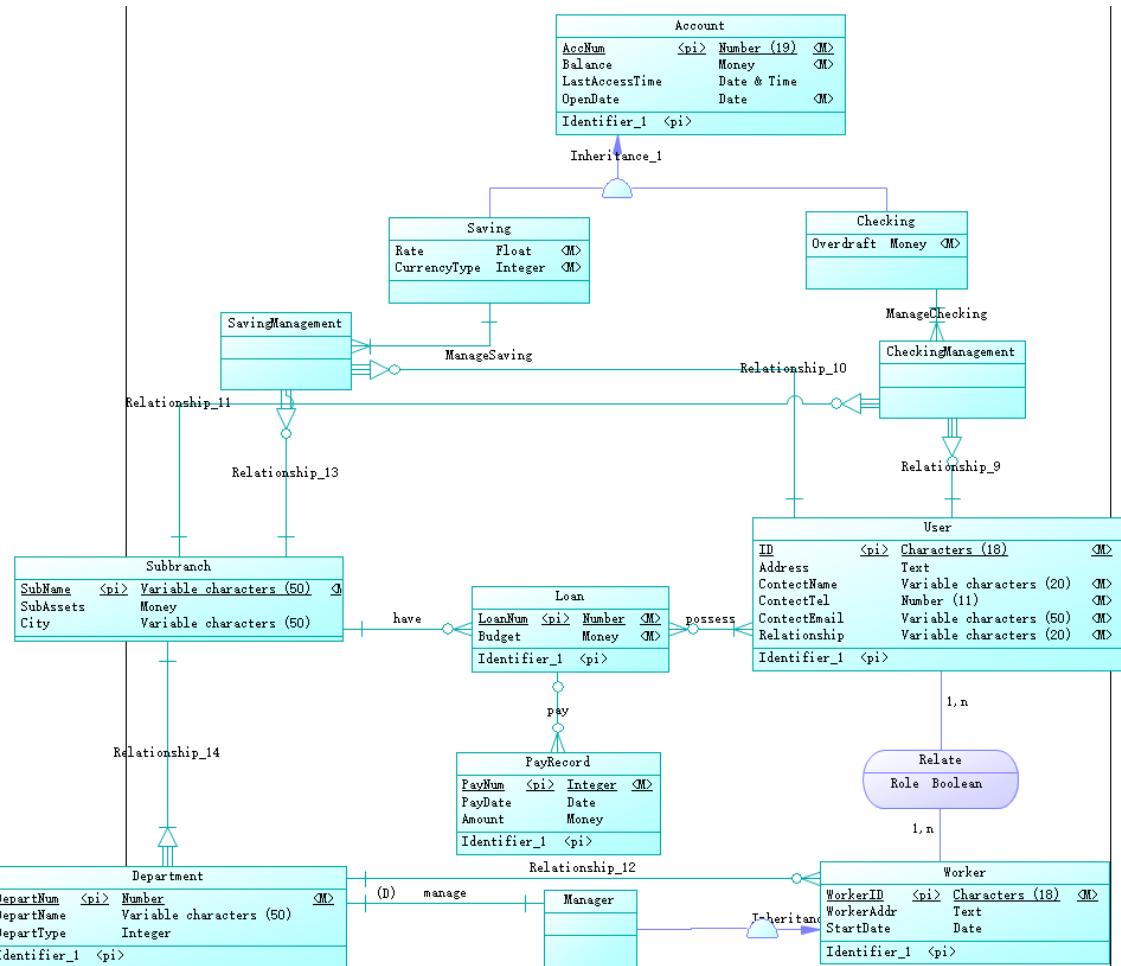


## 2.3 数据库设计

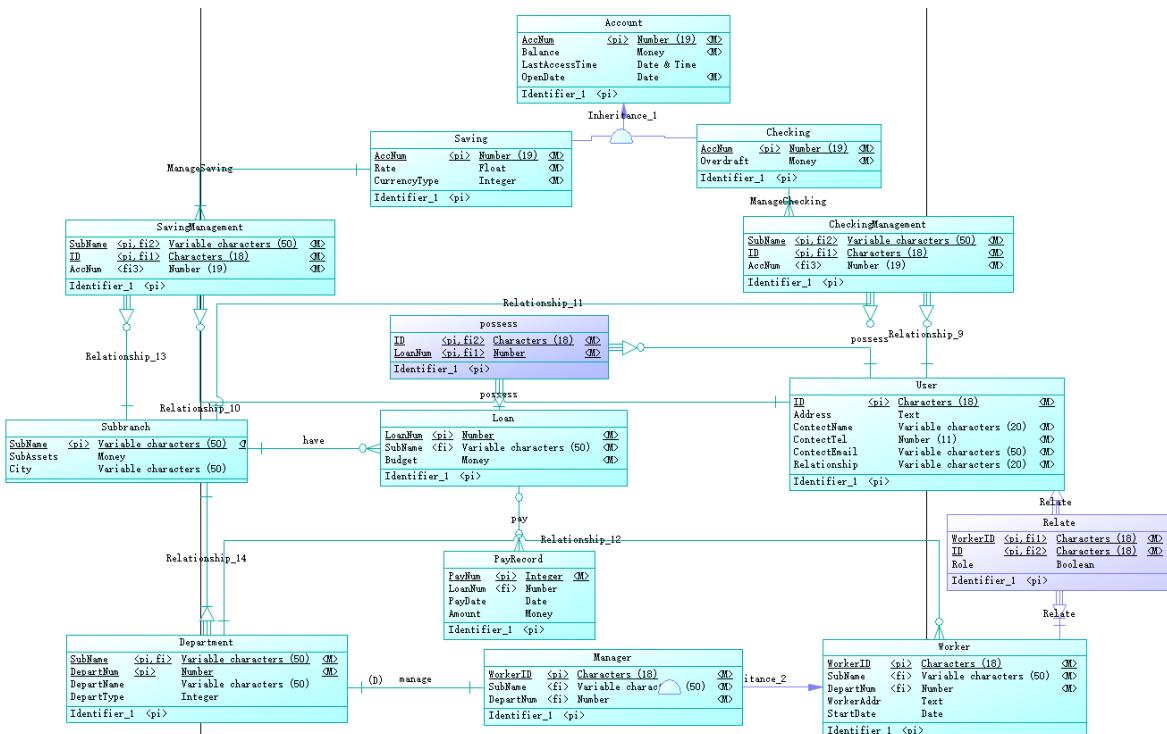
在整个设计中，最终的物理模型并没有产生任何冗余属性，整个数据库实现简洁，没有多余表格，可见设计完备。

### ER图

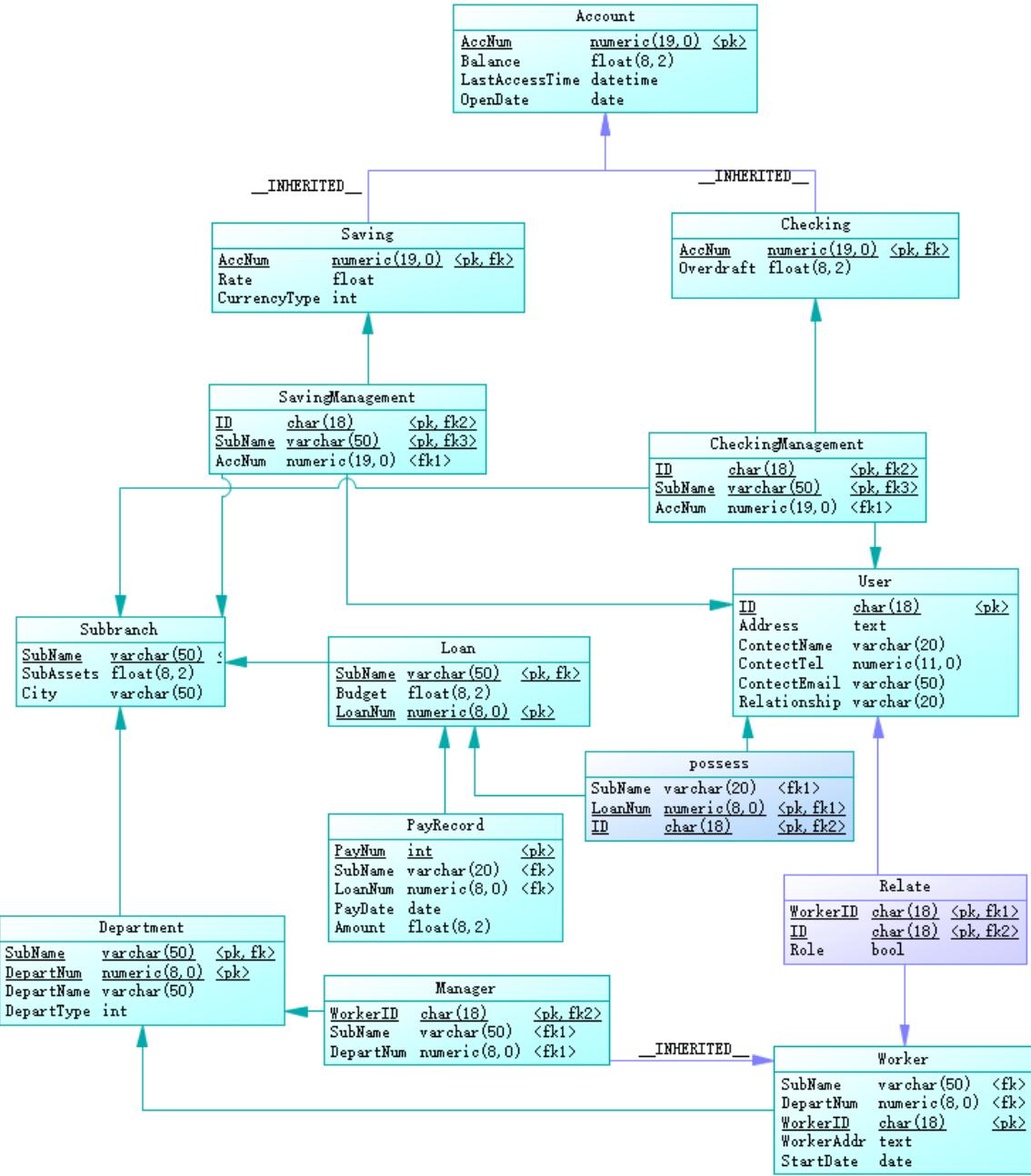
我直接使用power designer中的概念模型展示，不采用传统ER图图例



## 逻辑数据库结构



## 物理模型



### 3 详细设计

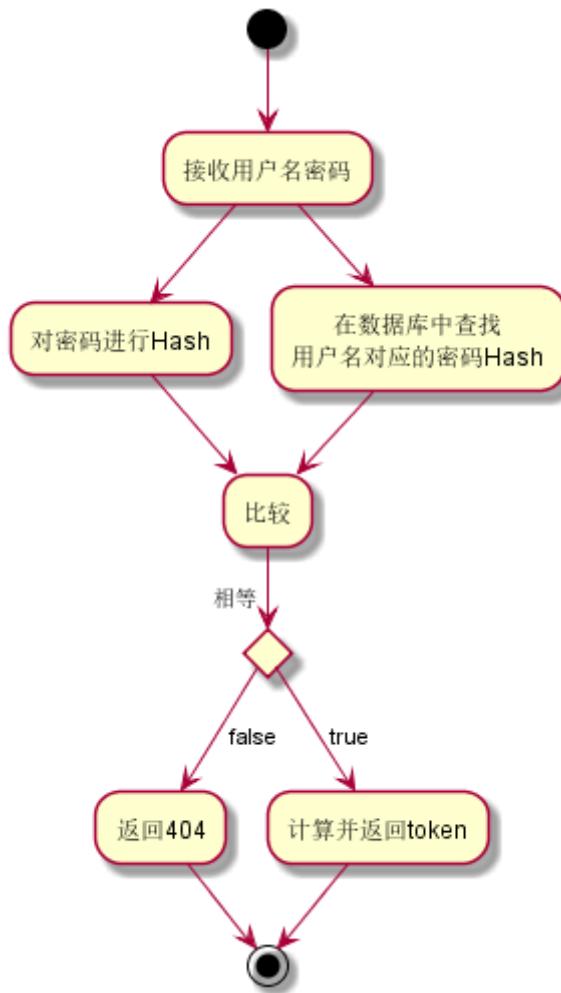
这个部分主要介绍后端的各个模块，因为前端主要只是进行输入检查和发送接收数据

#### 3.1 登录模块

输入: 用户名、密码

方法: POST

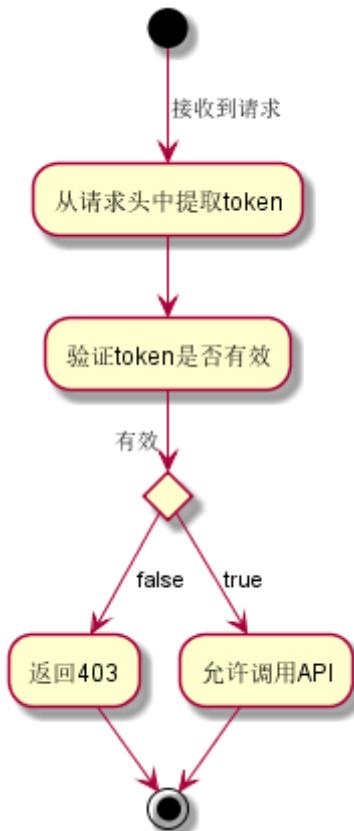
输出: token、status



## 3.2 身份验证模块

输入: token

输出: 访问是否被允许



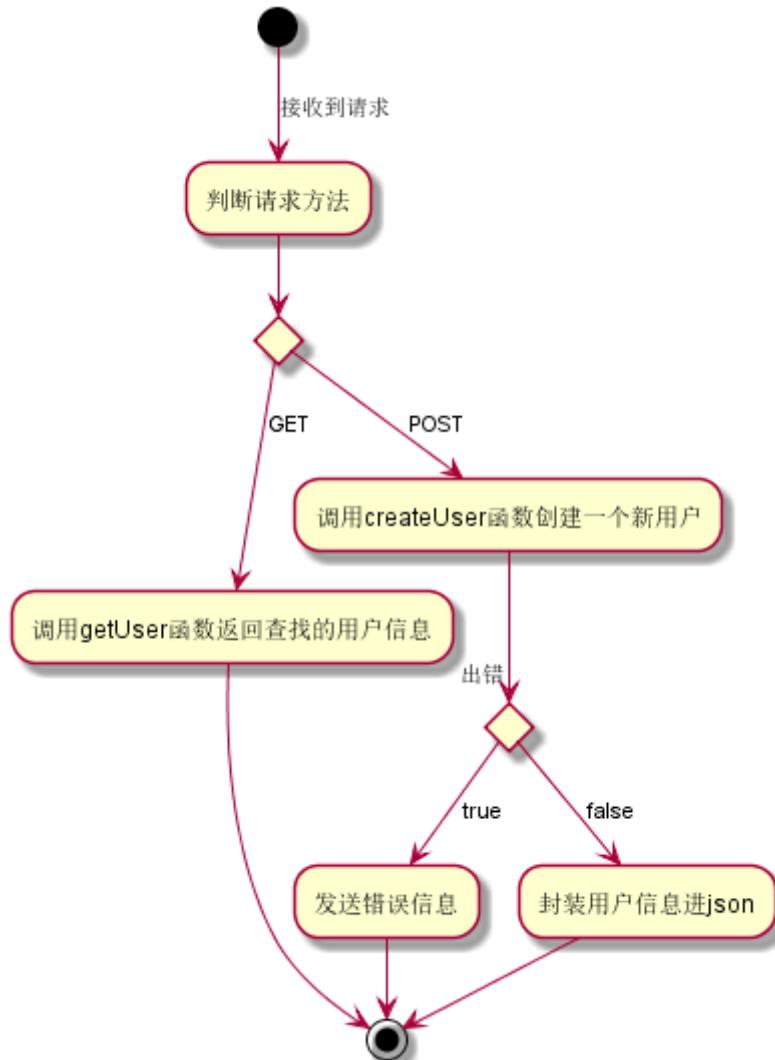
### 3.3 查找/添加用户模块

输入: [用户ID, Address, ContectName, ContectTel, ContectEmail, Relationship]

方法: POST, GET

输出: POST下为添加新用户; GET方法下为查询用户, 返回查找到的用户信息

效果: POST下添加一个用户;GET下返回满足条件的用户表单



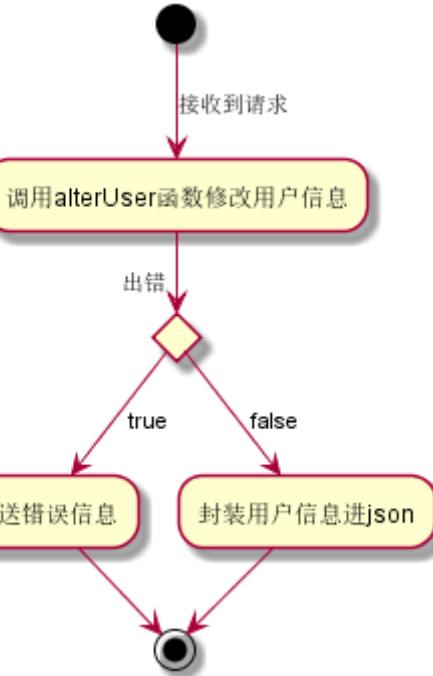
### 3.4 修改用户模块

输入: [用户ID, 以及新的Address, ContectName, ContectTel, ContectEmail, Relationship]

方法: POST

输出: 修改是否成功

效果: 删除一个用户信息



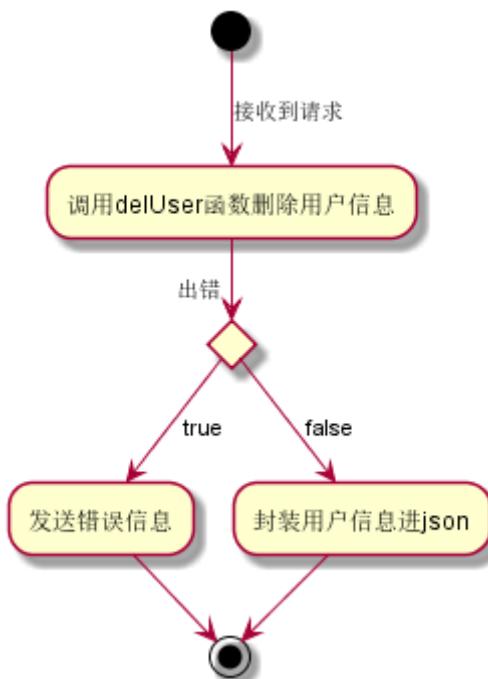
## 3.5 删除用户模块

输入: 用户ID

方法: POST

输出: 删除是否成功

效果: 删除一个用户



由于剩余几个模块的内容和上面用户部分流程类似，因此不做赘述，仅仅介绍每个模块的输入输出

## 3.6 查找/添加账户模块

输入: 账户AccNum, 用户ID, Balance, OpenDate, SubName, Rate, CurrencyType, overdraft

方法: POST、GET

输出: POST下为添加新账户; GET方法下为查询账户, 返回查找到的账户信息

效果: POST下添加一个账户;GET下返回满足条件的账户表单

### 3.7 删除账户模块

输入: 账户AccNum

方法: POST

输出: 删除是否成功

效果: 删除一个账户

### 3.8 增加账户用户模块

输入: 账户AccNum, 用户ID

方法: POST

输出: 用户添加是否成功

效果: 给一个账户添加一个用户 (因为一个账户可以被多个用户共享)

### 3.9 查看账户类型模块

输入: 账户AccNum

方法: POST

输出: 账户类型 (Checking或者Saving)

效果: 返回一个账户类型

### 3.10 修改账户信息模块

输入: 账户AccNum, Balance, LastAccessTime, OpenDate

方法: POST

输出: 账户是否修改成功

效果: 修改一个账户信息

### 3.11 查找/添加贷款模块

输入: 贷款LoanNum, SubName, LoanNum, Budget, 该贷款的用户列表UserList

方法: POST、GET

输出: POST下为添加新贷款 GET方法下为查询贷款, 返回查找到的贷款信息

效果: POST下添加一个贷款;GET下返回满足条件的贷款表单

### 3.12 删除贷款模块

输入: 贷款LoanNum

方法: POST

输出: 删除是否成功

效果: 删除一个贷款

### 3.13 发放贷款模块

输入: 贷款LoanNum

方法: POST

输出: 发放是否成功

效果: 给一个发放贷款发放一定数额

### 3.14 查询支行模块

输入: 无

方法: GET

输出: 支行列表

效果: 返回当前的支行列表

### 3.15 数据统计模块

输入: 支行列表, 统计时间起止

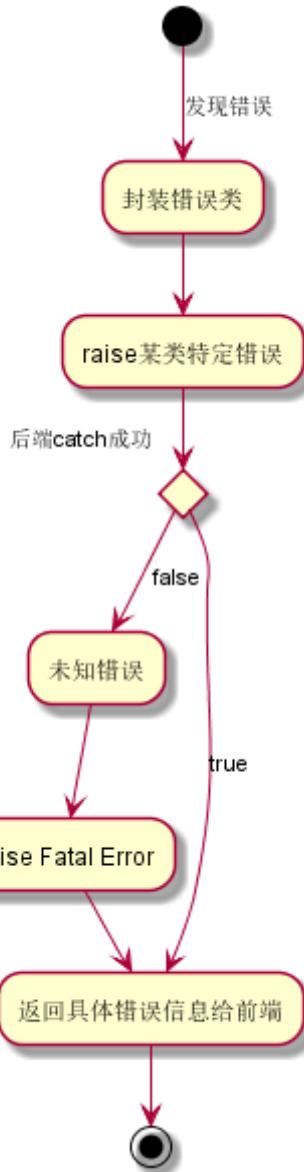
方法: GET

输出: 被查询支行的业务信息统计

效果: 返回被查询支行的业务信息统计

### 3.16 错误处理模块

错误处理流程如下



在错误处理中我定义了如下错误类

```

1  class DupId(APIException):
2      code = 600
3      msg = 'duplicated key'
4      error_code = 600
5
6  class IncompleteData(APIException):
7      code = 601
8      msg = 'Incomplete data'
9      error_code = 601
10
11 class NotFind(APIException):
12     code = 602
13     msg = 'Not find'
14     error_code = 602
15
16 class Unmodifiable(APIException):
17     code = 603
18     msg = "Can't modify primary key"
19     error_code = 603
20
21 class PermissionDenied(APIException):

```

```

22     code = 604
23     msg = "No permission"
24     error_code = 604
25
26 class UndefindBehaviour(APIException):
27     code = 605
28     msg = "Undefined Behaviour"
29     error_code = 605
30
31 class outofBound(APIException):
32     code = 606
33     msg = "Amount out of bound"
34     error_code = 606
35
36 class UnknownError(APIException):
37     code = 607
38     msg = "Fetal error"
39     error_code = 607

```

对应错误内容如下

错误码	错误信息	备注
600	duplicated key	主键重复
601	Incomplete data	缺少必填字段
602	Not find	未找到对应数据
603	Can't modify primary key	尝试修改主键
604	No permission	权限不足
605	Undefined Behaviour	未知错误
606	Amount out of bound	发放贷款额度超过贷款总额
607	Fetal error	数据库或Flask内部错误

## 4 实现与测试

### 4.1 实现结果

#### 网页服务器

使用 `npm run serve` 运行网页服务器

```
(venv) root@...:~/home/ubuntu/code/Bank_Management_sys/frontend# npm run serve  
> architectui-vue-free@0.1.0 serve /home/ubuntu/code/Bank_Management_sys/frontend  
> vue-cli-service serve  
  
[INFO] Starting development server...  
[WARN] A new version of sass-loader is available. Please upgrade for best experience.  
98% after emitting CopyPlugin  
  
[DONE] Compiled successfully in 6241ms          下午6:13:30
```

App running at:  
- Local: <http://localhost:8080/>  
- Network: <http://127.0.0.1:8080/>

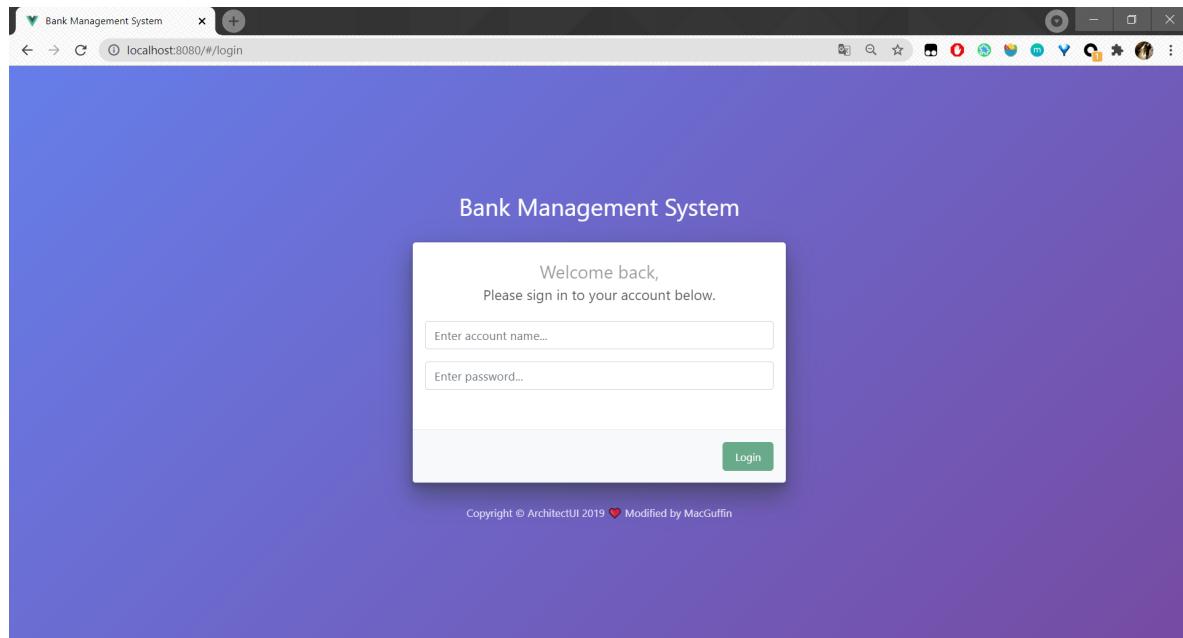
Note that the development build is not optimized.  
To create a production build, run `npm run build`.

## 后端服务器

```
(venv) root@...:~/home/ubuntu/code/Bank_Management_sys# ./run.sh  
* Serving Flask app 'app' (lazy loading)  
* Environment: production  
WARNING: This is a development server. Do not use it in a production deployment.  
Use a production WSGI server instead.  
* Debug mode: on  
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)  
* Restarting with stat  
* Debugger is active!  
* Debugger PIN:
```

## 前端界面展示

### 登录访问8080端口



### 数据统计页面

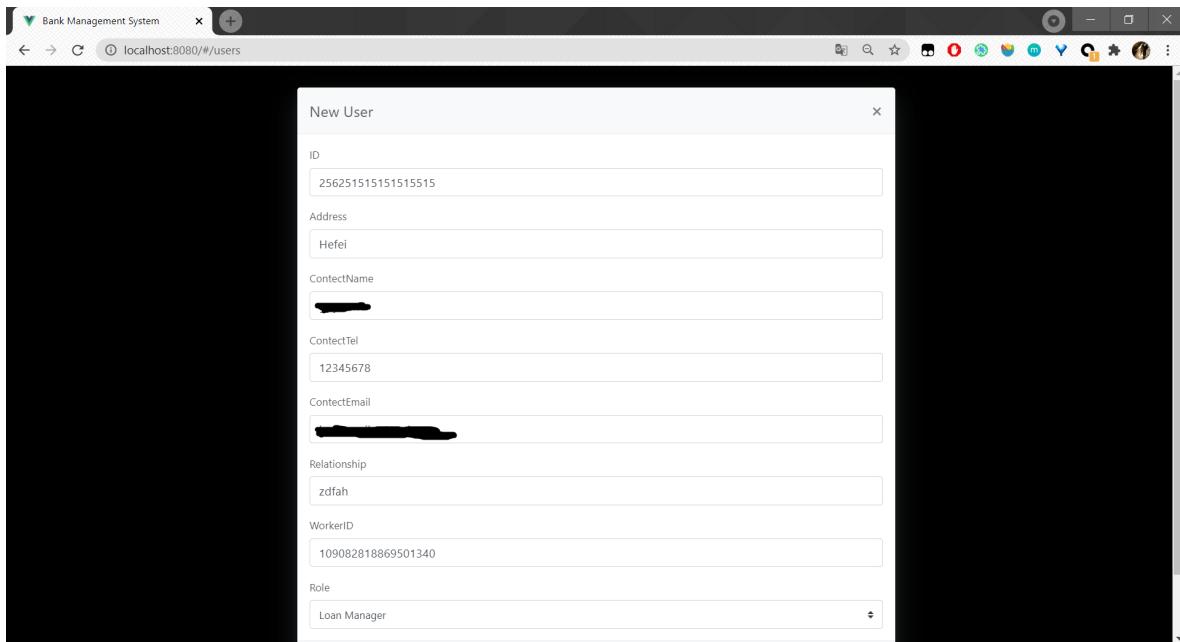
Subbranch	Assets	Saving Account Num	Saving Assets	Checking Account Num	Checking Assets	Loan Assets
Beijing支行	1000.5	1	1000.5	1	100	-100
Hefei支行	0	0	0	0	0	0
Shanghai支行	0	0	0	0	0	0

## 客户管理页面

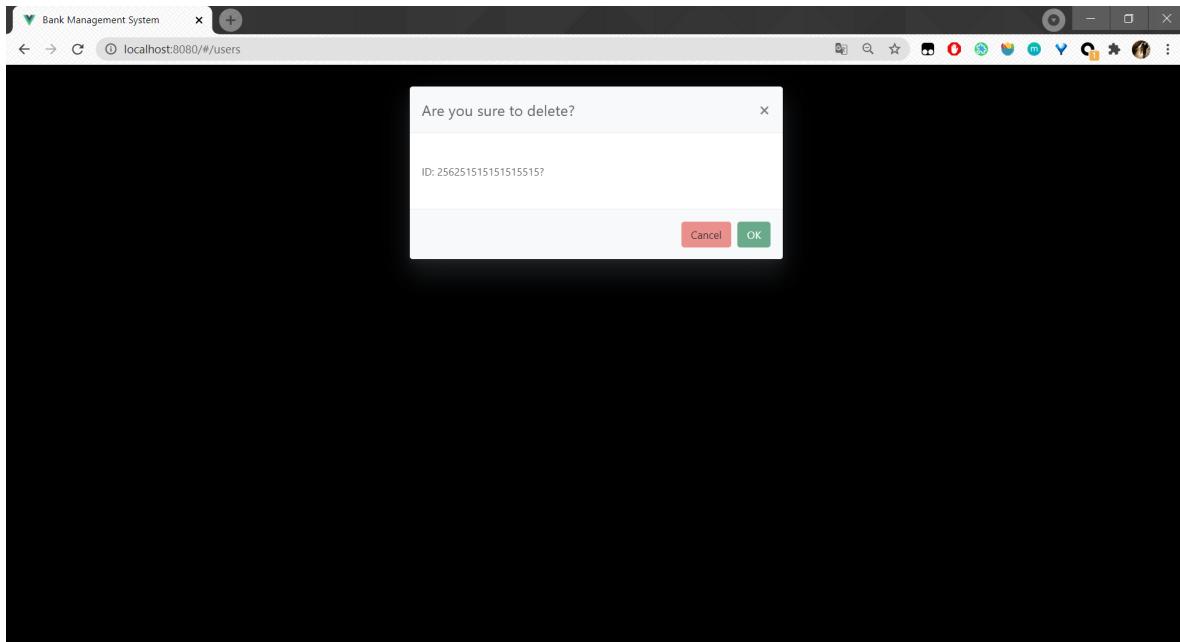
ID	Address	Contact Name	Contact Tel	Contact Email	Relationship	Worker ID	Role
25625151515151515	Hefei	guyanwu	12345678		zdfah	109082818869501340	Loan Manager
406311755555555555	Hefei	kjsdnfjsnfi	52894848		father	109082818869501340	Loan Manager
484848484848484848	Nanjing	sdgkj	86416544	c@mail.ustc.edu.cn	zsdg	187610503053292640	Account Manager
855850346852094000	Hefei	dagsr	54488888	hc@mail.ustc.edu.cn	dsga	479498355439864100	Account Manager

## 添加用户界面

## 修改用户界面



## 删除用户界面



## 账户管理界面

The screenshot shows the 'Bank Management' application's 'Accounts' section. On the left, a sidebar titled 'MAIN NAVIGATION' includes 'Analytics', 'Users', 'Accounts' (which is highlighted in green), and 'Loans'. The main content area has a title 'Accounts' with the sub-instruction 'You can add delete alter search accounts here.' Below this are two sections: 'Search Accounts' with fields for ID, AccNum, Account Type (dropdown menu showing 'Select'), SubName, BalanceMin, and BalanceMax, along with 'Search' and 'Reset' buttons; and a table titled 'Accounts' listing two entries. The table columns are Acc Num, ID, Sub Name, Balance, Last Access Time, Open Date, Rate, Currency Type, and Overdraft. The first entry is for account 2584941651684885825 with a balance of 100.0. The second entry is for account 1564841518452849846 with a balance of 1000.5.

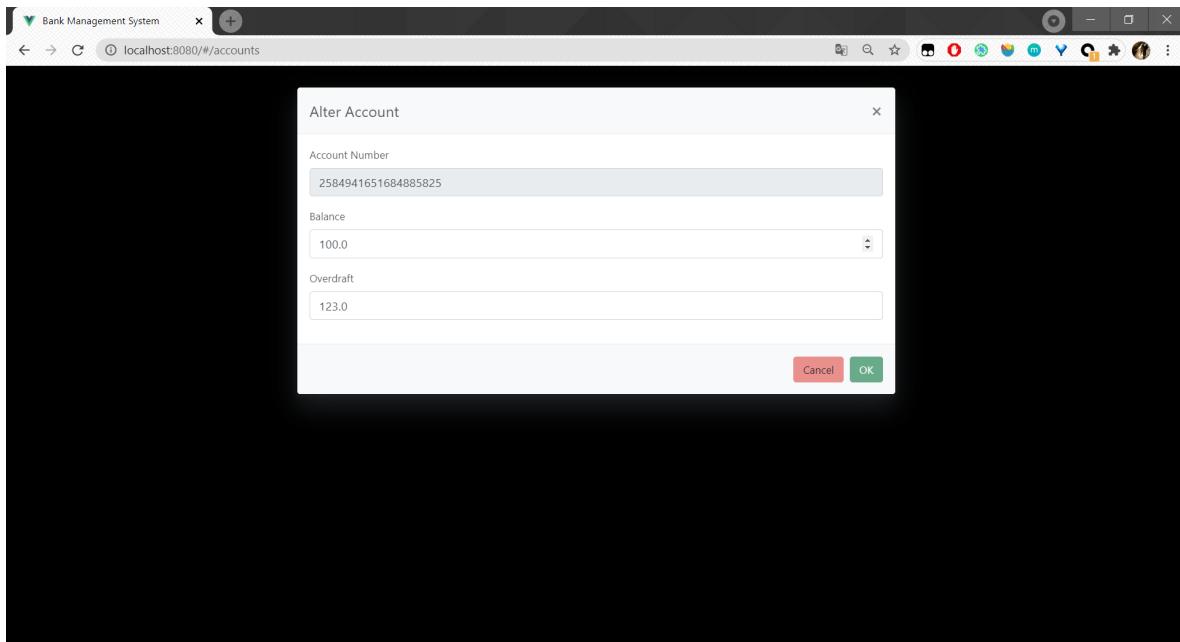
## 添加账户界面

The screenshot shows a modal dialog titled 'New Account'. It contains fields for selecting 'Saving Account' or 'Checking Account' (with a note 'Please select one'), 'Account Number' (with a note 'Account Number is required'), 'ID' (with a note 'ID is required'), 'Balance' (with a note 'Balance is required'), 'OpenDate' (a date picker with a note 'OpenDate is required'), and 'SubName' (with a note 'SubName is required'). At the bottom are 'Cancel' and 'OK' buttons.

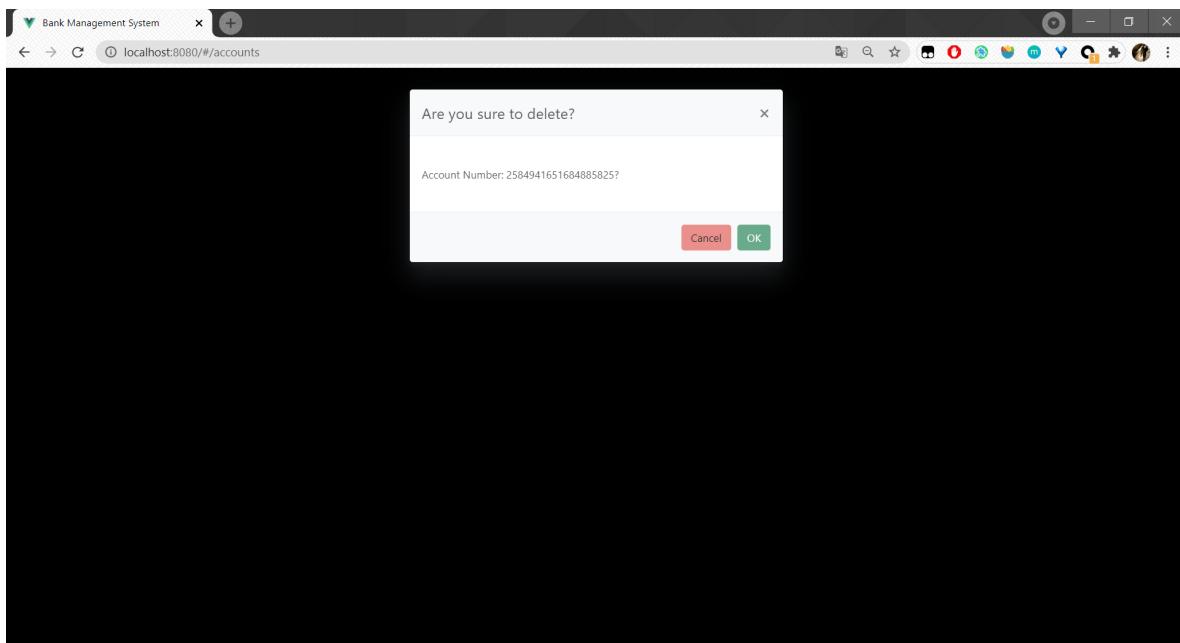
## 添加用户到账户界面

The screenshot shows a modal dialog titled 'Add a user to account'. It contains fields for 'Account Number' (set to 2584941651684885825), 'ID' (with a note 'ID is required'), and 'OK' and 'Cancel' buttons at the bottom.

## 修改账户界面



## 删除账户界面



## 贷款管理界面

The screenshot shows the 'Bank Management' section of the system. On the left, a sidebar lists 'Analytics', 'Users', 'Accounts', and 'Loans' (which is currently selected). The main area is titled 'Loans' and contains a search form with fields for ID, LoanNum, SubName, MinBudget, MaxBudget, and Status. Below the search is a table titled 'Loans' with columns: Loan Num, Sub Name, Budget, Paid, and Status. One row is shown: 46151684, Beijing支行, 1000.0, 100, ING. At the bottom, a copyright notice reads 'Copyright 2019 DashboardPack.com ❤️ Modified by MacGuffin'.

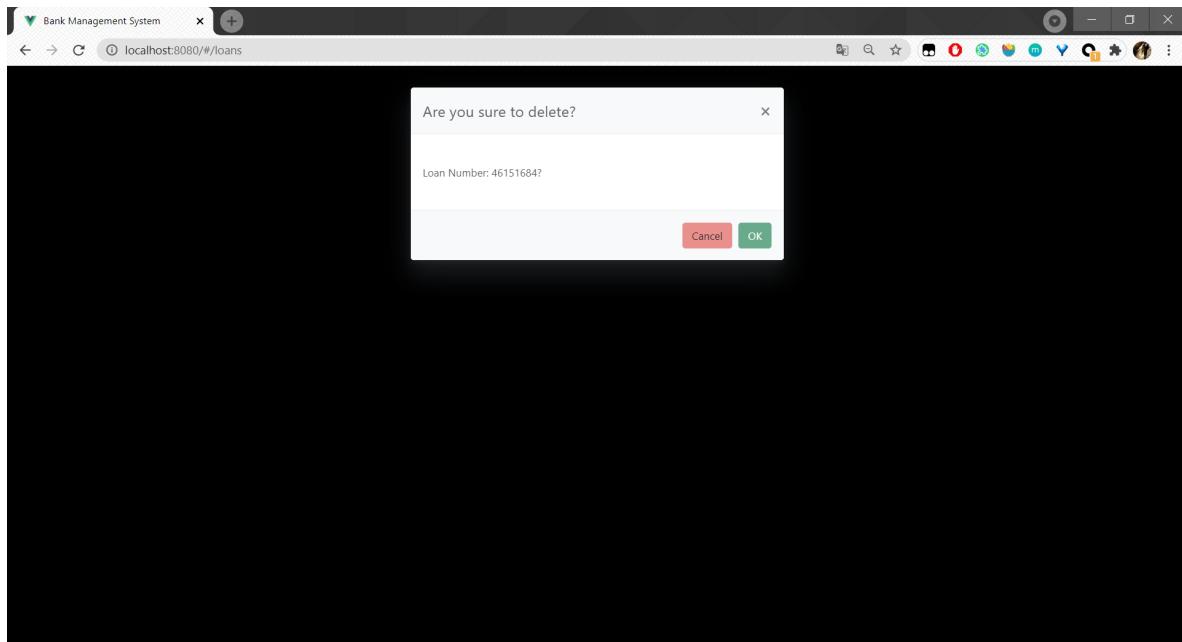
## 贷款添加界面

A modal dialog titled 'New Loan' is displayed. It contains four input fields: 'LoanNum' (with error 'LoanNum is required'), 'Budget' (with error 'Budget is required'), 'SubName' (with error 'SubName is required'), and 'User' (with error 'ID is required'). A green button '+ Add New User' is available. At the bottom are 'Cancel' and 'OK' buttons.

## 贷款发放界面

A modal dialog titled 'Grant Loan' is displayed. It contains three input fields: 'Pay Number' (with error 'Pay Number is required'), 'Loan Number' (containing '46151684'), and 'PayDate' (a date picker with placeholder '年 /月/日'). The 'Pay Date is required' error is shown below the date field. An 'Amount' field is present with the error 'Amount is required'. At the bottom are 'Cancel' and 'OK' buttons.

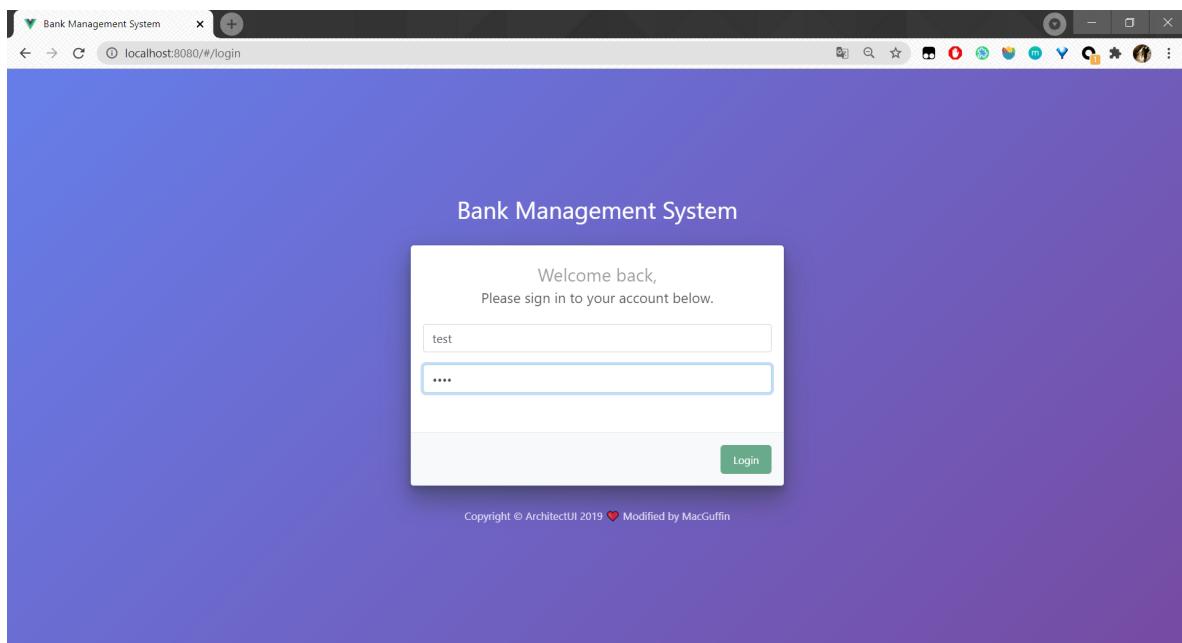
## 贷款删除界面



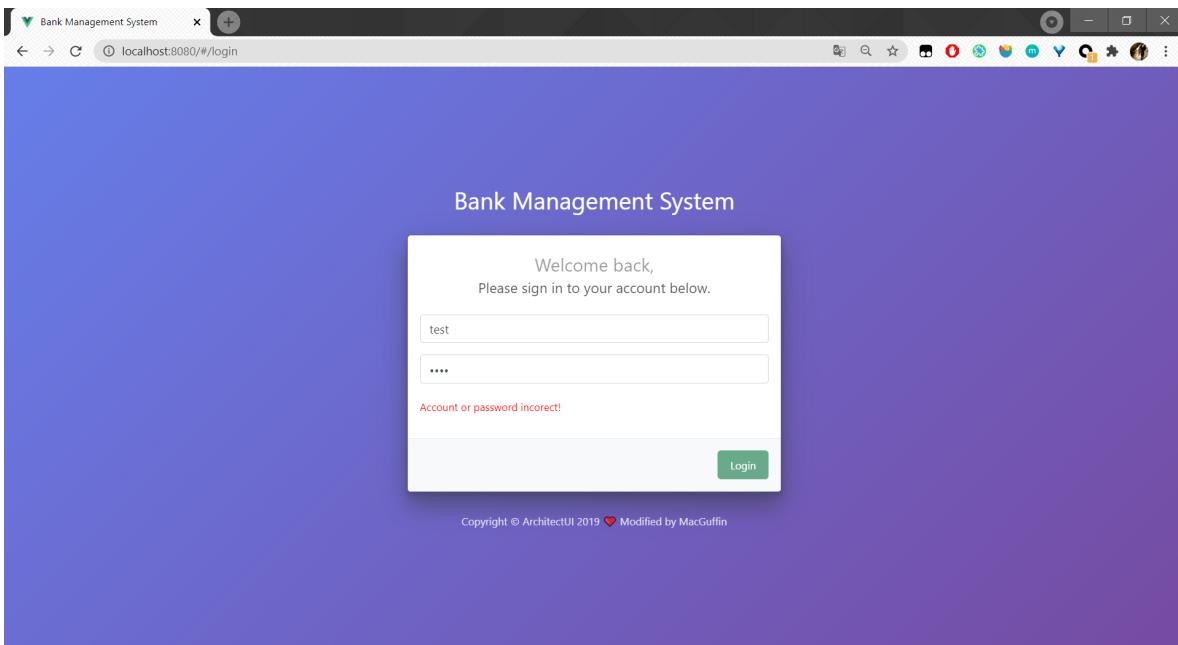
## 4.2 测试结果

我们从登录开始，一步一步演示整个系统的功能

### 1. 输入用户名密码



如果密码错误则会提示"Account or password incorrect!"



如果输入正确则直接跳转到数据统计页面

## 2. 添加用户

切换到Users页面，并点击Create User按钮

ID	Address	Contact Name	Contact Tel	Contact Email	Relationship	Worker ID	Role
25625151515151515	Hefei	guyanwu	12345678	[REDACTED]	zdfah	109082818869501340	Loan Manager
40631175555555555	Hefei	kjsdnfjsnfi	52894848	[REDACTED]@ail.ustc.edu.cn	father	109082818869501340	Loan Manager
48484848484848484	Nanjing	sdgkj	86416544	c@mail.ustc.edu.cn	zsdg	187610503053292640	Account Manager
855850346852094000	Hefei	dagsr	54488888	hc@mail.ustc.edu.cn	dsga	47949835439864100	Account Manager

在弹出框中输入用户信息，这里包含了前端检测，如果输入不合法的数据，将会在前端被提醒

Bank Management System

localhost:8080/#/users

ID	85585034685209400X
Address	Hefei
ContactName	xiaohua
ContactTel	123456 ContactTel must be 8 or 11 digits.
ContactEmail	hhh@mail.ustc.edu.cn
Relationship	Father
WorkerID	133598265843465920
Role	Account Manager

Cancel OK

输入正确数据如下并确认

Bank Management System

localhost:8080/#/users

New User

ID	85585034685209400X
Address	Hefei
ContactName	xiaohua
ContactTel	12345678
ContactEmail	hhh@mail.ustc.edu.cn
Relationship	Father
WorkerID	133598265843465920
Role	Account Manager

于是我们成功添加一个用户

Bank Management

MAIN NAVIGATION

- Analytics
- Users
- Accounts
- Loans

Search Users

ID	Address	ContactName	ContactTel	ContactEmail	Relationship
WorkerID	Role				

Search Reset

Users

ID	Address	Contact Name	Contact Tel	Contact Email	Relationship	Worker ID	Role
25625151515151515	Hefei	guyanwu	12345678	hhh@mail.ustc.edu.cn	zdfah	109082818869501340	Loan Manager
40631175555555555	Hefei	kjsdnfjsnfj	52894848	hhh@mail.ustc.edu.cn	father	109082818869501340	Loan Manager
85585034685209400X	Hefei	xiaohua	12345678	hhh@mail.ustc.edu.cn	Father	133598265843465920	Account Manager
484848484848488484	Nanjing	sdgkj	86416544	c@mail.ustc.edu.cn	zsdg	187610503053292640	Account Manager
855850346852094000	Hefei	dagsr	54488888	hc@mail.ustc.edu.cn	dsga	479498355439864100	Account Manager

### 3. 修改用户

用鼠标单击表格中的条目，并点击Alter User按钮即可修改用户

The screenshot shows a web-based application titled "Bank Management System". In the top left, there's a sidebar with "MAIN NAVIGATION" containing "Analytics", "Users" (which is highlighted in green), "Accounts", and "Loans". The main content area is titled "Users" and contains a search form with fields for ID, Address, ContactName, ContactTel, ContactEmail, Relationship, WorkerID, and Role. Below the search form is a table titled "Users" with columns: ID, Address, Contact Name, Contact Tel, Contact Email, Relationship, Worker ID, and Role. The table lists several user entries. A red arrow labeled "1" points from the text "修改这两项并确认" to the "Contact Name" field in the table. Another red arrow labeled "2" points from the text "修改这两项并确认" to the "Alter User" button located at the top right of the page.

修改这两项并确认

This screenshot shows a modal dialog box titled "Alter User" over a black background. It contains fields for modifying a user's details: ID (85585034685209400X), Address (Hefei), ContactName (Lihua), ContactTel (12345678888), ContactEmail (hhb@mail.ustc.edu.cn), Relationship (Father), WorkerID (133598265843465920), and Role (Account Manager). Each field has a green checkmark indicating it has been modified. At the bottom right of the dialog are "Cancel" and "OK" buttons.

可以看到对应项被成功修改

Bank Management System

MAIN NAVIGATION

- Analytics
- Users**
- Accounts
- Loans

Search Users

ID	Address	Contact Name	Contact Tel	Contact Email	Relationship	Worker ID	Role
25625151515151515	Hefei	guyanwu	12345678	hzc@mail.ustc.edu.cn	zdfah	109082818869501340	Loan Manager
40631175555555555	Hefei	kjsdnjsnfi	52894848	████████@mail.ustc.edu.cn	father	109082818869501340	Loan Manager
48484848484848484	Nanjing	sdgkj	86416544	c@mail.ustc.edu.cn	zsdg	187610503053292640	Account Manager
855850346852094000	Hefei	dagsr	54488888	hc@ail.ustc.edu.cn	dsqa	479498355439864100	Account Manager
85585034685209400X	Hefei	Lihua	12345678888	hhh@mail.ustc.edu.cn	Father	133598265843465920	Account Manager

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## 4. 删除用户

选中用户并点击删除按钮

Bank Management System

MAIN NAVIGATION

- Analytics
- Users**
- Accounts
- Loans

Users

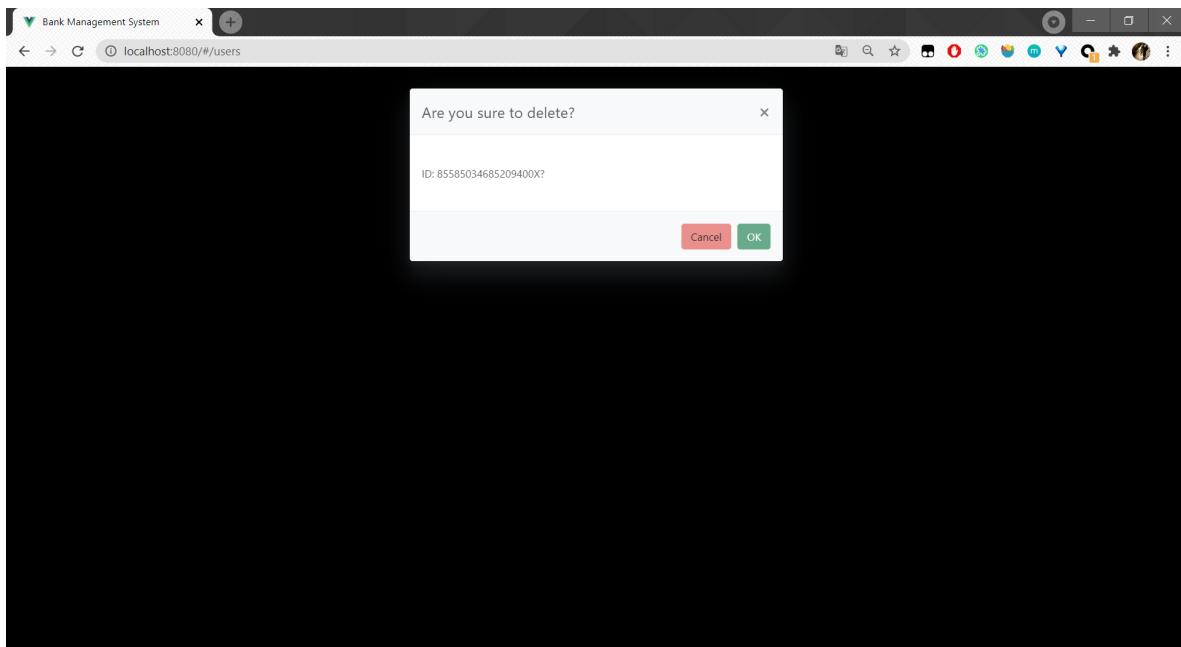
You can add delete alter search users here.

+ Create User   Alter User   Delete User

Search Users

ID	Address	Contact Name	Contact Tel	Contact Email	Relationship	Worker ID	Role
25625151515151515	Hefei	guyanwu	12345678	hzc@mail.ustc.edu.cn	zdfah	109082818869501340	Loan Manager
40631175555555555	Hefei	kjsdnjsnfi	52894848	████████@mail.ustc.edu.cn	father	109082818869501340	Loan Manager
48484848484848484	Nanjing	sdgkj	86416544	c@mail.ustc.edu.cn	zsdg	187610503053292640	Account Manager
855850346852094000	Hefei	dagsr	54488888	hc@ail.ustc.edu.cn	dsqa	479498355439864100	Account Manager
85585034685209400X	Hefei	Lihua	12345678888	hhh@mail.ustc.edu.cn	Father	133598265843465920	Account Manager

弹出确认删除的对话框，并点击OK



用户被成功删除

A screenshot of the "Bank Management" application. The left sidebar has a "MAIN NAVIGATION" section with links for Analytics, Users (which is highlighted in green), Accounts, and Loans. The main content area is titled "Search Users" and contains fields for ID, Address, ContactName, ContactTel, ContactEmail, Relationship, WorkerID, and Role. Below this is a "Users" table with columns: ID, Address, Contact Name, Contact Tel, Contact Email, Relationship, Worker ID, and Role. A specific row in the table is highlighted with a red border. At the bottom of the page, there is a copyright notice: "Copyright 2019 DashboardPack.com ❤️ Modified by MacGuffin".

如果用户存在关联账户

A screenshot of the "Bank Management" application. The left sidebar has a "MAIN NAVIGATION" section with links for Analytics, Users, Accounts (which is highlighted in green), and Loans. The main content area is titled "Accounts" and contains a message: "You can add delete alter search accounts here." with buttons for "+ Create Account", "Add User to Account", "Alter Account", and "Delete Account". Below this is a "Search Accounts" form with fields for ID, AccNum, Account Type, SubName, BalanceMin, and BalanceMax. At the bottom is a "Accounts" table with columns: Acc Num, ID, Sub Name, Balance, Last Access Time, Open Date, Rate, Currency Type, and Overdraft. A specific row in the table is highlighted with a red border. At the bottom of the page, there is a copyright notice: "Copyright 2019 DashboardPack.com ❤️ Modified by MacGuffin".

则删除账户会报错

The screenshot shows a browser window for the 'Bank Management System' at localhost:8080/#/users. The main navigation bar includes 'Analytics', 'Users' (selected), 'Accounts', and 'Loans'. On the right, there's a search form for users with fields for ID, Address, ContactName, ContactTel, ContactEmail, Relationship, WorkerID, and Role. Below the search form is a table titled 'Users' with columns: ID, Address, Contact Name, Contact Tel, Contact Email, Relationship, Worker ID, and Role. A row for user '855850346852094000' is selected and highlighted with a red border. An error message 'Can't delete item with foreign key' is displayed in a red box at the top of the page.

如果用户存在贷款记录

The screenshot shows a browser window for the 'Bank Management System' at localhost:8080/#/loans. The main navigation bar includes 'Analytics', 'Users', 'Accounts', and 'Loans' (selected). On the right, there's a search form for loans with fields for ID, LoanNum, SubName, MinBudget, MaxBudget, and Status. Below the search form is a table titled 'Loans' with columns: Loan Num, Sub Name, Budget, Paid, and Status. A row for loan '46151684' is selected and highlighted with a red border. At the bottom of the page, there's a copyright notice: 'Copyright 2019 DashboardPack.com ❤ Modified by MacGuffin'.

则同样不允许删除

The screenshot shows a browser window for 'Bank Management System' at 'localhost:8080/#/users'. The main navigation bar includes 'Analytics', 'Users' (which is selected), 'Accounts', and 'Loans'. On the right, there are buttons for '+ Create User', 'Alter User', and 'Delete User'. A red-bordered warning message 'Can't delete item with foreign key' is displayed. Below it is a 'Search Users' form with fields for ID, Address, ContactName, ContactTel, ContactEmail, Relationship, WorkerID, and Role. A dropdown menu under 'Role' shows 'Select'. At the bottom are 'Search' and 'Reset' buttons. The main table area is titled 'Users' and lists two rows of data. The first row has a red border around its entire row. The second row has a red border around the 'Address' column.

ID	Address	Contact Name	Contact Tel	Contact Email	Relationship	Worker ID	Role
2562515151515515	Hefei	guyanwu	12345678	hzc@mail.ustc.edu.cn	zdfah	109082818869501340	Loan Manager
406311755555555555	Hefei	kjsdnfjsnfl	52894848	[REDACTED]@mail.ustc.edu.cn	father	109082818869501340	Loan Manager

## 5. 查询用户

我主要使用的是模糊匹配的方式，当查询字符串中有相等的部分，则认为匹配，并且支持多字段同时匹配查找

如果要查找家住“Hefei”并且和某个员工是贷款关系的所有用户，则可以用如下的搜索条件

The screenshot shows the same 'Bank Management System' interface. In the 'Search Users' form, the 'Address' field contains 'Hefei' and the 'Role' dropdown is set to 'Loan Manager'. Red arrows point from these input fields to the corresponding columns in the resulting user list. The user list table has a red border around the 'Address' and 'Role' columns of the first two rows. The first row also has a red border around its entire row.

ID	Address	Contact Name	Contact Tel	Contact Email	Relationship	Worker ID	Role
2562515151515515	Hefei	guyanwu	12345678	hzc@mail.ustc.edu.cn	zdfah	109082818869501340	Loan Manager
406311755555555555	Hefei	kjsdnfjsnfl	52894848	[REDACTED]@mail.ustc.edu.cn	father	109082818869501340	Loan Manager
4848484848488484	Nanjing	sdgkj	86416544	c@mail.ustc.edu.cn	zsdg	187610503053292640	Account Manager
855850346852094000	Hefei	dagsr	54488888	hc@mail.ustc.edu.cn	dsqa	479498355439864100	Account Manager

点击搜索后返回符合要求的用户

The screenshot shows the 'Bank Management' application interface. On the left, a sidebar titled 'MAIN NAVIGATION' includes 'Analytics', 'Users' (which is highlighted in green), 'Accounts', and 'Loans'. The main content area is titled 'Users' and contains a search form with fields for ID, Address, ContactName, ContactTel, ContactEmail, Relationship, WorkerID, and Role. Below the search form is a table titled 'Users' with columns: ID, Address, Contact Name, Contact Tel, Contact Email, Relationship, Worker ID, and Role. Two rows of data are listed: one for a user in Hefei with address 'Hefei' and another for a user in Hefei with address 'kjsdnfsnf'. At the bottom of the page, there is a copyright notice: 'Copyright 2019 DashboardPack.com ❤️ Modified by MacGuffin'.

## 6.开户

进入Accounts界面并点击Create Account按钮，在弹出框中输入账户信息

The screenshot shows a modal dialog box titled 'New Account' with the following fields: 'Saving Account' (radio button) is not selected, while 'Checking Account' is selected; 'Account Number' is set to '12432324534421434'; 'ID' is set to '855850346852094000'; 'Balance' is set to '567'; 'OpenDate' is set to '2021/07/01'; 'SubName' is set to 'Shanghai支行'; and 'Overdraft' is set to '0'. At the bottom right of the dialog are 'Cancel' and 'OK' buttons.

点击确认后即可看到账户被成功添加

Bank Management System

MAIN NAVIGATION

- Analytics
- Users
- Accounts**
- Loans

Accounts

You can add delete alter search accounts here.

+ Create Account Add User to Account Alter Account Delete Account

Search Accounts

ID	AccNum	Account Type	SubName	BalanceMin	BalanceMax		
1243232324534421434	855850346852094000	Select	Shanghai支行	567.0	None	2021-07-01	0.0
2584941651684885825	855850346852094000	Select	Beijing支行	100.0	None	2021-04-07	123.0
1564841518452849846	2562515151515151515	Select	Beijing支行	1000.5	None	2021-06-08	1.0 1

Search Reset

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值得注意的是，添加账户时的用户ID必须是有效的，否则将发生如下错误

Bank Management System

MAIN NAVIGATION

- Analytics
- Users
- Accounts**
- Loans

Accounts

You can add delete alter search accounts here.

+ Create Account Add User to Account Alter Account Delete Account

add error

Search Accounts

ID	AccNum	Account Type	SubName	BalanceMin	BalanceMax		
1243232324534421434	855850346852094000	Select	Shanghai支行	567.0	None	2021-07-01	0.0
2584941651684885825	855850346852094000	Select	Beijing支行	100.0	None	2021-04-07	123.0
1564841518452849846	2562515151515151515	Select	Beijing支行	1000.5	None	2021-06-08	1.0 1

Search Reset

## 7. 给账户添加新的用户

由于一个账户可以被多人共享，因此，使用添加功能可以给一个账户添加多个用户

选中账户并点击Add User to Account

Bank Management System

MAIN NAVIGATION

- Analytics
- Users
- Accounts**
- Loans

Accounts

You can add delete alter search accounts here.

+ Create Account Add User to Account Alter Account Delete Account

Search Accounts

ID	AccNum	Account Type	SubName	BalanceMin	BalanceMax
		Select			

Search Reset

Acc Num	ID	Sub Name	Balance	Last Access Time	Open Date	Rate	Currency Type	Overdraft
1243232324534421434	855850346852094000	Shanghai支行	567.0	None	2021-07-01			0.0
2584941651684885825	855850346852094000	Beijing支行	100.0	None	2021-04-07			123.0
1564841518452849846	2562515151515151515	Beijing支行	1000.5	None	2021-06-08	1.0	1	

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给账户添加一个新用户

Add a user to account

Account Number  
1243232324534421434

ID  
40631175555555555555

Cancel OK

用户添加成功后将在表格中显示

Bank Management System

MAIN NAVIGATION

- Analytics
- Users
- Accounts**
- Loans

Accounts

You can add delete alter search accounts here.

+ Create Account Add User to Account Alter Account Delete Account

Search Accounts

ID	AccNum	Account Type	SubName	BalanceMin	BalanceMax
		Select			

Search Reset

Acc Num	ID	Sub Name	Balance	Last Access Time	Open Date	Rate	Currency Type	Overdraft
1243232324534421434	40631175555555555555	Shanghai支行	567.0	None	2021-07-01			0.0
1243232324534421434	855850346852094000	Shanghai支行	567.0	None	2021-07-01			0.0
2584941651684885825	855850346852094000	Beijing支行	100.0	None	2021-04-07			123.0
1564841518452849846	2562515151515151515	Beijing支行	1000.5	None	2021-06-08	1.0	1	

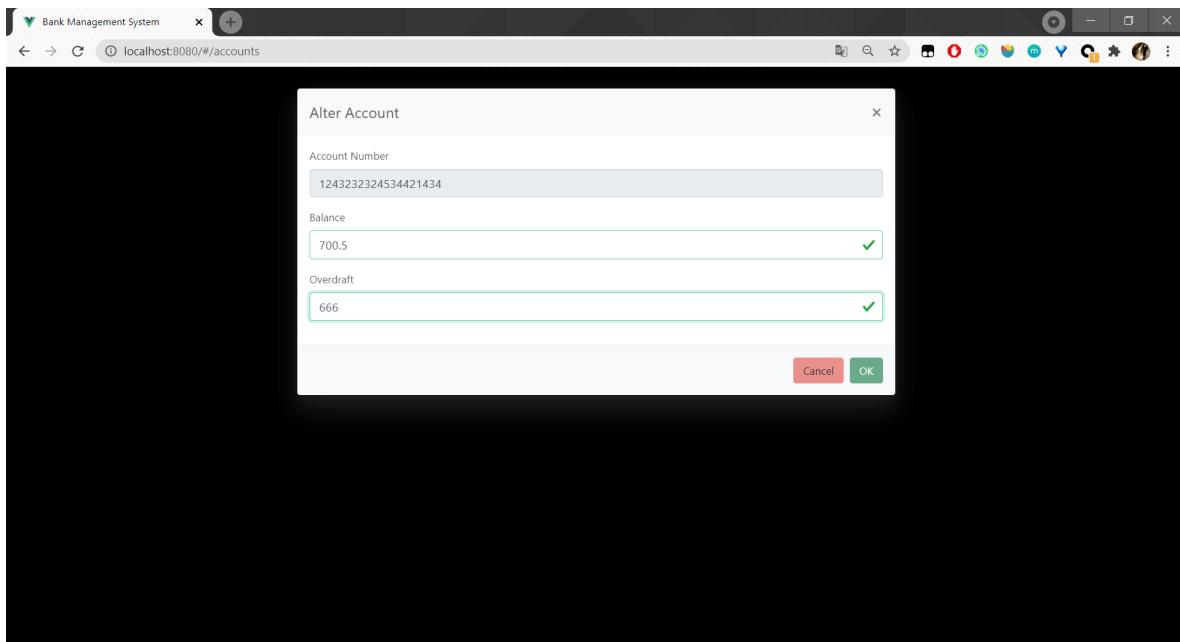
## 8. 修改账户

The screenshot shows the 'Bank Management System' interface. In the main navigation bar, the 'Accounts' link is highlighted with a green background. The main content area displays a table titled 'Accounts' with columns: Acc Num, ID, Sub Name, Balance, Last Access Time, Open Date, Rate, Currency Type, and Overdraft. The first row's 'Acc Num' column contains the value '1243232324534421434', which is also highlighted with a green background. At the top right of the table, there are four buttons: '+ Create Account', 'Add User to Account' (highlighted with a red box), 'Alter Account' (highlighted with a red arrow), and 'Delete Account'. Below the table, there is a search form with fields for ID, AccNum, Account Type, SubName, BalanceMin, and BalanceMax, along with 'Search' and 'Reset' buttons. The footer of the page includes the copyright notice 'Copyright 2019 DashboardPack.com' and 'Modified by MacGuffin'.

对于账户来说，账户号不允许修改，所以将会显示为灰色不可修改

The screenshot shows a modal dialog box titled 'Alter Account'. Inside the dialog, there are three input fields: 'Account Number' containing '1243232324534421434' (grayed out), 'Balance' containing '567.0', and 'Overdraft' containing '0.0'. At the bottom of the dialog are two buttons: 'Cancel' (red) and 'OK' (green).

修改账户如下



可以看到账户信息被成功修改

Bank Management

MAIN NAVIGATION

- Analytics
- Users
- Accounts**
- Loans

Accounts

You can add delete alter search accounts here.

+ Create Account Add User to Account Alter Account Delete Account

Search Accounts

ID	AccNum	Account Type	SubName	BalanceMin	BalanceMax
		Select			

Search Reset

Accounts

Acc Num	ID	Sub Name	Balance	Last Access Time	Open Date	Rate	Currency Type	Overdraft
1243232324534421434	406311755555555555	Shanghai支行	700.5	None	2021-07-01			666.0
1243232324534421434	855850346852094000	Shanghai支行	700.5	None	2021-07-01			666.0
2584941651684885825	855850346852094000	Beijing支行	100.0	None	2021-04-07			123.0
1564841518452849846	256251515151515151	Beijing支行	1000.5	None	2021-06-08	1.0	1	

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## 9. 删除账户

Bank Management

MAIN NAVIGATION

- Analytics
- Users
- Accounts**
- Loans

Accounts

You can add delete alter search accounts here.

+ Create Account Add User to Account **Alter Account** Delete Account

Search Accounts

ID	AccNum	Account Type	SubName	BalanceMin	BalanceMax
		Select			

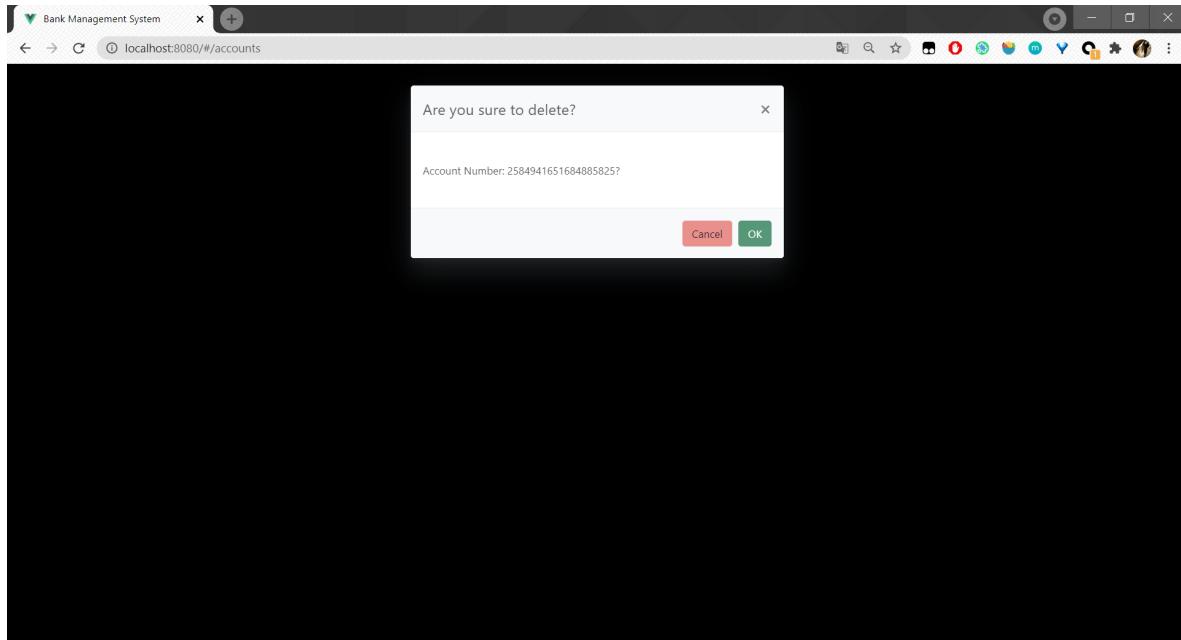
Search Reset

Accounts

Acc Num	ID	Sub Name	Balance	Last Access Time	Open Date	Rate	Currency Type	Overdraft
1243232324534421434	406311755555555555	Shanghai支行	700.5	None	2021-07-01			666.0
1243232324534421434	855850346852094000	Shanghai支行	700.5	None	2021-07-01			666.0
2584941651684885825	855850346852094000	Beijing支行	100.0	None	2021-04-07			123.0
1564841518452849846	256251515151515151	Beijing支行	1000.5	None	2021-06-08	1.0	1	

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## 弹出确认框



账户被成功删除

A screenshot of the "Bank Management System" application. The main navigation bar includes links for Analytics, Users, Accounts (which is highlighted in green), and Loans. The "Accounts" section contains a sub-navigation with "Accounts" (highlighted in green), "Create Account", "Add User to Account", "Alter Account", and "Delete Account". Below this is a search form for accounts, with fields for ID, AccNum, Account Type (dropdown), SubName, BalanceMin, and BalanceMax, along with "Search" and "Reset" buttons. A table lists account details with columns: Acc Num, ID, Sub Name, Balance, Last Access Time, Open Date, Rate, Currency Type, and Overdraft. The table shows three entries. At the bottom, there is a copyright notice: "Copyright 2019 DashboardPack.com ❤ Modified by MacGuffin".

## 10. 账户查询

账户查询和用户查询一样

输入要查询的账户信息，点击search即可得到结果

查询账户余额在500-800元的支票账户结果如下

Bank Management System

MAIN NAVIGATION

- Analytics
- Users
- Accounts**
- Loans

Accounts

You can add delete alter search accounts here.

+ Create Account Add User to Account Alter Account Delete Account

Search Accounts

ID	AccNum	Account Type	SubName	BalanceMin	BalanceMax
		Checking		500	800

Search Reset

Accounts

Acc Num	ID	Sub Name	Balance	Last Access Time	Open Date	Rate	Currency Type	Overdraft
1243232324534421434	406311755555555555	Shanghai支行	700.5	None	2021-07-01			666.0
1243232324534421434	855850346852094000	Shanghai支行	700.5	None	2021-07-01			666.0

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## 11. 添加贷款

切换到Loans页面，点击Create Loan按钮

输入贷款信息

New Loan

LoanNum	28
Budget	500
SubName	Shanghai支行
User 0	484848484848484848
User 1	855850346852094000

+ Add New User

Cancel OK

通过Add New User按钮可以添加更多共享此贷款的用户账号

点击OK

The screenshot shows the 'Bank Management' application's 'Loans' page. The main navigation bar includes 'Analytics', 'Users', 'Accounts', and 'Loans' (which is highlighted). On the right, there are buttons for '+ Create Loan', 'Grant Loan', and 'Delete Loan'. Below these are search fields for 'ID', 'LoanNum', 'SubName', 'MinBudget', 'MaxBudget', and 'Status', with 'Search' and 'Reset' buttons. The main table lists loans with columns: 'Loan Num', 'Sub Name', 'Budget', 'Paid', and 'Status'. Two rows are visible: one for Beijing branch with a budget of 1000.0 and paid amount of 100, and another for Shanghai branch with a budget of 500.0 and paid amount of 0. The row for Shanghai is highlighted with a red border. At the bottom left, it says 'Copyright 2019 DashboardPack.com ❤ Modified by MacGuffin'.

可以看到该贷款信息被成功插入

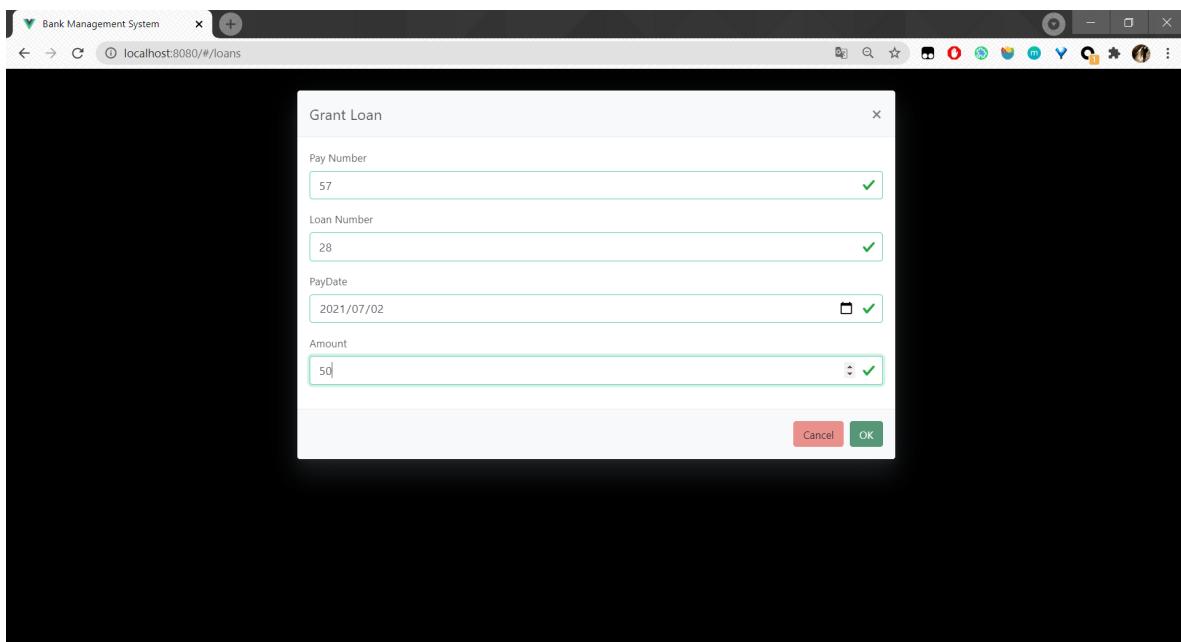
## 12. 贷款信息修改

贷款信息不允许修改，所以没有提供该功能接口

## 13. 贷款发放

This screenshot is similar to the previous one but includes red arrows and numbers for instructions. Red arrow 1 points to the 'Shanghai' loan row in the table. Red arrow 2 points to the 'Grant Loan' button at the top right. The table data remains the same as in the previous screenshot.

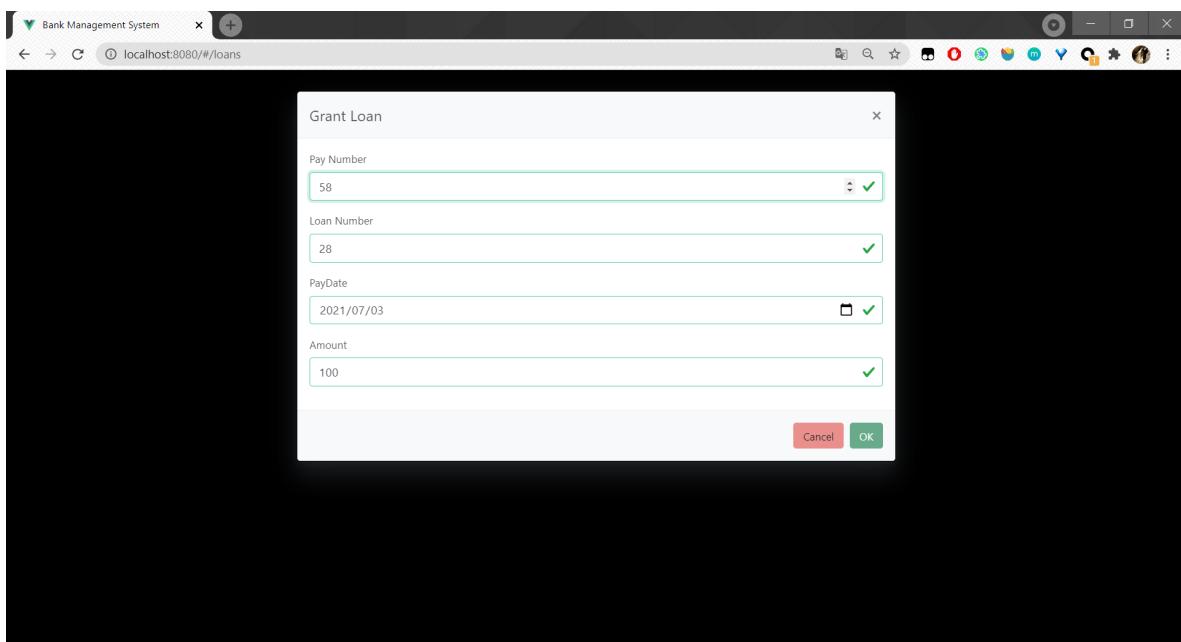
输入发放的贷款信息，并输入发放金额



Loan Num	Sub Name	Budget	Paid	Status
46151684	Beijing支行	1000.0	100	ING
28	Shanghai支行	500.0	450	ING

可以看到贷款被成功发放

如果超量发放贷款款



The screenshot shows a web browser window for the 'Bank Management System' at localhost:8080/#/loans. The main navigation bar includes 'Analytics', 'Users', 'Accounts', and 'Loans' (which is highlighted). The 'Loans' section has a heading 'Loans' with the sub-instruction 'You can add delete grant search loans here.' Below it is a search form with fields for ID, LoanNum, SubName, MinBudget, MaxBudget, and Status, along with 'Search' and 'Reset' buttons. A modal dialog titled 'Amount out of bound' is displayed, indicating an error. The main table lists two loans:

Loan Num	Sub Name	Budget	Paid	Status
46151684	Beijing支行	1000.0	100	ING
28	Shanghai支行	500.0	450	ING

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则提示发放的贷款过多

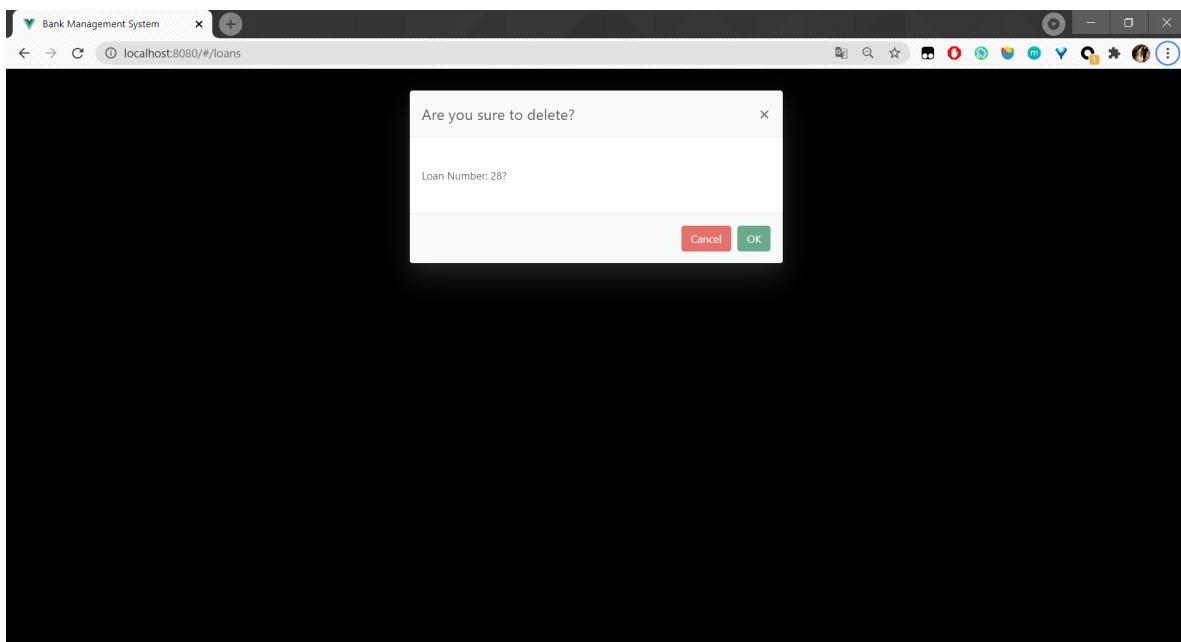
## 14. 贷款删除

只能删除已经发放完毕或尚未开始发放的贷款

The screenshot shows the same 'Bank Management System' interface. The 'Delete Loan' button in the top right of the 'Loans' section is highlighted with a red arrow. The main table now shows the second loan with a status of 'DONE':

Loan Num	Sub Name	Budget	Paid	Status
46151684	Beijing支行	1000.0	100	ING
28	Shanghai支行	500.0	500	DONE

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A screenshot of the 'Bank Management System' loans page. The sidebar shows 'MAIN NAVIGATION' with 'Analytics', 'Users', 'Accounts', and 'Loans' (selected). The main area has a 'Search Loans' section with fields for ID, LoanNum, SubName, MinBudget, MaxBudget, and Status (dropdown). Below it is a 'Loans' table with columns: Loan Num, Sub Name, Budget, Paid, and Status. A single row is highlighted with a green background. The 'Grant Loan' button is highlighted with a red arrow.

可以看到贷款删除成功。

如果想要删除发放中（即status为ING的贷款）

A screenshot of the 'Bank Management System' loans page. The sidebar shows 'MAIN NAVIGATION' with 'Analytics', 'Users', 'Accounts', and 'Loans' (selected). The main area has a 'Search Loans' section with fields for ID, LoanNum, SubName, MinBudget, MaxBudget, and Status (dropdown). Below it is a 'Loans' table with columns: Loan Num, Sub Name, Budget, Paid, and Status. A single row is highlighted with a green background. The 'Delete Loan' button is highlighted with a red arrow. Red numbers 1 and 2 are overlaid on the table and the 'Delete Loan' button respectively.

The screenshot shows a web browser window for a 'Bank Management System' at localhost:8080/#/loans. The main navigation bar includes 'Analytics', 'Users', 'Accounts', and 'Loans' (which is highlighted). The 'Loans' section has a 'Search Loans' form with fields for ID, LoanNum, SubName, MinBudget, MaxBudget, and Status. Below it is a table titled 'Loans' with columns: Loan Num, Sub Name, Budget, Paid, and Status. A single row is shown: 46151684, Beijing支行, 1000.0, 100, ING. An orange banner at the top says 'No permission'. At the bottom, there is a copyright notice: Copyright 2019 DashboardPack.com ❤ Modified by MacGuffin.

则会提示No permission

## 15. 贷款查询

和之前的查询一样，查询得到的结果中包括贷款当前的状态

状态标注如下

状态	备注
IDLE	尚未开始发放
ING	正在发放中
DONE	已经发放完毕

查询北京支行的贷款

The screenshot shows the same 'Bank Management System' interface. In the 'Search Loans' form, the 'SubName' field is filled with 'Beijing支行' and is highlighted with a red rectangle. The resulting table row for loan 46151684 is also highlighted with a red rectangle. The rest of the interface is identical to the previous screenshot.

## 16. 数据统计

在数据统计中可以看到所有银行当前的统计信息

The screenshot shows the 'Analytics' section of the Bank Management System. On the left, there's a main navigation bar with 'Analytics' selected. The central area has a title 'Analytics' with the sub-instruction 'View each subbranch statistic.' Below this is a search interface with a dropdown for 'Select Subbranch' and two date pickers for 'Choose start date' and 'Choose end date'. A green 'Search' button is at the bottom right of the search area. Below the search area is a table titled 'Statistic' with columns: Subbranch, Assets, Saving Account Num, Saving Assets, Checking Account Num, Checking Assets, and Loan Assets. The table contains three rows of data for Beijing, Hefei, and Shanghai branches.

Subbranch	Assets	Saving Account Num	Saving Assets	Checking Account Num	Checking Assets	Loan Assets
Beijing支行	900.5	1	1000.5	0	0	-100
Hefei支行	0	0	0	0	0	0
Shanghai支行	700.5	0	0	1	700.5	0

通过选择左边的Subbranch信息，可以看到不同支行单独的数据统计

This screenshot is similar to the one above, showing the 'Analytics' page. Red numbers 1, 2, and 3 are overlaid on the interface to highlight specific elements: 1 points to the 'Select Subbranch' dropdown menu, 2 points to the 'Search' button, and 3 points to the 'Statistic' table below. The table data remains the same as in the first screenshot.

通过约束右边的起止日期，可以约束到年报表、月报表、周报表

月报表示例

至于其它时间段，都可以通过起止时间来限定，这比老师的要求更加灵活多变

## 4.3 实现中的难点问题及解决

### 1. 从未接触过前端技术

由于之前从未接触过前端技术，包括 `html`, `js` 等，所以需要从头学习，我最终选定的前端技术是 `vue`，因为 `vue` 是当前比较热的一款前端框架，该框架使得业务逻辑和网页分离，使用该框架有助于我对前端的入门，并且专注于逻辑的书写。

### 2. 登录验证

由于 `vue` 采用的 `axios` 库并没有找到合适的 `cookie` 教程，并且之前没有接触过前端的登陆交互，所以我最终采用了 `store + axios` 钩子的方式进行登录验证，每访问一个页面就需要在访问头中加入 `token`，并且在后端验证 `token` 有效之后，前端才会跳转，如果 `token` 无效，前端会强制用户退回 `login` 界面。

### 3. ORM模型的生成

由于采用了ORM模型，但ORM模型本身的书写较为困难，需要大量的重复操作，比如手动将各个表格的约束书写成 `model`，这与使用 `power designer` 生成 `sql`，并通过 `sql` 生成数据库的初衷违背。所以我找到了 `sqlacodegen` 工具，它可以自动将数据库中已经有的表格转换为 `SQLAlchemy model` 代码，从而简化了工作量。