

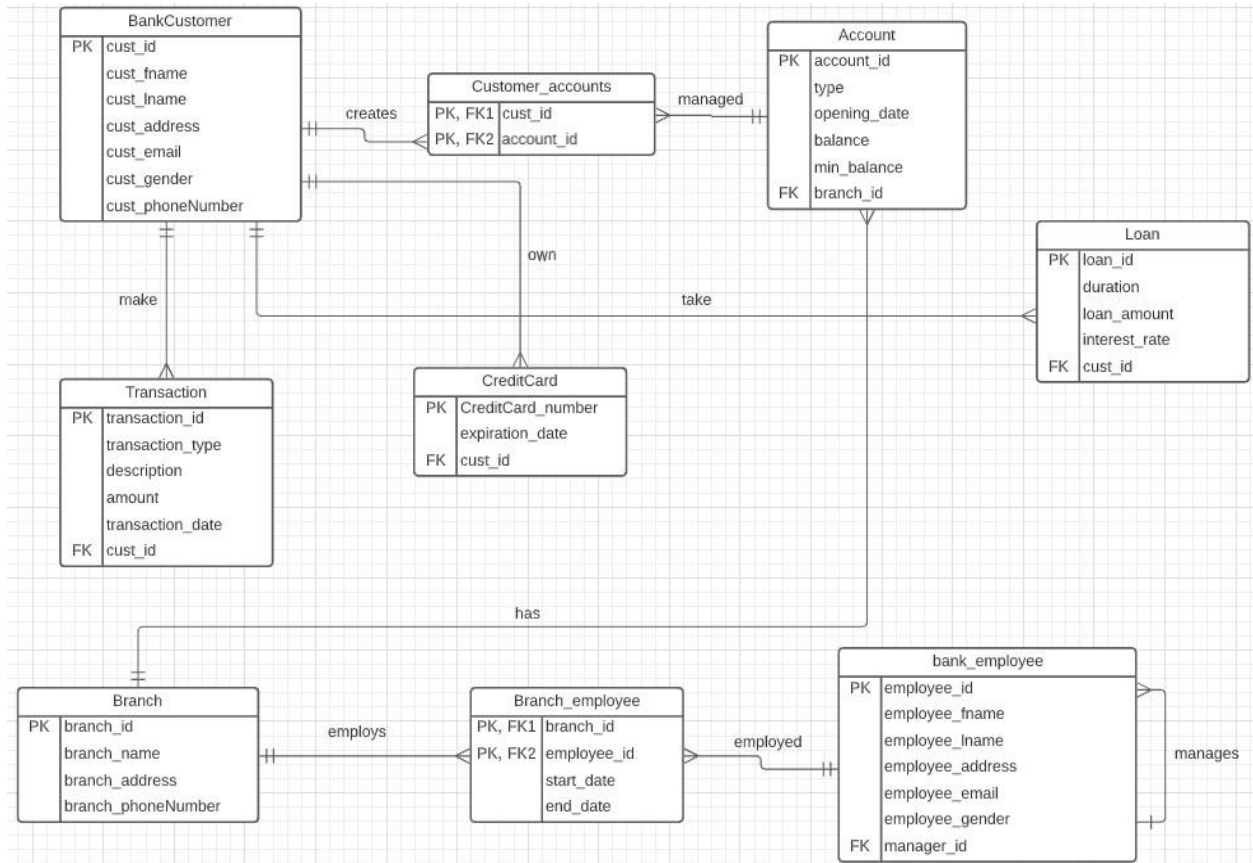


## **Bank Management System**

## V. Database Design

### a. Entity Relationship Model

The entity relationship model is a demonstration of the different tables in our database. It also includes the different primary keys, foreign keys, and relationships between tables alongside their cardinalities.



### b. Relational schema

This section defines the tables' structure that will be present in the database.

- BankCustomer(cust\_id, cust\_fname, cust\_lname, cust\_address, cust\_email, cust\_gender, cust\_phoneNumber): This table stores information about the customers of the bank. The primary key is cust\_id
- Account(account\_id, type, opening\_date, balance, min\_balance, branch\_id): This table stores information about the accounts in a certain bank branch. The primary key is account\_id, and it has one foreign key which branch\_id.

- Customer\_accounts(cust\_id, account\_id): This table is a bridge table between BankCustomer and Account since these two entities have a many-to-many relationship between them. A customer can have different accounts (deposit account, saving account, etc.), and an account can be shared by many customers (associations account, married couple shared account, etc.). In order to have such a relationship, we need a bridge table between the two entities that has both entities primary keys as foreign keys. This table has a composite primary key (cust\_id, account\_id), and it also has 2 foreign keys: cust\_id, and account\_id.
- Transaction(transaction\_id, transaction\_type, description, amount, transaction\_date) : This table stores information about the different transaction a customer makes. The primary key is transaction\_id, and it has one foreign key: cust\_id.
- CreditCard(CreditCard\_number, expiration\_date, cust\_id): This table stores information about a customer's credit cards. The primary key is CreditCard\_number, and it has one foreign key: cust\_id.
- Loan(loan\_id, duration, loan\_amount, interest\_rate, cust\_id): This table stores information about the different loans a customer takes. The primary key is loan\_id, and it has one foreign key cust\_id.
- Bank\_employee(employee\_id, employee\_fname, employee\_lname, employee\_address, employee\_email, employee\_gender, manager\_id): This table stores information about the employees of the bank. The primary key is employee\_id, and it has one foreign key: manager\_id, the foreign key comes from the unary relationship of the table.
- Branch(branch\_id, branch\_name, branch\_address, branch\_phoneNumber): This table stores information about the different branches a bank can have. The primary key is branch\_id.

- Branch\_employee(branch\_id, employee\_id, start\_date, end\_date): This table is a bridge table between bank\_employee and branch since the two entities have a many-to-many relationship between them. An employee can work at many bank branches, and a bank branch employs many employees. To create this relationship we need a bridge table that holds both tables primary keys. The composite primary key of this table is (branch\_id, employee\_id), and it has 2 foreign keys branch\_id, and employee\_id.

The revised database diagram generated by pgModeler is:



## VI. Implementation

For the project implementation we will be using a desktop application alongside a web application. The desktop application will mainly be for the admin to manage the customers as well as oversight the working of the bank. As for the web application, it will be for the bank users (the bank customers) that will have to authenticate and will be able to edit their information, view their transactions, as well as all operations related to their accounts (request a loan, make a transfer, etc.).

In the following, we will be working with the following database:

```
erroummatia-> Select * from bankcustomer;
```

cust_id	cust_fname	cust_lname	cust_address	cust_email	cust_gender	cust_phonenumber	cust_password
599	Blaine	Hernandez	P.O. Box 315, 4458 Luctus Rd.	pede@ametrullaDonec.co.uk	M	326-831770	AAAAA
761	Paloma	Hunter	270-1832 Vehicula St.	malesuada@Aeneanegestas.edu	F	346-639517	BBBBB
837	Marny	Campbell	Ap #543-1476 Parturient Rd.	Mauris@cursusluctusipsum.ca	M	959-934841	CCCCC
645	Charity	Willis	Ap #731-201 Aliquam, Street	tellus.Phasellus@anteMaecenasmi.co.uk	M	109-315390	DDDDD
140	Zahir	Mcpherson	P.O. Box 431, 5539 Ac Av.	imperdiet.erat.nonummy@eliterat.ca	M	722-144874	EEEEEE
804	Dane	Ellis	P.O. Box 590, 9139 Lacus. Av.	risus.Morbi.metus@fermentumconvallis.edu	M	180-374087	ZZZZZ
288	Patrick	Miranda	743-4961 Leo. Avenue	amet.massa@afelisullamcorper.edu	M	176-938814	KKKKKK
915	Drake	William	P.O. Box 230, 8408 Nascetur Rd.	massa@feugiatplacerat.com	M	214-227914	RRRRRR
700	Keelie	George	P.O. Box 722, 3715 Consequat Street	arcu.eu@Vivamuseuismodurna.net	M	473-389291	QQQQQQQ
338	Oscar	Spears	P.O. Box 159, 3026 Eget, Avenue	diam@massa.net	M	481-346356	WWWWWW
731	Bertha	Gallagher	8574 A Ave	volutpat.ornare@Proin.com	F	590-943631	HHHHHHH
736	Louis	Orr	Ap #918-7334 Augue. St.	ante@consequatlectus.ca	M	710-131411	NNNNNNN
364	Deborah	Dean	P.O. Box 581, 4215 Pellentesque Av.	non.enim@nequeNullamisl.co.uk	F	946-605468	XXXXXXXX
244	Lynn	Rollins	P.O. Box 310, 3302 Nisl Rd.	eu.eros.Nam@Phaselluslibero.co.uk	F	174-968643	NNNNNNN
666	Kaden	Atkins	Ap #998-760 Et Rd.	dictum@nunc.co.uk	M	215-406754	YYYYYYYY
730	Bradley	Carlson	3827 Et, St.	magna.Ut.tincidunt@tinciduntaliquamarcu.ca	M	906-469906	OOOOOOO
19	Oren	Roach	4703 Massa. Street	egestas.a.dui@lacusAliquam.net	M	675-438985	PPPPPPP
405	Kareem	Copeland	P.O. Box 644, 2943 Tincidunt Av.	augue.id@idenimCurabitur.com	M	983-732855	JJJJJJJ
941	Gannon	Wilson	872-5027 Turpis. Av.	id@sit.co.uk	M	938-181616	FFFFFFFFF
289	Idola	Clarke	P.O. Box 493, 2889 Arcu. St.	auctor.non.feugiat@quisarcuvel.ca	F	726-379003	GGGGGGGGG

(20 rows)

### a. The desktop application

What we have implemented so far is the following:

#### - Adding customers:

The screenshot shows the 'Clients' Management' application window. At the top, there is a 'Customer Id' field with the value '76312' and a 'See' button. Below this, there are input fields for 'First Name' (Anass), 'Last Name' (Erroummati), 'Gender' (M), 'Adress' (lfrane, 5300), 'Email' (a.erroummati@aui.ma), 'Phone Number' (06657889768), and 'Password'. At the bottom, there is a 'Customer added!' label, an 'Add' button, a 'Delete' button, and an 'Edit' button. A message box is displayed in the center, titled 'Message', with an information icon and the text 'Customer Added Successfully'. The message box has an 'OK' button.

If the input is invalid, we get the following error message:

The screenshot shows the 'Clients' Management' application window. At the top, there is a 'Customer Id' field with the value 'Anas' and a 'See' button. Below this, there are input fields for 'First Name' (Anass), 'Last Name' (Erroummati), 'Gender' (M), 'Adress' (lfrane, 5300), 'Email' (a.erroummati@aui.ma), and 'Phone Number'. At the bottom, there is an 'Add' button and a 'Delete' button. A message box is displayed in the center, titled 'Message', with an information icon and the text 'Incompatible Input Types, Please input you data as the following:'. The message box lists the following input types: ID => Integer, First Name => String, Last Name => String, Adress => String, Email => String, Phone Number => Integer, and Password => String. The message box has an 'OK' button.

The database after entering the customer:

```

erroummatia-> Select * from bankcustomer;

```

cust_id	cust_fname	cust_lname	cust_address	cust_email	cust_gender	cust_phonenumber	cust_password
599	Blaine	Hernandez	P.O. Box 315, 4458 Luctus Rd.	pede@ametrnullaDonec.co.uk	M	326-831770	AAAAA
761	Paloma	Hunter	270-1832 Vehicula St.	malesuada@Aeneanegestas.edu	F	346-639517	BBBBB
837	Manny	Campbell	Ap #543-1476 Parturient Rd.	Mauris@cursusluctusipsum.ca	M	959-934841	CCCCC
645	Charity	Willis	Ap #731-201 Aliquam, Street	tellus.Phasellus@anteMaecenasmi.co.uk	M	109-315390	DDDD
140	Zahir	Mcpherson	P.O. Box 431, 5539 Ac Av.	imperdiet.erat.nonummy@eliterat.ca	M	722-144874	EEEEEE
804	Dane	Ellis	P.O. Box 590, 9139 Lacus. Av.	risus.Morbi.metus@fermentumconvallis.edu	M	180-374087	ZZZZZ
288	Patrick	Miranda	743-4961 Leo. Avenue	amet.massa@afelisullamcorper.edu	M	176-938814	KKKKKK
915	Drake	William	P.O. Box 230, 8408 Nascetur Rd.	massa@feugiatplacerat.com	M	214-227914	RRRRRR
700	Keelie	George	P.O. Box 722, 3715 Consequat Street	arcu.eu@Vivamuseuismodurna.net	M	473-389291	QQQQQQQ
338	Oscar	Spears	P.O. Box 159, 3026 Eget, Avenue	diam@massa.net	M	481-346356	WWWWWW
731	Bertha	Gallagher	8574 A Ave	volutpat.ornare@Proin.com	F	590-943631	HHHHHHH
736	Louis	Orr	Ap #918-7334 Augue. St.	ante@consequatlectus.ca	M	710-131411	NNNNNNNN
364	Deborah	Dean	P.O. Box 581, 4215 Pellentesque Av.	non.enim@nequeNullamnisl.co.uk	F	946-605468	XXXXXXXX
244	Lynn	Rollins	P.O. Box 310, 3302 Nisl Rd.	eu.eros.Nam@Phaselluslibero.co.uk	F	174-968643	NNNNNNN
666	Kaden	Atkins	Ap #998-760 Et Rd.	dictum@nunc.co.uk	M	215-406754	YYYYYYY
730	Bradley	Carlson	3827 Et, St.	magna.Ut.tincidunt@tinciduntaliquamarcu.ca	M	906-469906	OOOOOOO
19	Oren	Roach	4703 Massa. Street	egestas.a.dui@IacusAliquam.net	M	675-438985	PPPPPPP
405	Kareem	Copeland	P.O. Box 644, 2943 Tincidunt Av.	augue.id@idenimCurabitur.com	M	983-732855	JJJJJJJ
941	Gannon	Wilson	872-5027 Turpis. Av.	id@sit.co.uk	M	938-181616	FFFFFFFFF
289	Idola	Clarke	P.O. Box 493, 2089 Arcu. St.	auctor.non.feugiat@quisarcuvel.ca	F	726-379083	GGGGGGGGG
76312	Anass	Erroummati	Ifrane, 5300	a.erroummati@aui.ma	M	06657889768	AZERTY

(21 rows)

## - Manage customer information

### 1. Search for customer by ID

First, we have to enter the ID of the customer:

The screenshot shows a web application window titled "Clients' Management". At the top, there is a "Customer Id" field containing the value "76312" and a "See" button. Below this, the application displays a form with several input fields and a dropdown menu. The fields are labeled "First Name", "Last Name", "Gender", "Adress", "Email", "Phone Number", and "Password". The "Gender" dropdown menu is currently set to "M". At the bottom of the form, there are four buttons: "Add", "Delete", "Clear", and "Edit".

After clicking on see, we get the following:



The screenshot shows a web application window titled "Clients' Management". At the top, there is a "Customer Id" field containing the value "76312" and a "See" button. Below this, the customer's details are displayed in a form layout:

First Name	Anass	Adress	Ifrane, 5300
Last Name	Erroummati	Email	a.erroummati@aui.ma
Gender	M	Phone Number	06657889768
		Password	AZERTY

At the bottom of the form, there are four buttons: "Add", "Delete", "Clear", and "Edit".

To clear out all text fields, we click on “Clear”:

The screenshot shows the same "Clients' Management" application window, but after clicking the "Clear" button. The "Customer Id" field is now empty. All the text input fields for the customer's details (First Name, Last Name, Address, Email, Phone Number, and Password) are also empty. The "Gender" dropdown menu remains set to "M". The "Add", "Delete", "Clear", and "Edit" buttons are still present at the bottom.

## 2. Edit customer information

To edit customer information, we first have to search for the customer by ID (example above), then we can edit the customer information in the text box, and click on “edit”. In the following example we will change customer “Anass Erroummati” name to “Ahmed Erroummati”:



Customers' Management

Customer Id: 76312 See

First Name: Ahmed Address: Ifrane, 5300

Last Name: Erroummati Email: a.erroummati@au.ma

Gender: M Phone Number: 06657889768

Password: Message

Customer Edited Successfully

Customer Modified! Add Delete Edit

Going back to the database we can see the change:

```
erroummati-> Select * from bankcustomer;
```

cust_id	cust_fname	cust_lname	cust_address	cust_email	cust_gender	cust_phonenumber	cust_password
599	Blaine	Hernandez	P.O. Box 315, 4458 Luctus Rd.	pede@ametnullaDonec.co.uk	M	326-831770	AAAAA
761	Paloma	Hunter	270-1832 Vehicula St.	malesuada@Aeneanegestas.edu	F	346-639517	BBBBB
837	Marny	Campbell	Ap #543-1476 Parturient Rd.	Mauris@cursusluctusipsum.ca	M	959-934841	CCCCC
645	Charity	Willis	Ap #731-201 Aliquam, Street	tellus.Phasellus@anteMaecenasmi.co.uk	M	109-315390	DDDDD
140	Zahir	Mcpherson	P.O. Box 431, 5539 Ac Av.	imperdiet.erat.nonummy@eliterat.ca	M	722-144874	EEEEEE
804	Dane	Ellis	P.O. Box 590, 9139 Lacus. Av.	risus.Morbi.metus@fermentumconvallis.edu	M	180-374087	ZZZZZ
288	Patrick	Miranda	743-4961 Leo. Avenue	amet.massa@afelisullamcorper.edu	M	176-938814	KKKKKK
915	Drake	William	P.O. Box 230, 8408 Nascetur Rd.	massa@feugiatplacerat.com	M	214-227914	RRRRRR
700	Keelie	George	P.O. Box 722, 3715 Consequat Street	arcu.eu@Vivamuseuismodurna.net	M	473-389291	QQQQQQQ
338	Oscar	Spears	P.O. Box 159, 3026 Eget, Avenue	diam@massa.net	M	481-346356	WWWWW
731	Bertha	Gallagher	8574 A Ave	volutpat.ornare@Proin.com	F	590-943631	HHHHHHH
736	Louis	Orr	Ap #918-7334 Augue. St.	ante@consequatlectus.ca	M	710-131411	NNNNNNNN
364	Deborah	Dean	P.O. Box 581, 4215 Pellentesque Av.	non.enim@nequeNullamisl.co.uk	F	946-605468	XXXXXXXX
244	Lynn	Rollins	P.O. Box 310, 3302 Nisl Rd.	eu.eros.Nam@Phaselluslibero.co.uk	F	174-968643	NNNNNNN
666	Kaden	Atkins	Ap #998-760 Et Rd.	dictum@nunc.co.uk	M	215-406754	YYYYYYYY
730	Bradley	Carlson	3827 Et, St.	magna.Ut.tincidunt@tinciduntaliquamarcu.ca	M	906-469906	OOOOOOOO
19	Oren	Roach	4703 Massa. Street	egestas.a.dui@lacusAliquam.net	M	675-438985	PPPPPPPP
405	Kareem	Copeland	P.O. Box 644, 2943 Tincidunt Av.	augue.id@idenimCurabitur.com	M	983-732855	JJJJJJJJ
941	Gannon	Wilson	872-5027 Turpis. Av.	id@sit.co.uk	M	938-181616	FFFFFFFFF
289	Idola	Clarke	P.O. Box 493, 2089 Arcu. St.	auctor.non.feugiat@quisarcuvel.ca	F	726-379003	GGGGGGGGG
76312	Ahmed	Erroummati	Ifrane, 5300	a.erroummati@au.ma	M	06657889768	AZERTY

(21 rows)

### 3. Delete a customer:

To delete a customer, we have to first find the customer by his/her ID (same as above), and click on “Delete”:

Customers' Management

Customer Id: 76312 See

First Name: Anass Address: Ifrane, 5300

Last Name: Erroummati Email: a.erroummati@aui.ma

Gender: M Phone Number: 06657889768

Password: AZERTY

Add Delete Clear Edit

Customers' Management

Customer Id: 76312 See

First Name: Address:

Last Name: Email:

Gender: M Phone Number:

Password:

Add Delete Edit

Customer Deleted!

**Message**  
Customer Deleted Successfully  
OK

After the delete operation, the database becomes the following:

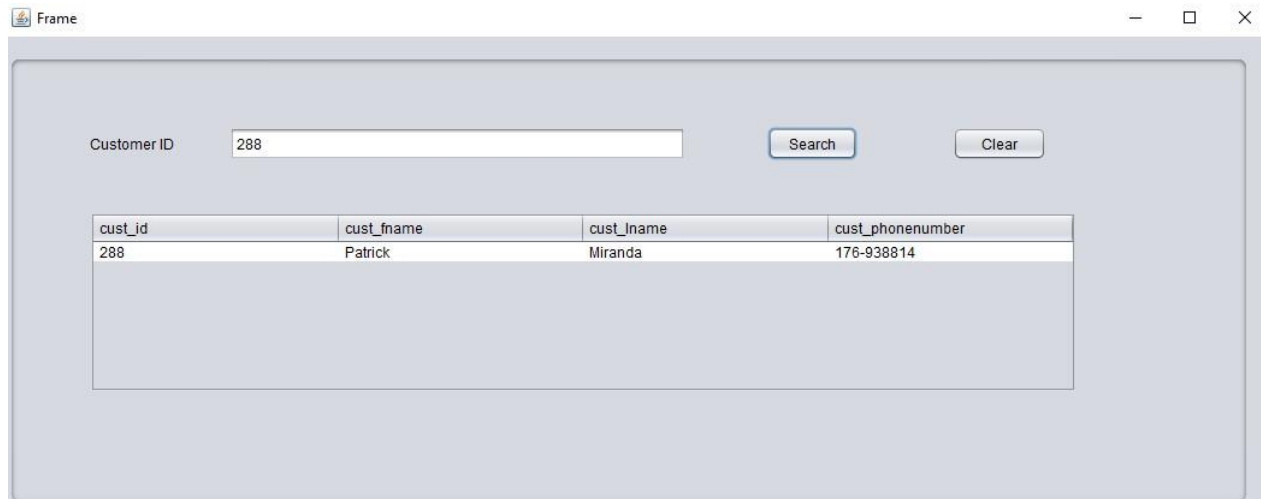
```
erroummati=> Select * from bankcustomer;
```

cust_id	cust_fname	cust_lname	cust_address	cust_email	cust_gender	cust_phonenumber	cust_password
599	Blaine	Hernandez	P.O. Box 315, 4458 Luctus Rd.	pede@ametrnullaDonec.co.uk	M	326-831770	AAAAA
761	Paloma	Hunter	270-1832 Vehicula St.	malesuada@Aeneanegestas.edu	F	346-639517	B888B
837	Manny	Campbell	Ap #543-1476 Parturient Rd.	Mauris@curtusluctusipsum.ca	M	959-934841	CCCCC
645	Charity	Willis	Ap #731-201 Aliquam, Street	tellus.Phasellus@anteMaecenasmi.co.uk	M	109-315390	DDDDD
140	Zahir	Mcpherson	P.O. Box 431, 5539 Ac Av.	imperdiet.erat.nonummy@eliterat.ca	M	722-144874	EEEEEE
804	Dane	Ellis	P.O. Box 590, 9139 Lacus. Av.	risus.Morbi.metus@fermentumconvallis.edu	M	180-374087	ZZZZZ
288	Patrick	Miranda	743-4961 Leo. Avenue	amet.massa@afelisullamcorper.edu	M	176-938814	KKKKKK
915	Drake	William	P.O. Box 230, 8408 Mascetur Rd.	massa@feugiatplacerat.com	M	214-227914	RRRRRR
700	Keelie	George	P.O. Box 722, 3715 Consequat Street	arcu.eu@Vivamuseismodurna.net	M	473-389291	QQQQQQQ
338	Oscar	Spears	P.O. Box 159, 3026 Eget, Avenue	diam@massa.net	M	481-346356	WWWWW
731	Bertha	Gallagher	8574 A Ave	volutpat.ornare@Proin.com	F	590-943631	HHHHHHH
736	Louis	Orr	Ap #918-7334 Augue. St.	ante@consequatlectus.ca	M	710-131411	MMMMMMMM
364	Deborah	Dean	P.O. Box 581, 4215 Pellentesque Av.	non.enim@nequeNullamisl.co.uk	F	946-605468	XXXXXXXX
244	Lynn	Rollins	P.O. Box 310, 3302 Nisl Rd.	eu.eros.Nam@Phaselluslibero.co.uk	F	174-968643	NNNNNNN
666	Kaden	Atkins	Ap #998-760 Et Rd.	dictum@nunc.co.uk	M	215-406754	YYYYYYY
730	Bradley	Carlson	3827 Et, St.	magna.Ut.tincidunt@tinciduntaliquamarcu.ca	M	906-469906	OOOOOOO
19	Oren	Roach	4703 Massa. Street	egestas.a.dui@lacusAliquam.net	M	675-438985	PPPPPPPP
495	Kareem	Copeland	P.O. Box 644, 2943 Tincidunt Av.	augue.id@idenimCurabitur.com	M	983-732855	JJJJJJJJ
941	Gannon	Wilson	872-5027 Turpis. Av.	id@sit.co.uk	M	938-181616	FFFFFFFFF
289	Idola	Clarke	P.O. Box 493, 2089 Arcu. St.	auctor.non.feugiat@quisarcuvel.ca	F	726-379003	GGGGGGGGG

(20 rows)

#### 4. Search for a customer:

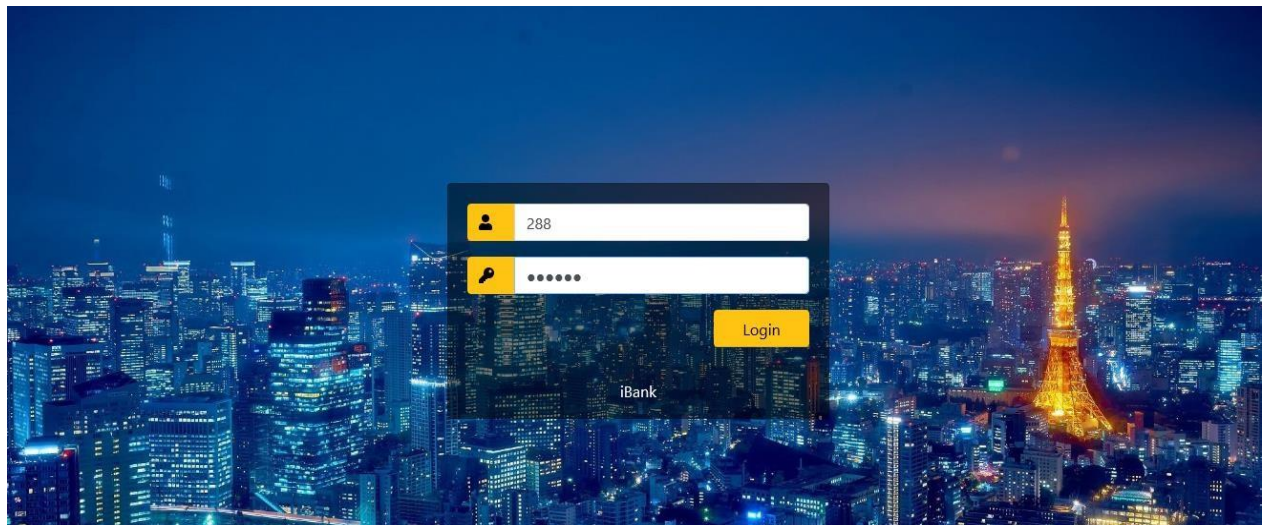
We have used another JFrame to search for a customer by his/her ID:



cust_id	cust_fname	cust_lname	cust_phonenumber
288	Patrick	Miranda	176-938814

### b. Web Application

The web application, as mentioned before, demands that a customer enters his/her account:



After successfully accessing the account, the following user interface is displayed:



After accessing his/her account, the user can do the following:

### **1. View transactions**

On the top right, we can click “My Transactions” to view the different transactions done by the customer. The following web page appears:

iBank Home MyTransactions Personal Information Disabled				
transaction_id	transaction_type	description	amount	Date
4253	transfert	transfert for family	10000.0	2015-03-03
6428	deposit	null	10000.0	2019-07-30

### **2. View personal information**

The customer can also view his/her personal information by clicking on “Personal information” above. The following web page appears:

### Your Personal Account

First Name

Patrick

Last Name

Miranda

Password

KKKKKK

Address

743-4961

Email

amet.massa@afelisullamcorper.edu

Phone Number

176-938814

### 3. Edit personal information

The customer can also change his/her personal information in the same web page, by entering the new values and clicking on “Edit Personal information” as the following web page shows:

### Your Personal Account

First Name

Anas

Last Name

Miranda

Password

KKKKKK

Address

743-4961 Leo. Avenue

Email

amet.massa@afelisullamcorper.edu

Phone Number

176-938814

Edit Personal Information

After updating his/her personal information, we notice that the database becomes as follow:



```

erroummatia-> Select * from bankcustomer;

```

cust_id	cust_fname	cust_lname	cust_address	cust_email	cust_gender	cust_phonenumber	cust_password
599	Blaine	Hernandez	P.O. Box 315, 4458 Luctus Rd.	pede@ametrnullaDonec.co.uk	M	326-831770	AAAAA
761	Paloma	Hunter	270-1832 Vehicula St.	malesuada@Aeneanegestas.edu	F	346-639517	BBBBBB
837	Marny	Campbell	Ap #543-1476 Parturient Rd.	Mauris@cursusluctusipsum.ca	M	959-934841	CCCCC
645	Charity	Willis	Ap #731-201 Aliquam, Street	tellus.Phasellus@anteMaecenasmi.co.uk	M	109-315390	DDDDD
140	Zahir	Mcpherson	P.O. Box 431, 5539 Ac Av.	imperdiet.erat.nonummy@eliterat.ca	M	722-144874	EEEEEE
804	Dane	Ellis	P.O. Box 590, 9139 Lacus. Av.	risus.Morbi.metus@fermentumconvallis.edu	M	180-374087	ZZZZZ
915	Drake	William	P.O. Box 230, 8408 Nascetur Rd.	massa@feugiatplacerat.com	M	214-227914	RRRRRR
700	Keelie	George	P.O. Box 722, 3715 Consequat Street	arcu.eu@Vivamuseuismodurna.net	M	473-389291	QQQQQQQ
338	Oscar	Spears	P.O. Box 159, 3026 Eget, Avenue	diam@massa.net	M	481-346356	MMMMM
731	Bertha	Gallagher	8574 A Ave	volutpat.ornare@Proin.com	F	590-943631	HHHHHHH
736	Louis	Orr	Ap #918-7334 Augue. St.	ante@consequatlectus.ca	M	710-131411	MMMMMMMM
364	Deborah	Dean	P.O. Box 581, 4215 Pellentesque Av.	non.enim@nequeNullamnisl.co.uk	F	946-605468	XXXXXXXX
244	Lynn	Rollins	P.O. Box 310, 3302 Nisl Rd.	eu.eros.Nam@Phaselluslibero.co.uk	F	174-968643	NNNNNNN
666	Kaden	Atkins	Ap #998-760 Et Rd.	dictum@nunc.co.uk	M	215-406754	YYYYYYY
730	Bradley	Carlson	3827 Et, St.	magna.Ut.tincidunt@tinciduntaliquamarcu.ca	M	906-469906	OOOOOOO
19	Oren	Roach	4703 Massa. Street	egestas.a.dui@lacusAliquam.net	M	675-438985	PPPPPPP
405	Kareem	Copeland	P.O. Box 644, 2943 Tincidunt Av.	augue.id@idenimCurabitur.com	M	983-732855	JJJJJJJ
941	Gannon	Wilson	872-5027 Turpis. Av.	id@sit.co.uk	M	938-181616	FFFFFFFFF
289	Idola	Clarke	P.O. Box 493, 2089 Arcu. St.	auctor.non.feugiat@quisarcuvel.ca	F	726-379003	GGGGGGGGG
76312	Ahmed	Erroummati	Ifrane, 5300	a.erroummati@aui.ma	M	06657889768	AZERTY
288	Anas	Miranda	743-4961 Leo. Avenue	amet.massa@afelisullamcorper.edu	M	176-938814	KKKKKK

(21 rows)