Problem A: Creating Bank Accounts with Abstract Classes

(30%, related to Lab 9 & Lab 10)

Problem Description

Below are an abstract class **baseAccount** and two derived classes **savingAcount** and **checkingAcount** respectively for saving and checking accounts:

```
class baseAccount
{
public:
    static const double baseIntrsRate; // base interest rate
    baseAccount( int = 0, string = "", string = "", string = "", int = 0);       // default ClientData constructor
    void setAccountNumber( int );       // accessor functions for accountNumber
    int getAccountNumber() const;
    void setLastName( string );         // accessor functions for lastName
    string getLastName() const;
    void setFirstName( string );        // accessor functions for firstName
    string getFirstName() const;
    void setCityName(string);           // accessor functions for cityName
    string getCityName() const;
    void setBalance( int );             // accessor functions for balance
    int getBalance() const;
    static void incNumOfAccount();      // Increase numOfAccount by 1
    static int getNumOfAccount();       // accessor functions for numOfAccount
    virtual void printAccount() const;  // print the data of a baseAccount
    virtual int calculateIntrs() = 0;   // calculate interest and add it to balance

private:
    int accountNumber;          // unique account number
    string lastName;            // Last name
    string firstName;           // First name
    string cityName;            // City name
    int balance;                // balance of an account
    static int numOfAccount; // Total number of accounts, a sum of saving accounts and checking accounts
}; // end class baseAccount

class savingAccount : public baseAccount
{
public:
      savingAccount( int = 0, string = "", string = "", string = "", int = 0, double = 0.0); // default constructor
      void setFloatingIntrsRate(double);    // Accessor functions for floatingIntrsRate
      double getFloatingIntrsRate() const;
      virtual void printAccount() const;    // print data of a saving account
      virtual int calculateIntrs();         // calculate interest of a saving account
      static void incNumOfAccount();    // Increase numOfAccount by 1
      static int getNumOfAccount();     // accessor functions for numOfAccount
private:
      double floatingIntrsRate;             // floating interest rate
```

```
    static int numOfAccount;            // number of saving accounts
};

class checkingAccount: public baseAccount
{
public:
    checkingAccount( int = 0, string = "", string = "", string = "", int = 0.0); // default constructor
    virtual void printAccount() const;      // print data of a checking account
    virtual int calculateIntrs();           // calculate interest of a checking account
    static void incNumOfAccount();          // Increase numOfAccount by 1
    static int getNumOfAccount();           // accessor function for checking account
private:
    static int numOfAccount;                // number of checking accounts
};
```

You are asked to implement all the member functions of these three classes. Besides, the four static data members should also be properly initialized. **baseIntrsRate** should be initialized to 0.01 and the rest are initialized to zero**.**

The main() function will be given and should not be changed. The main() function uses the following four functions to carry out its tasks:

- **void readFile(ifstream &, vector<baseAccount *> &)** will read a formatted file named **inputFilePA.dat** in which each line contains information sufficient to create either a saving account or a checking account. The accounts whether they are checking or saving accounts **should be stored in a vector of <baseAccount *> &)**. A checking account in the input file has six fields in order of account number, last name, first name, city name, balance, account type. The first five fields correspond to the first five data members in baseAccount. If account type is "C", the account is a checking account. If it is "S", the account is a saving account. A saving account has one more field at the end of a line. It is a floating interest rate that corresponds to the variable **floatingIntrsRate** in savingAccount class.
- **void printSavingAccounts(vector<baseAccount *> &)** will print all the saving accounts on a monitor. The output format can be learned from the example output.
- **void printCheckingAccounts(vector<baseAccount *> &)** will print all the checking accounts on a monitor. The output format can be learned from the example output.
- **int calculateInterest(vector<baseAccount *> &)** calculates the interests of all accounts and adds the interests to their balances, respectively. It also returns interest back to the calling function. If it is a checking account, the interest is calculated as follows:

  $$interest = baseIntrsRate \times balance$$

  If it is a saving account and its balance is larger than 10000, the interest is calculated as follows:

  $$interest = 10000 \times baseIntrsRate + (balance - 10000) * (baseIntrsRate + floatingIntrsRate)$$

  Otherwise, it is calculated as follows:

  $$interest = (baseIntrsRate + floatingIntrsRate) \times balance$$

Requirements:

- Class definitions should not be modified.
- main() function should not be modified.
- The prototypes of other global functions should not be modified.
- **The contents of output should be exactly the same as that given in the example output.** The fields among lines should be aligned well for readability, but may not be exactly the same as that given in the example output.

Hints for solving the problems:

- The class definition is provided. You will find it in the folder.
- Can refer to Chapter 10.6 for reviewing the use of static data members.

- Should know how to read data from a formatted file.
- Should know how to use **vector** container in STL.
- Should know how to create abstract classes with polymorphism and use these classes.
- Should know how to program with downcasting (Chapter 13.8) of a class object.

Input:

Given in a file named inputFilePA.dat.

Example Output:

```
Total number of accounts: 39    Number of saving accounts: 24    Number of checking accounts: 15

*** Saving Accounts ***
Acct #    Last Name       First Name City Name           Balance  Floating Rate

1         Brams           Vick-III   Kaohsiung             4286     0.017
4         Brams           Pey-II     SaintPaul             1587     0.017
5         Bach            Vick-VIII  WashingtonDC         29175     0.013
6         Bach            Will-VII   SanFransisco         21510     0.011
7         Brams           Mary-III   WashingtonDC         11692     0.016
8         Brams           Gord-VIII  SanFransisco         11053     0.017
9         Monteli         Mary-III   SaintPaul              244     0.018
20        Subert          John-I     NewYork              26188     0.015
23        Morzart         Mary-IX    Kaohsiung            24994     0.010
24        Morzart         Gord-IV    Taipei               27130     0.011
37        Smith           Berg-IX    London                5572     0.010
42        Heisenberg      Jane-II    London               28351     0.016
47        Bach            Mary-VIII  Seattle              16897     0.010
49        Jhonston        Pey-X      London                5949     0.013
51        Morzart         Vick-V     SanFransisco           211     0.010
53        Jhonston        Tom-III    WashingtonDC         24385     0.014
55        Jhonston        Han-I      London               10620     0.014
56        Jhonston        Jane-IX    SaintPaul            29252     0.014
58        Smith           John-I     OuterSpaceGalaxyM     6289     0.018
65        Adams           Tom-IX     SanFransisco          6223     0.019
82        Jhonston        Will-IX    OuterSpaceGalaxyM    28518     0.017
85        Brams           Tom-VII    NewYork                993     0.018
93        Smith           Will-III   Kaohsiung             3750     0.016
100       Bach            Gord-VI    Paris                 8396     0.017

*** Checking Accounts ***
Acct #    Last Name       First Name City Name           Balance

2         Smith           John-VI    Paris                15591
3         Adams           Jane-I     Minneapolis          18891
10        Monteli         Mary-II    Kaohsiung            28913
11        Hamilton        Will-V     Minneapolis          20492
50        Monteli         Pey-VIII   Kaohsiung              652
54        Adams           Mary-VIII  London               31697
70        Heisenberg      Jane-VI    Taipei               19152
73        Adams           Jane-VIII  OuterSpaceGalaxyM    13709
81        Brams           Vick-III   OuterSpaceGalaxyM     3330
86        Subert          Vick-VI    SaintPaul            10291
88        Bach            Han-X      NewYork              17968
90        Adams           Jane-I     WashingtonDC         10708
92        Subert          Gord-VI    SanFransisco         11424
95        Heisenberg      Vick-X     SanFransisco         20548
97        Brams           Jane-IX    Minneapolis          16947
```

```
*** Saving Accounts After Calculating Interest ***
    Base interest rate:      0.010
Acct #    Last Name       First Name City Name           Balance  Floating Rate

1         Brams           Vick-III   Kaohsiung             4401     0.017
4         Brams           Pey-II     SaintPaul             1629     0.017
5         Bach            Vick-VIII  WashingtonDC         29716     0.013
6         Bach            Will-VII   SanFransisco         21851     0.011
7         Brams           Mary-III   WashingtonDC         11835     0.016
8         Brams           Gord-VIII  SanFransisco         11181     0.017
9         Monteli         Mary-III   SaintPaul              250     0.018
20        Subert          John-I     NewYork              26692     0.015
23        Morzart         Mary-IX    Kaohsiung            25393     0.010
24        Morzart         Gord-IV    Taipei               27589     0.011
37        Smith           Berg-IX    London                5683     0.010
42        Heisenberg      Jane-II    London               28928     0.016
47        Bach            Mary-VIII  Seattle              17134     0.010
49        Jhonston        Pey-X      London                6085     0.013
51        Morzart         Vick-V     SanFransisco           215     0.010
53        Jhonston        Tom-III    WashingtonDC         24830     0.014
55        Jhonston        Han-I      London               10734     0.014
56        Jhonston        Jane-IX    SaintPaul            29814     0.014
58        Smith           John-I     OuterSpaceGalaxyM     6465     0.018
65        Adams           Tom-IX     SanFransisco          6403     0.019
82        Jhonston        Will-IX    OuterSpaceGalaxyM    29117     0.017
85        Brams           Tom-VII    NewYork               1020     0.018
93        Smith           Will-III   Kaohsiung             3847     0.016
100       Bach            Gord-VI    Paris                 8622     0.017

*** Checking Accounts After Calculating Interest ***
Acct #    Last Name       First Name City Name           Balance

2         Smith           John-VI    Paris                15746
3         Adams           Jane-I     Minneapolis          19079
10        Monteli         Mary-II    Kaohsiung            29202
11        Hamilton        Will-V     Minneapolis          20696
50        Monteli         Pey-VIII   Kaohsiung              658
54        Adams           Mary-VIII  London               32013
70        Heisenberg      Jane-VI    Taipei               19343
73        Adams           Jane-VIII  OuterSpaceGalaxyM    13846
81        Brams           Vick-III   OuterSpaceGalaxyM     3363
86        Subert          Vick-VI    SaintPaul            10393
88        Bach            Han-X      NewYork              18147
90        Adams           Jane-I     WashingtonDC         10815
92        Subert          Gord-VI    SanFransisco         11538
95        Heisenberg      Vick-X     SanFransisco         20753
97        Brams           Jane-IX    Minneapolis          17116

Process returned 0 (0x0)   execution time : 0.334 s
```