

# CS 201, Summer 2022

## Homework Assignment 3

Due: 23:55, July 21, 2022

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### Important Notes:

**Please do not start the assignment before reading these notes.**

1. This assignment is due by 23:55, July 21. You should upload your homework to the upload link on Moodle before the deadline. This upload link will be available between June 18 and June 28. The standard rules about late homework submissions apply. Please see the course syllabus for further discussion of the late homework policy as well as academic integrity.
2. You must have separate interface and implementation files (i.e., separate `.h` and `.cpp` files) for your class. We will test your implementation by writing our own driver `.cpp` file which will include your header file. For this reason, your class' name **MUST BE** “`BankingSystem`” and your files' name **MUST BE** “`BankingSystem.h`” and “`BankingSystem.cpp`”. We also recommend you to write your own driver file to test each of your functions. However, you **MUST NOT** submit this test code (we will use our own test code). In other words, your submitted code for the should not include any `main` function.
3. You must use your own implementation of linked lists. In other words, you cannot use any existing linked list code from other sources such as the `list` class in the C++ standard template library (STL).  
Additionally, you will get NO points if you use an array-based implementation of the list or if you use any other data structures such as vector/array from STL.  
However, if necessary, you may define additional data members and member functions. You may also define additional classes.  
You are not allowed to use any global variables or any global functions.
4. Your code must not have any memory leaks. You will lose points if you have memory leaks in your program even though the outputs of the operations are correct.
5. Your implementation should consider all names as case sensitive. For example, last names Ozsoyoglu and OZSOYOGLU should be considered as different names. Also Özsoyoğlu and Ozsoyoglu are different last names due to Turkish characters.
6. You are free to write your programs in any environment (you may use either Linux or Windows). On the other hand, we will test your programs on “`dijkstra.ug.bcc.bilkent.edu.tr`” and we will expect your programs to compile and run on the “`dijkstra`” machine. If we could not get your program properly work on the “`dijkstra`” machine, you would lose a considerable amount of points. Therefore, we recommend you to make sure that your program compiles and properly works on “`dijkstra.ug.bcc.bilkent.edu.tr`” before submitting your assignment.
7. This homework will be graded by your TA Mert Kara (mert.kara at bilkent.edu.tr). Thus, you may ask your homework related questions directly to him.

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In this homework, you will implement a banking system using linked lists. The bank has multiple customers where each customer has an id, first name and last name. The customers can have multiple accounts where each account has an id and a balance.

In your implementation, you **MUST** keep the customers in a sorted linked list where the customers are stored as sorted according to their last names. For each of these customers, you **MUST** use another sorted linked list to store her/his accounts where the accounts are stored as sorted according to account ids.

The banking system will have the following functionalities; the details of these functionalities are given below:

1. Add a customer
2. Delete a customer
3. Add an account for a customer
4. Delete an account
5. Show the list of all accounts
6. Show the list of all customers
7. Show detailed information about a particular customer

**Add a customer:** The banking system will allow to add a new customer indicating her/his customer id, first name and last name. Since the customer ids are unique, the system should check whether or not the specified customer id already exists (i.e., whether or not it is the id of another customer), and if the customer exists, it should not allow the operation and display a warning message. Use the following conditions for sorting the customers in the list:

- The customers should be sorted according to last names.
- If there are more than one customer with the same last name, you should compare the first names.
- If the banking system contains a customer with the same first name and last name as the new input, you should not add this customer again and should display a warning message.

**Delete a customer:** The banking system will allow to delete an existing customer indicating her/his customer id. If the customer does not exist (i.e., if there is no customer with the specified id), the system should display a warning message. Note that this operation will also delete all accounts for the customer of interest.

**Add an account for a customer:** The banking system will allow to add a new account for a particular customer. For that, the customer id and the deposited amount have to be specified. The system should check whether or not this customer exists; if she/he does not, it should prevent to add an account and display a warning message. If the customer exists, a unique account id is generated and a new account is created with the specified deposit amount. The system should return this account id to the user. The accounts are stored as sorted in ascending order of account ids. If the customer does not exist, the returned account id is -1. Note that the account ids are unique within the banking system; thus, by using an account id, the user can access this account.

**Delete an account:** The banking system will allow to delete an existing account indicating its account id. If the account does not exist (i.e., if there is no account with the specified id), the system should display a warning message.

**Show the list of all accounts:** The banking system will allow displaying a list of all the accounts. This list includes the account id, the customer id, the customer name, and the account balance. Note that the accounts have to be shown in sorted order with respect to the last names of the customers they belong to. If there are more than one customer with the same last name, those should be shown in sorted order with respect to their first names.

**Show the list of all customers:** The banking system will allow displaying a list of all the customers. This list includes the customer id and the customer name. Note that the customers have to be shown in sorted order with respect to the last names. If there are more than one customer with the same last name, those should be shown in sorted order with respect to their first names.

**Show detailed information about a particular customer:** The banking system will allow to specify a customer id and display detailed information about that particular customer. This information includes the customer id, the customer name, the number of accounts opened by this customer, the list of accounts owned by this customer including the account id and the account balance for each account.

If the customer does not exist (i.e., if there is no customer with the specified customer id), the system should display a warning message.

Below is the required **public** part of the **BankingSystem** class that you must write in this assignment. The name of the class must be **BankingSystem**, and must include these public member functions. We will use these functions to test your code. The interface for the class must be written in a file called **BankingSystem.h** and its implementation must be written in a file called **BankingSystem.cpp**. You can define additional public and private member functions and data members in this class. You can also define additional classes in your solution.

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```
class BankingSystem {

public:
    BankingSystem();
    ~BankingSystem();

    void addCustomer( const int customerId, const string firstName, const
                     string lastName );
    void deleteCustomer( const int customerId );

    int addAccount( const int customerId, const double amount );
    void deleteAccount( const int accountId );

    void showAllAccounts();
    void showAllCustomers();
    void showCustomer( const int customerId );
};
```

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Here is an example test program that uses this class and the corresponding output. We will use a similar program to test your solution so make sure that the name of the class is **BankingSystem**, its interface is in the file called **BankingSystem.h**, and the required functions are defined as shown above.

#### Example test code:

---

```
#include <iostream>
using namespace std;

#include "BankingSystem.h"

int main() {

    BankingSystem B;

    B.addCustomer( 1234, "Ayla", "Kaya" );
    B.addCustomer( 4567, "Kemal", "Say" );
    B.addCustomer( 891234, "Serhan", "Yilmaz" );
    B.addCustomer( 891234, "Fatih", "Soylu" );
    B.addCustomer( 5678, "Nedim", "Acar" );
```

```

        B.addCustomer( 8901, "Ayla", "Akar" );
        B.addCustomer( 9876, "Ayla", "Akar" );

        B.deleteCustomer( 5678 );
        B.deleteCustomer( 1267 );

        int X, Y, Z, Q;
        B.addAccount( 4567, 100.00 );
        X = B.addAccount( 1234, 200.00 );
        Y = B.addAccount( 4567, 300.00 );
        B.addAccount( 4567, 1000.00 );
        Z = B.addAccount( 8901, 100.00 );
        B.addAccount( 5678, 100.00 );
        B.addAccount( 1234, 500.00 );

        B.deleteAccount( X );
        B.deleteAccount( Y );
        B.deleteAccount( Z );

        B.addAccount( 891234, 500.00 );
        B.addAccount( 4567, 200.00 );
        B.addAccount( 1234, 1500.00 );
        Q = B.addAccount( 1234, 300.00 );
        B.deleteAccount( Q );

        B.showAllAccounts();
        B.showAllCustomers();
        B.showCustomer( 8901 );
        B.showCustomer( 4567 );
        B.showCustomer( 1212 );

        return 0;
    }

```

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### Output of the example test code:

```

Customer 1234 has been added
Customer 4567 has been added
Customer 891234 has been added
Customer 891234 already exists
Customer 5678 has been added
Customer 8901 has been added
Customer Ayla Akar already exists
Customer 5678 has been deleted
Customer 1267 does not exist

```

```

Account 1 added for customer 4567
Account 2 added for customer 1234
Account 3 added for customer 4567
Account 4 added for customer 4567
Account 5 added for customer 8901
Customer 5678 does not exist

```

Account 6 added for customer 1234  
 Account 2 has been deleted  
 Account 3 has been deleted  
 Account 5 has been deleted  
 Account 7 added for customer 891234  
 Account 8 added for customer 4567  
 Account 9 added for customer 1234  
 Account 10 added for customer 1234  
 Account 10 has been deleted

Account id	Customer id	Customer name	Balance
1	4567	Kemal Say	100.00
4	4567	Kemal Say	1000.00
8	4567	Kemal Say	200.00
6	1234	Ayla Kaya	500.00
9	1234	Ayla Kaya	1500.00
7	891234	Serhan Yilmaz	500.00

Customer id	Customer name
4567	Kemal Say
8901	Ayla Akar
1234	Ayla Kaya
891234	Serhan Yilmaz

Customer id: 8901    Customer name: Ayla Akar    Number of accounts: 0

Customer id: 4567    Customer name: Kemal Say    Number of accounts: 3  
 Accounts of this customer:

Account id	Balance
1	100.00
4	1000.00
8	200.00

Customer 1212 does not exist