جامعة الأخوين

ⵜⴰⵙⴷⴰⵡⵉⵜ ⵏ ⵓⵅⴰⵡⴰⵢⵏ

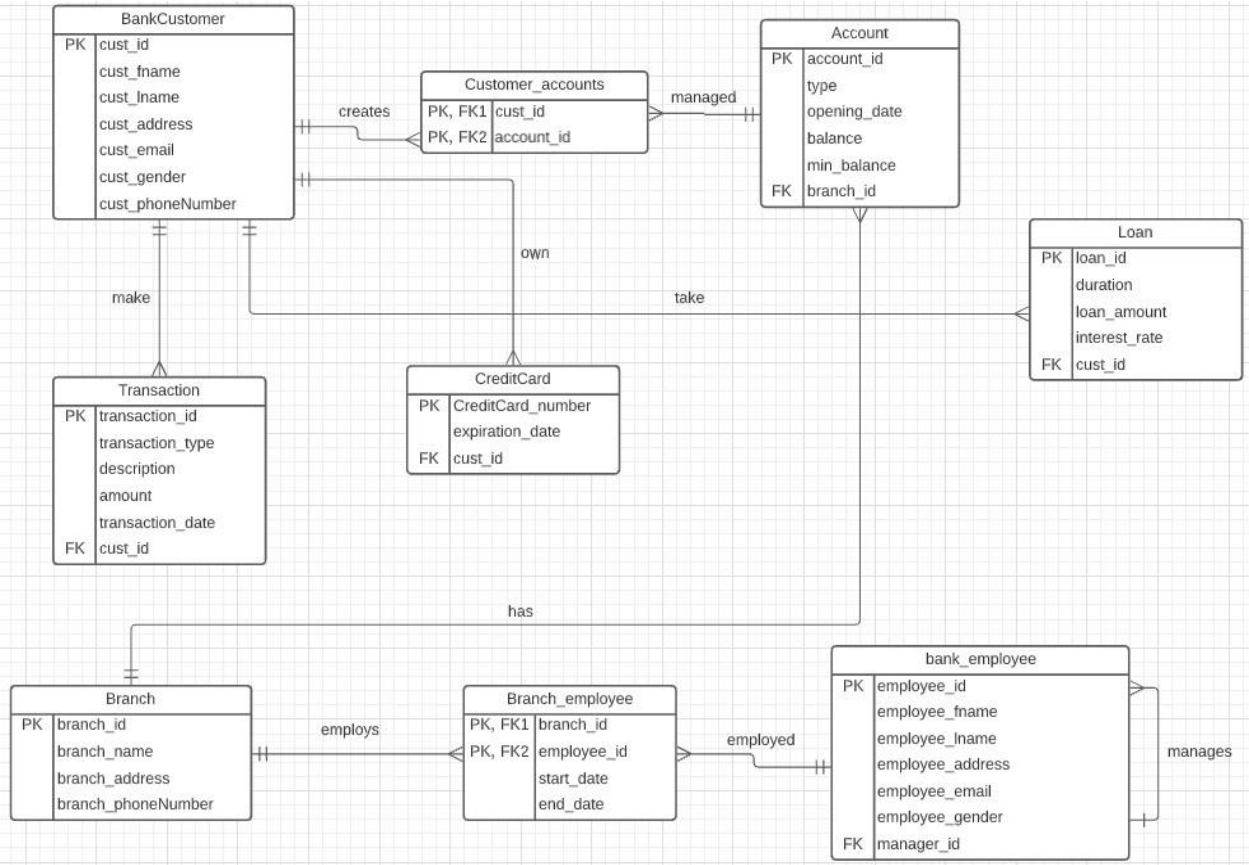
AL AKHAWAYN UNIVERSITY

# 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.

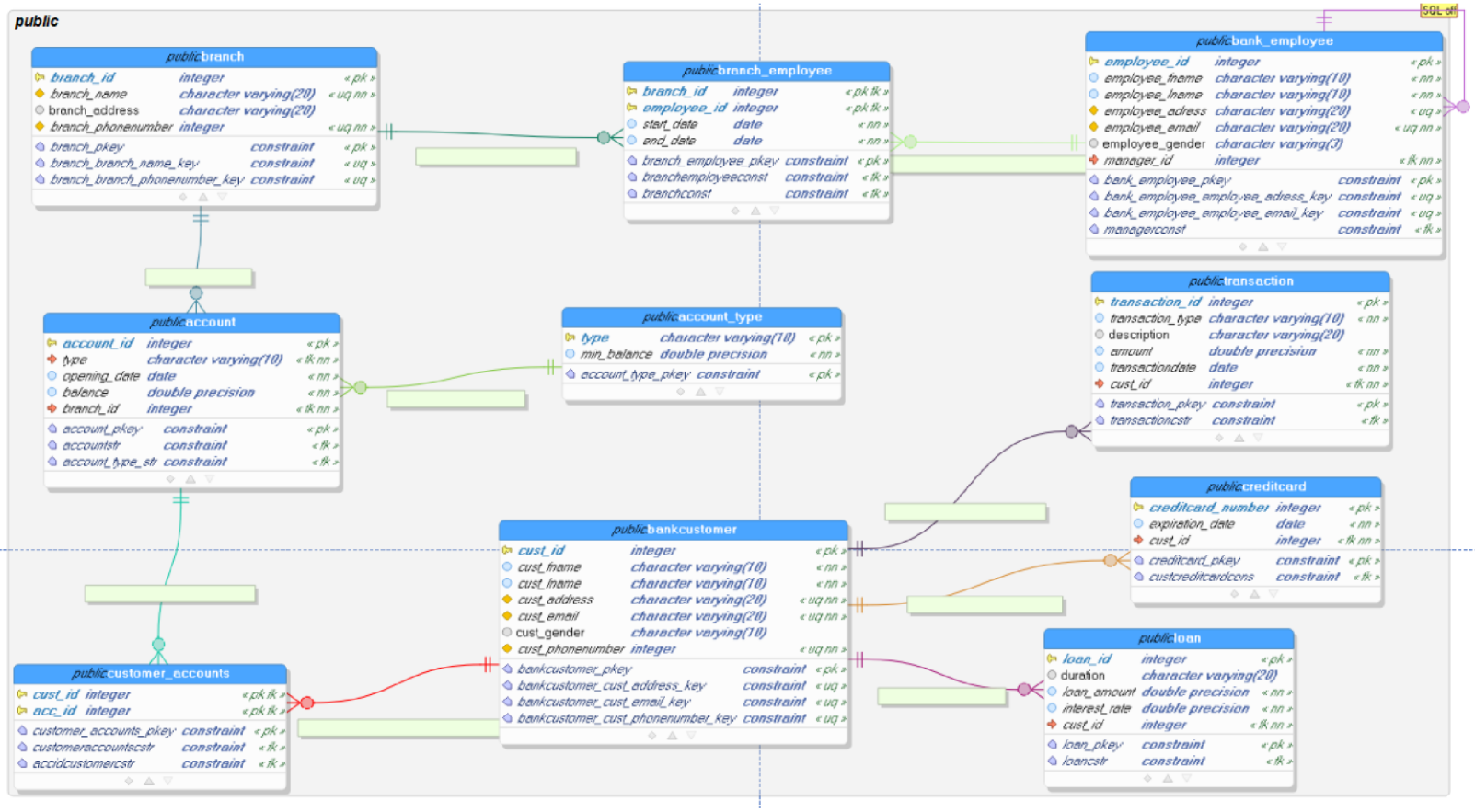
- Loan(loan_id, duration, loan_amount, interest_rate, cust_id): This table stores information about the different loans a customer takes. The primary key is loan_id, and it has one foreign key cust_id.

- 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.).

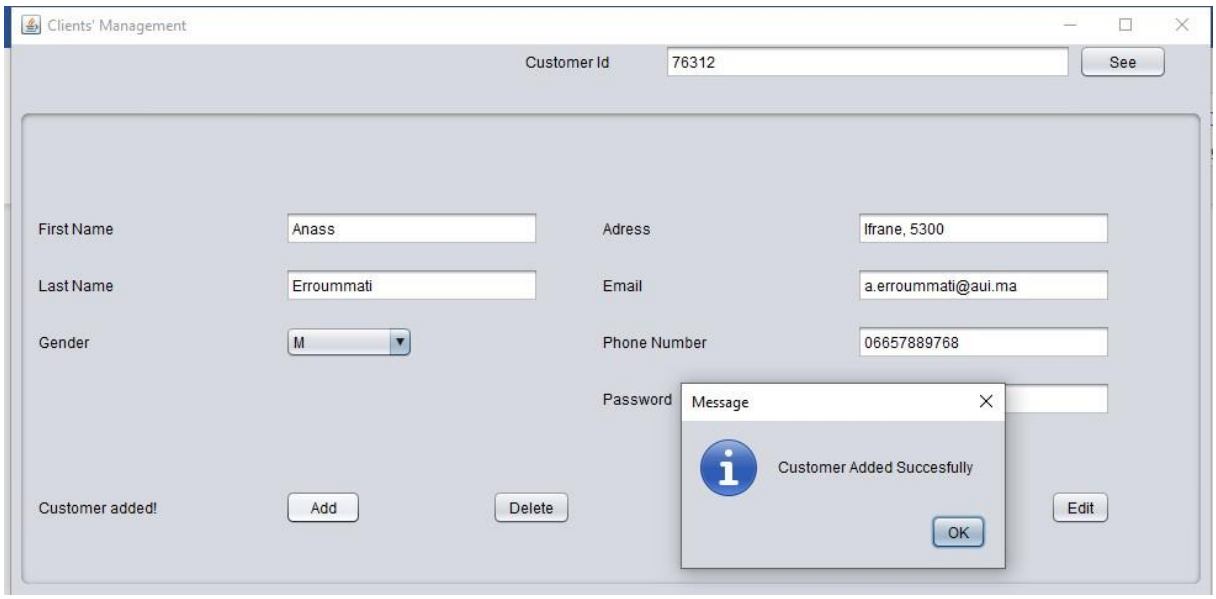
In the following, we will be working with the following database:

```
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@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       | 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       | QQQQQQQQ
     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       | HHHHHHHH
     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       | 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       | FFFFFFFFFF
     289 | Idola      | Clarke     | P.O. Box 493, 2089 Arcu. St.      | auctor.non.feugiat@quisarcuvel.ca       | F           | 726-379003       | GGGGGGGGGG
(20 rows)
```

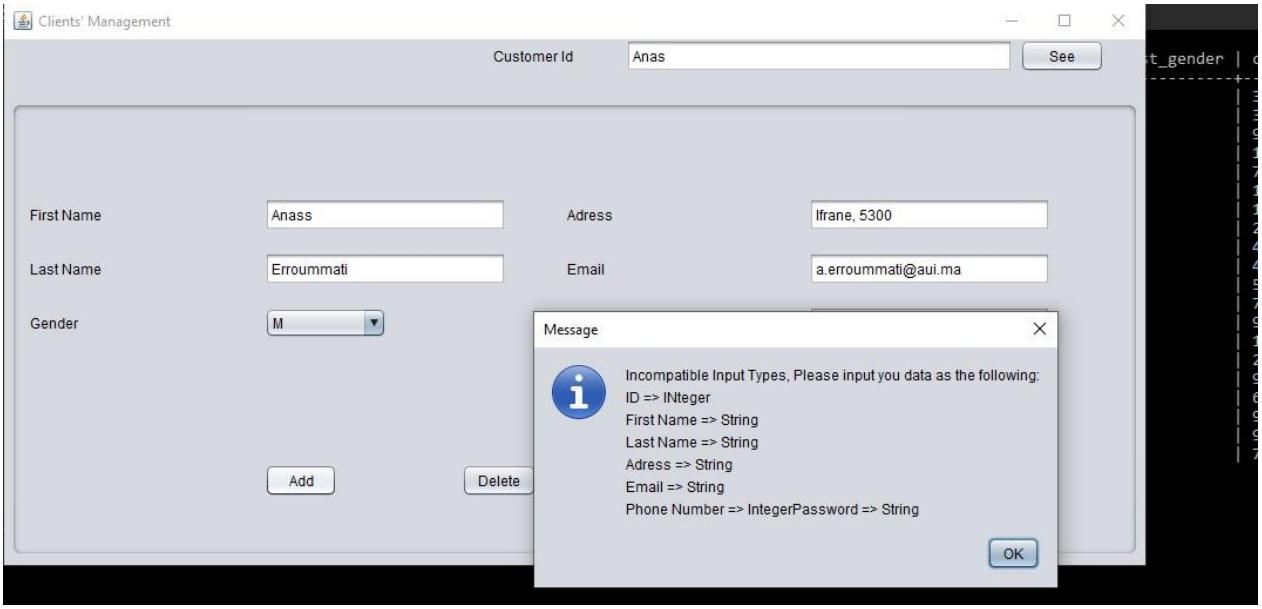
### a. The desktop application

What we have implemented so far is the following:

- **<u>Adding customers:</u>**




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



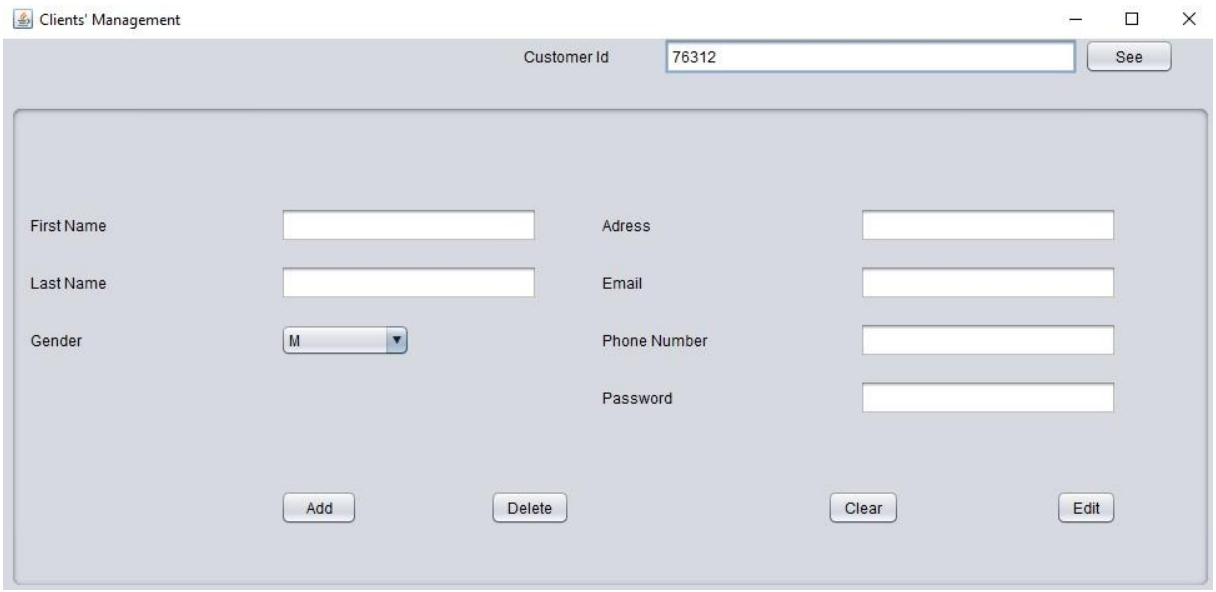

The database after entering the customer:

```
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@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       | 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       | QQQQQQQQ
     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       | HHHHHHHH
     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       | 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       | FFFFFFFFFF
     289 | Idola      | Clarke     | P.O. Box 493, 2089 Arcu. St.      | auctor.non.feugiat@quisarcuvel.ca        | F           | 726-379003       | GGGGGGGGGG
   76312 | Anass      | Erroummati | Ifrane, 5300                      | a.erroummati@aui.ma                      | M           | 06657889768      | AZERTY
(21 rows)
```

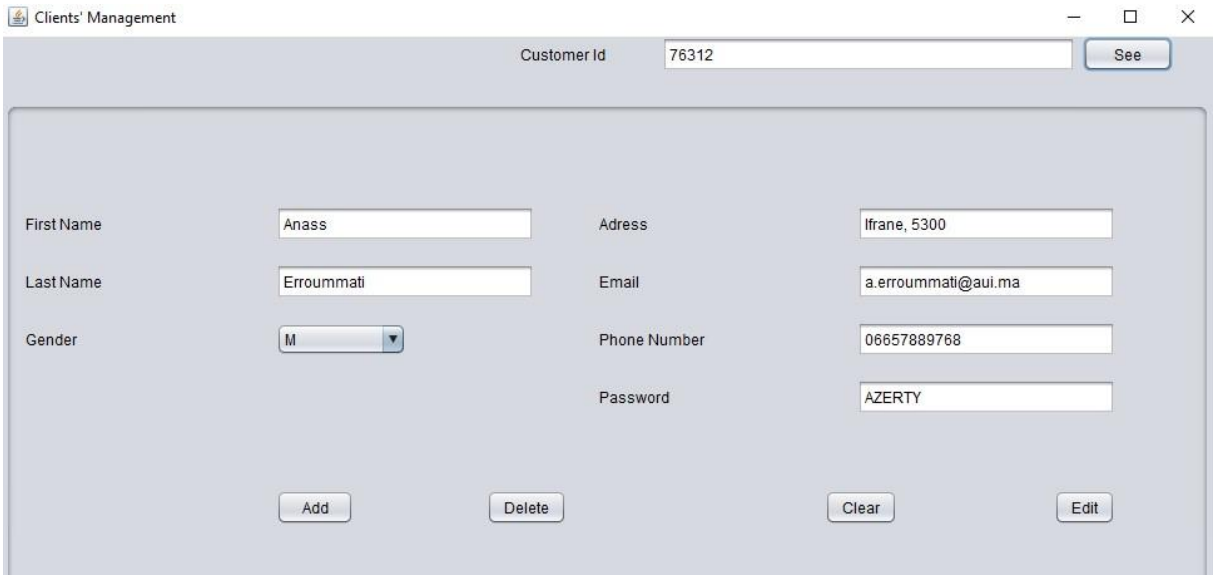
- **<u>Manage customer information</u>**

1. <u>Search for customer by ID</u>

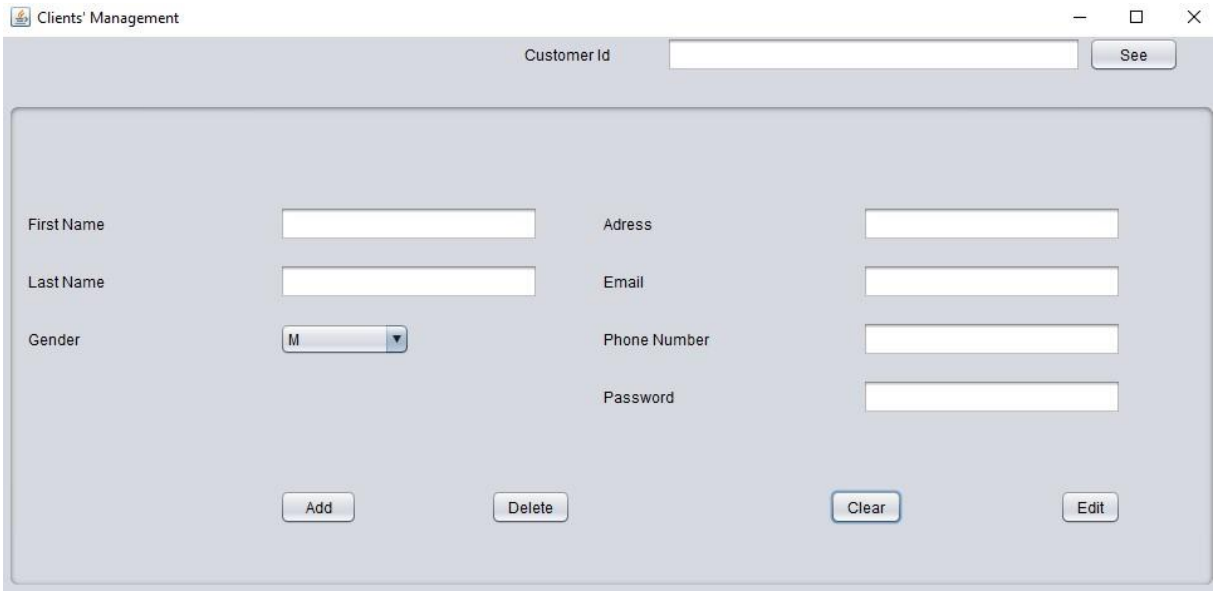
First, we have to enter the ID of the customer:




After clicking on see, we get the following:

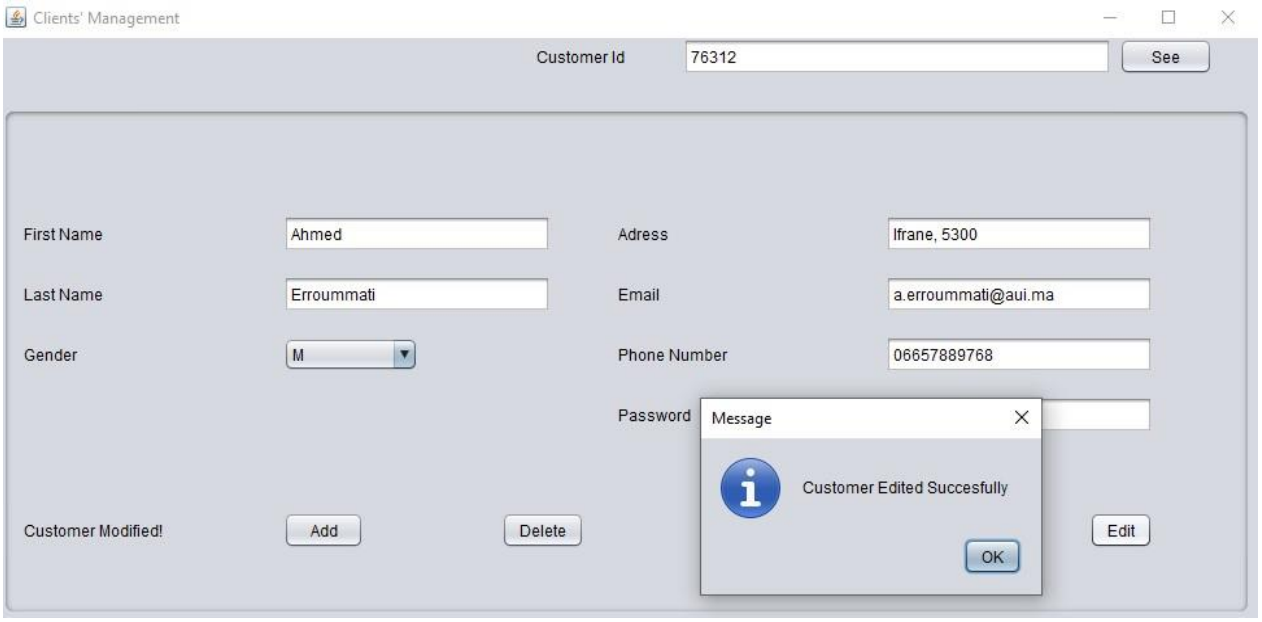



To clear out all text fields, we click on “Clear”:




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”:

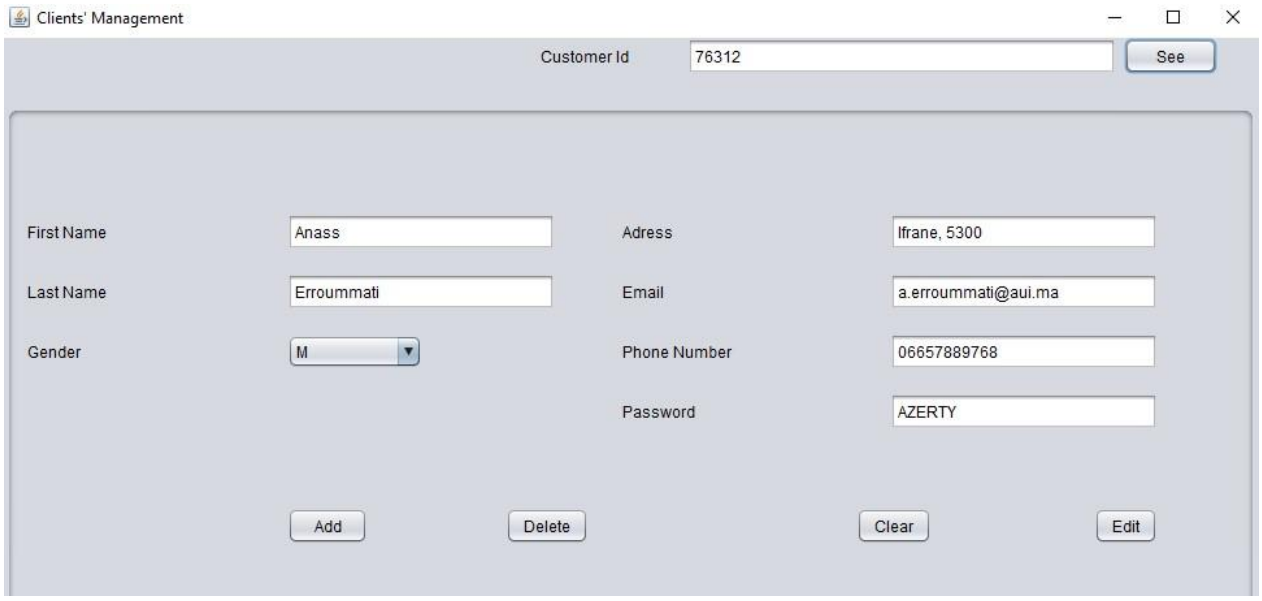


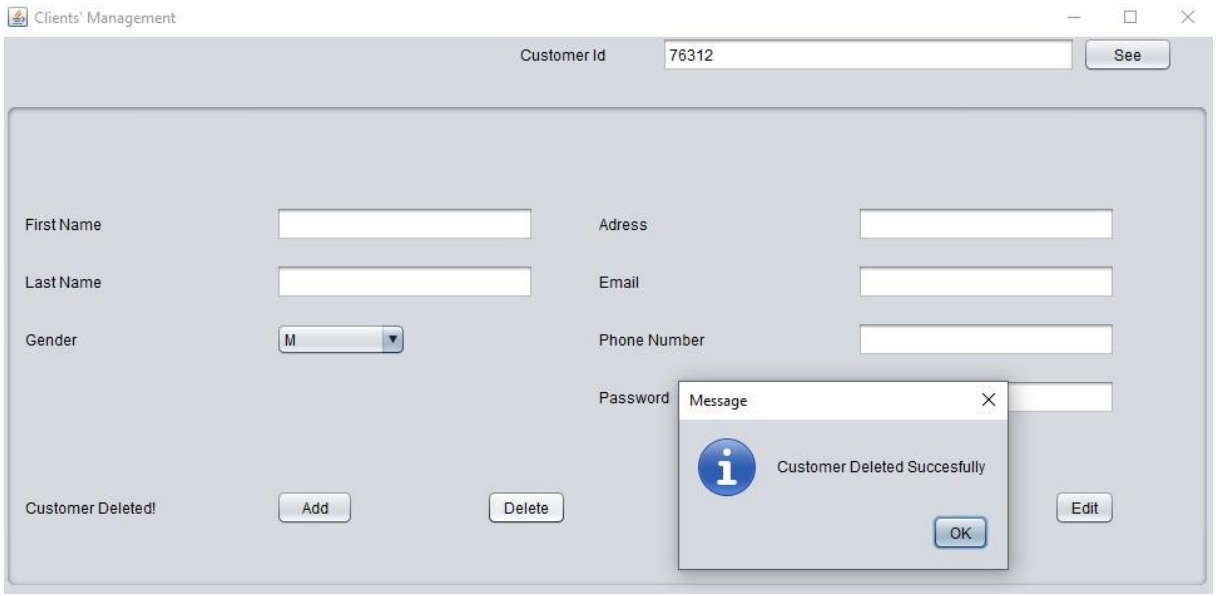

Going back to the database we can see the change:

```
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@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       | 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       | WWWWW
     731 | Bertha     | Gallagher  | 8574 A Ave                        | volutpat.ornare@Proin.com               | F           | 590-943631       | HHHHHHHH
     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       | 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       | FFFFFFFFFF
     289 | Idola      | Clarke     | P.O. Box 493, 2089 Arcu. St.      | auctor.non.feugiat@quisarcuvel.ca       | F           | 726-379003       | GGGGGGGGGGG
   76312 | Ahmed      | Erroummati | Ifrane, 5300                      | a.erroummati@aui.ma                     | M           | 06657889768      | AZERTY
(21 rows)
```

3. <u>Delete a customer:</u>

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



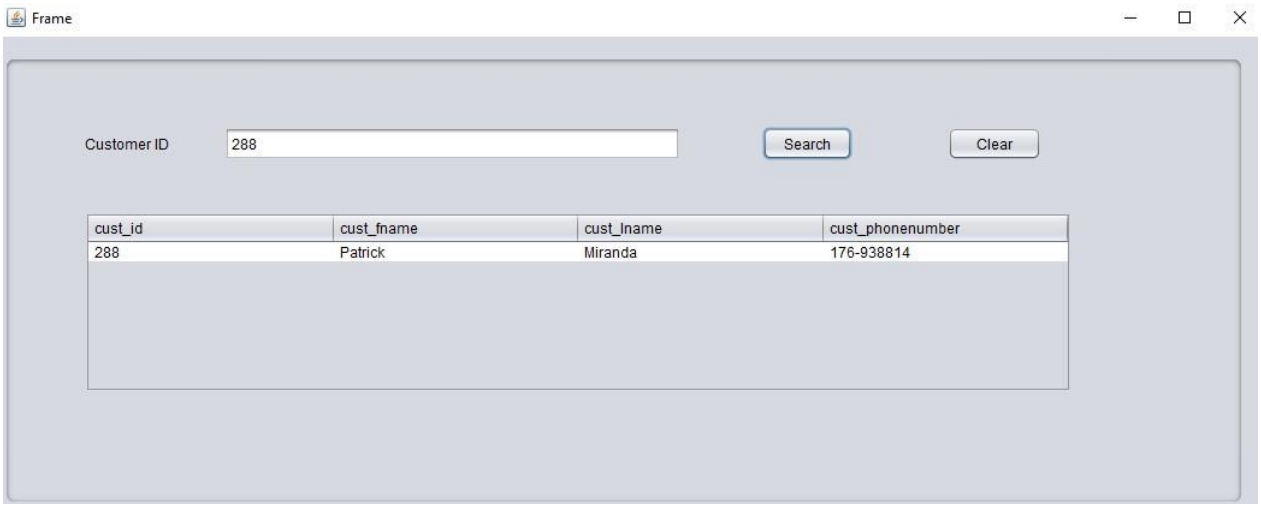




After the delete operation, the database becomes the following:

```
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@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       | 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       | QQQQQQQQ
     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       | HHHHHHHH
     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@Phasellus1ibero.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       | FFFFFFFFFF
     289 | Idola      | Clarke     | P.O. Box 493, 2089 Arcu. St.     | auctor.non.feugiat@quisarcuvel.ca      | F           | 726-379003       | GGGGGGGGGG
(20 rows)
```

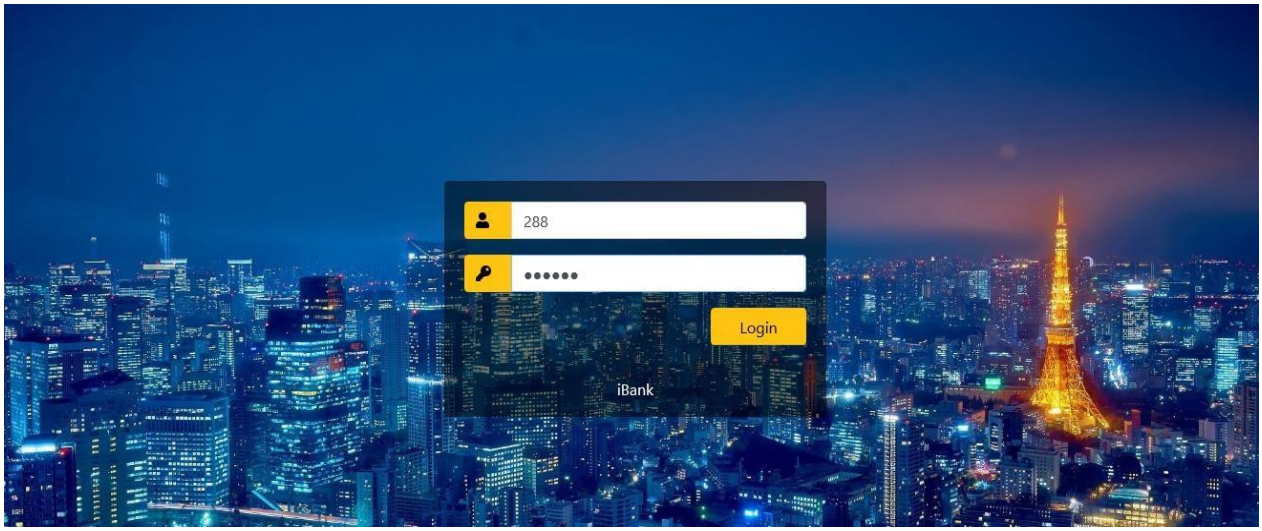
4. Search for a customer:

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

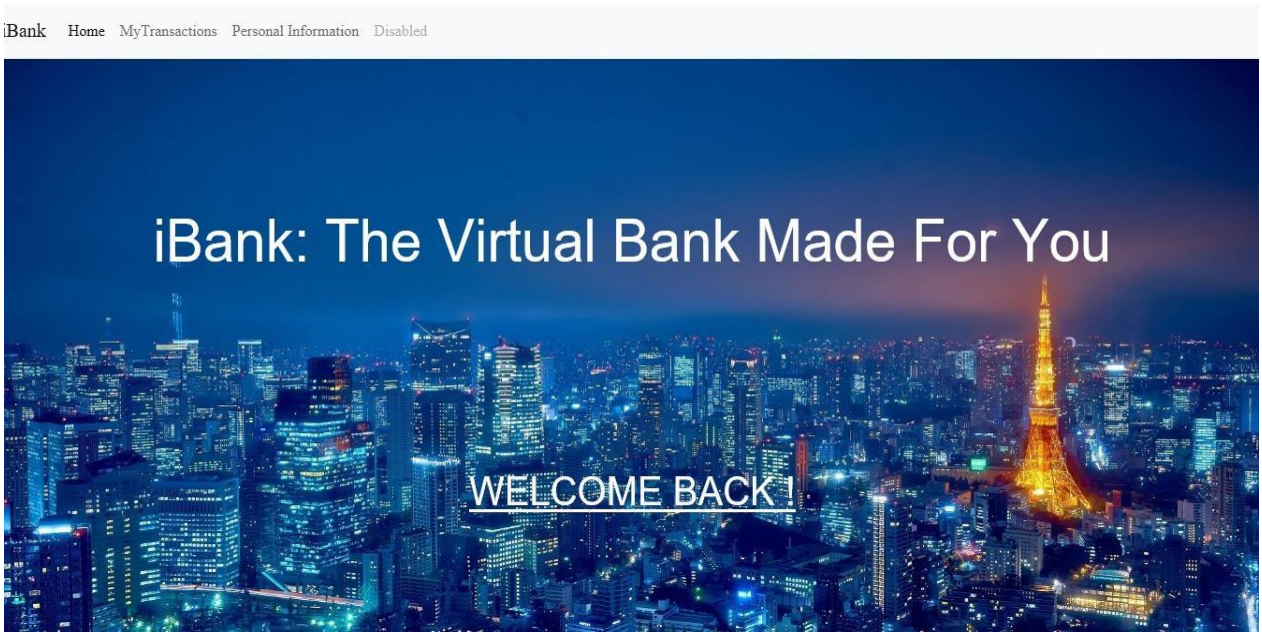



**b. Web Application**

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



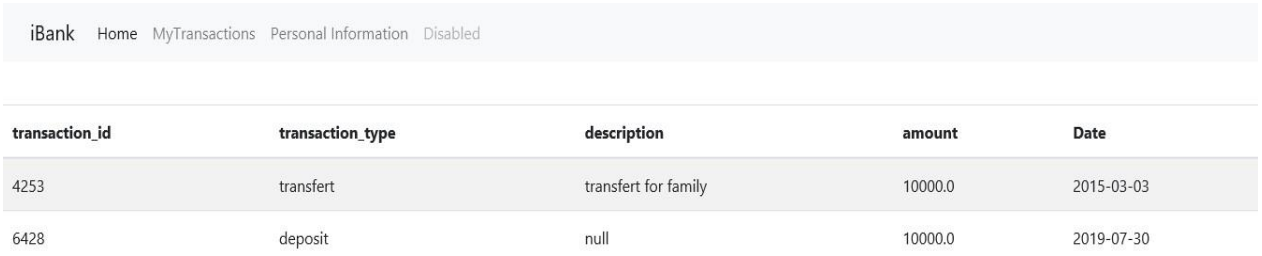

After successfully accessing the account, the following user interface is displayed:




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

### 1. View transactions

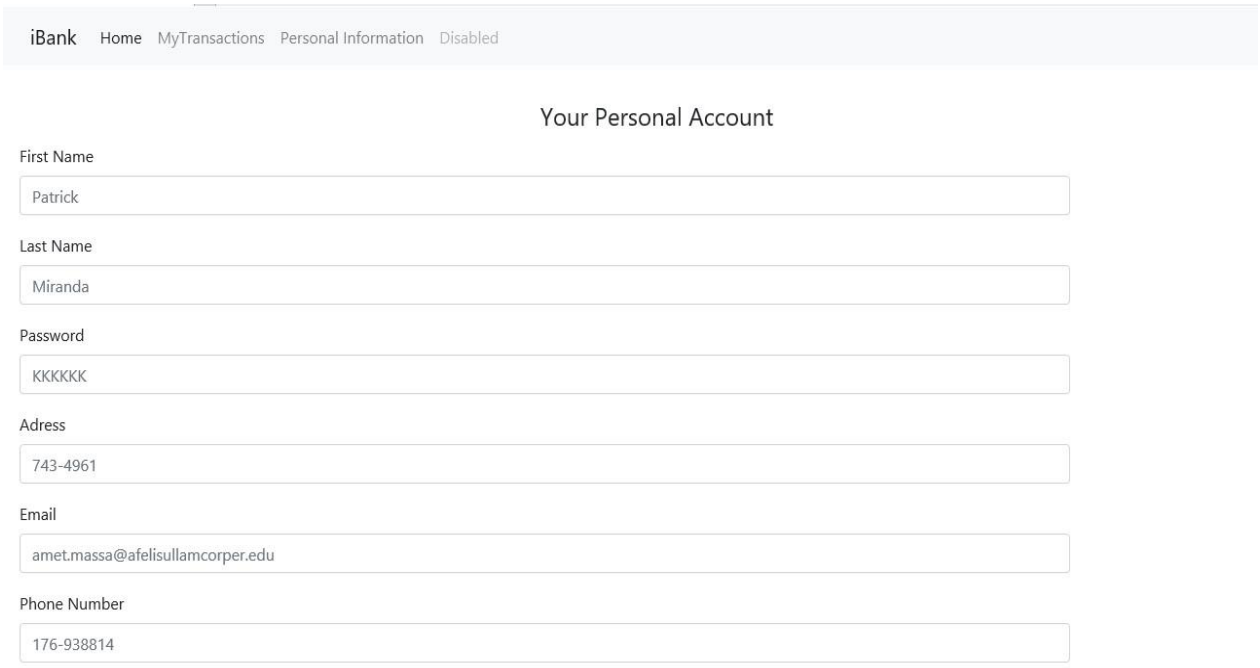
On the top right, we can click “My Transactions” to view the different transactions done by the customer. The following web page appears:




| 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 |

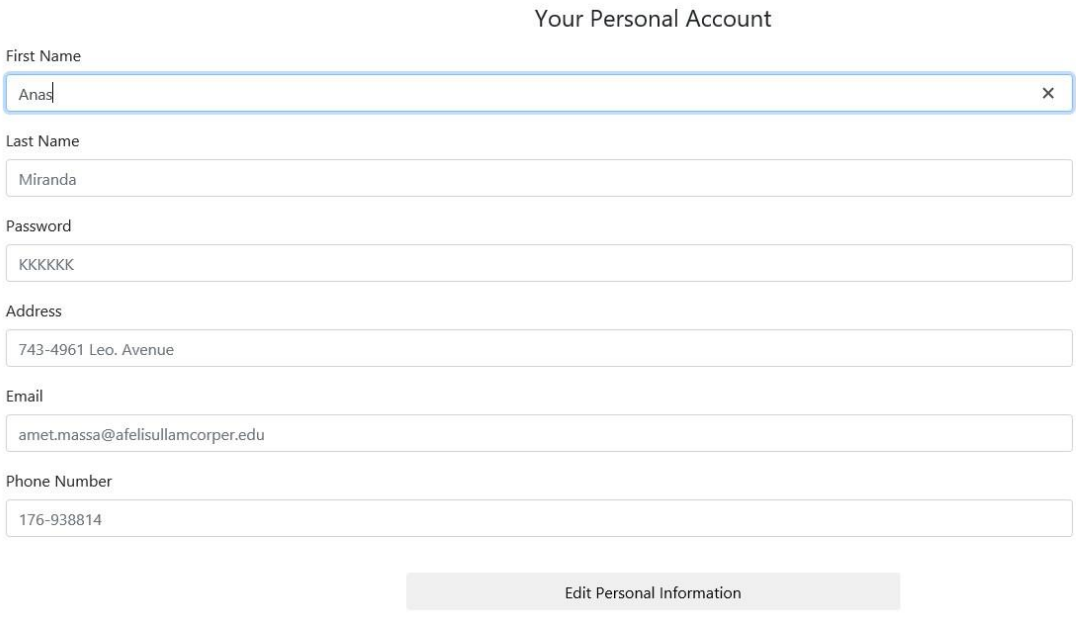
### 2. View personal information

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




## 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:




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@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       | 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
     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       | QQQQQQQQ
     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       | HHHHHHHH
     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       | 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       | FFFFFFFFFF
     289 | Idola      | Clarke     | P.O. Box 493, 2089 Arcu. St.   | auctor.non.feugiat@quisarcuvel.ca      | F           | 726-379003       | GGGGGGGGGG
   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)
```