THE HONG KONG POLYTECHNIC UNIVERSITY
Department of Electronic and Information Engineering

Computer Programming (ENG236) - Homework 2

A. By using Visual Studio .NET, implement all member functions of the class `Calculator` based on the class specification as given below. Then develop a console application that will:
   1. Create an object of the class `Calculator` with input parameter equal to your student ID no.
   2. Call the member functions `menu()`, `obtainUserInput()` and `calculating()` of `Calculator` one by one to show the implementation of these member functions is correct. You can call the functions any way you want as long as they can show their implementation meeting all the requirements in the specifications.

```
// The class Calculator is defined as follows:
// (Words started with $ refer to the member variables as stated in the
//   private section)
class Calculator
{
public:
     Calculator(int studentid);  //Constructor
     // When the object is instantiated, save the input parameter, i.e.
     //   $user_number = studentid (excluding the first 0 and the last alphabet)
     // For other member variables, initialize them to 0
     // Also, show the following message "xxxxxxx, welcome to use
     //   Calculator!!!", where xxxxxxx is the value of studentid

     ~Calculator();
     // Destructor. Do nothing.

     bool menu();
     // The following menu should be shown when menu() is called
     //       Calculator Menu
     //       1. Calculate the power
     //       2. Calculate the factorial
     //       3. Calculate the exponential function
     //       4. Show current result
     //       5. Quit
     // Allow the user to select any one of the above choices.
     // If the user enters 1 to 4, save the number to $operation.  Return true
     // If the user enters 5, save the number to $operation.  Return false

     void obtainUserInput();
     //   If $operation = 1 or 3, ask user to enter two numbers.
     //        $input1 = the first number entered by user in double form.
     //        $input2 = the second number entered by user in integer form.
     //   If $operation = 2, ask user to enter 1 number.
     //        $input2 = the number entered by user in integer form.
     //   For other operations, do nothing

     double calculating();
     // If $operation = 1, return $input1 to the power of $input2, i.e
     //        $input1^$input2 ; save the result to $calculate_result
     // If $operation = 2, return the factorial of $input2, i.e. $input2!;
     //        save the result to $calculate_result
     // If $operation = 3, return the exponential function of $input1 using the
     //        the following formula:
     //         1 + $input1 + $input1^2/2! + $input1^3/3! + … + $input1^$input2/$input2!
     //        Save the result to $calculate_result
     // If $operation = 4, show the current value of $calculate_result.
     //        and return 0
     // If $operation = 5, show a message: "Goodbye xxxxxxx!",
     //        where xxxxxxx is the value stored in $user_number;
     //        then return 0

     int getuser_number() const; // return the value of $user_number
     int getoperation() const;   // return the value of $operation
```

```
    double getcalculate_result() const;   // return the value of
$calculate_result
    double getinput1() const;    // return the value of $input1
    int getinput2() const;       // return the value of $input2

private:
    int user_number;         // Store the studentid number
    int operation;     // Indicate the operation selected.
                       //   1 = power; 2 = factorial; 3 = exponential;
                       //   4 = show result; 5 = quit
    double calculate_result;     // Keep the result of the calculation
    double input1;     // Keep the first input of the user
    int input2;        // Keep the second input of the user
};
```

B. By using Visual Studio .NET, develop a static library, namely `EIE_Calculator.lib`, based on the class specification as given in part A.

C. By using the static library you developed in part B, develop a console application in Visual Studio .NET such that it will first give a welcome message to the user and ask the user to enter his studentID (excluding the first 0 and the last alphabet). It will then repeatedly show the following menu:

```
Calculator Menu
1. Calculate the power
2. Calculate the factorial
3. Calculate the exponential function
4. Show current result
5. Quit
```

If the user chooses 1, your program should allow the user to enter a double number A and an integer B and then compute the result of A^B.
If the user chooses 2, your program should allow the user to enter an integer B and then compute the factorial of B, i.e. $B! = B \times (B-1) \times (B-2) \times \cdots \times 1$.
If the user chooses 3, your program should allow the user to enter a double number A and an integer B and then compute the result using the following formula:

$$\text{result} = 1 + A + A^2/2! + A^3/3! + \ldots + A^B/B!$$

If the user chooses 4, the result of the last operation selected by the user is shown.
If the user chooses 5, show a message "Goodbye xxxxxxx!", where xxxxxxx is your student ID (excluding the first 0 and the last alphabet); and then the program quits.

When doing the computation as mentioned above, it is compulsory to use the member functions of your library whenever applicable.

Instructions

1. It is compulsory to use a new project for each question.
2. Try to explain your program as clear as possible using comments.
3. Apart from `iostream`, do NOT use any other standard library provided by Visual Studio.
4. The program structure will be an important part when assessing your work. Never try to write your program with a single `main()` function. To improve the program structure, it is allowed to add more member functions into the class.

```
// As Part C is doing the same job of Part A but uses Static Library, only the suggested
// solution of Part C is given below.
//The following should be inside the file "Calculator.h"
class Calculator
{
public:
      Calculator(int studentid);
      ~Calculator();
      bool menu();
      void obtainUserInput();
      double calculating();
      int getuser_number() const;     //Return the value of $user_number
      int getoperation() const; //Return the value of $operation
      double getcalculate_result() const;  //Return the value of $calculate_result
      double getinput1() const; //Return the value of $input1
      int getinput2() const;    //Return the value of $input2

private:
      int user_number;          //Store the studentid number
      int operation;            //Indicate the operation selected.
                                //1 = power; 2 = factorial; 3 = exponential;
                                //4 = show result; 5 = quit
      double calculate_result;  //Keep the result of the calculation
      double input1;            //Keep the first input of the user
      int input2;               //Keep the second input of the user
      double power(double, int);//Added member function to compute power
      double factorial(int);    //Added member function to compute factorial
      double exponential(double, int);     //Added member function to calculate
exponential function
};

//The following should be inside a .cpp file for implementing the member functions
#include <iostream>
#include "Calculator.h"    //Header file
using namespace std;
//The following implements the member functions of the class
Calculator::Calculator(int studentid) //Constructor
{
      user_number=studentid;
      operation=0;              //--
      calculate_result=0;       //  |-- Initialize member variables to 0
      input1=0;                 //  |
      input2=0;                 //--
      cout<< studentid<< ", welcome to use Calculator!!!\n";
}

Calculator::~Calculator() //Destructor, do nothing
{
}

bool Calculator::menu() //User Menu
{
      char choice;    //To store the command input by user
      cout<<"\nCalculator Menu\n";
      cout<<"1. Calculate the power\n";
      cout<<"2. Calculate the factorial\n";
      cout<<"3. Calculate the exponential function\n";
      cout<<"4. Show current result\n";
      cout<<"5. Quit\n\n";
      cout << "Please enter your choice: ";
      cin >> choice;
      switch (choice)
      {
            case '1': operation=1; break;
            case '2': operation=2; break;
            case '3': operation=3; break;
            case '4': operation=4; break;
            case '5': operation=5; return false; //Shall quit here
            default : operation=99;   //Let calculating() does nothing
                  cout << "Wrong input!\n"; break;
      }
      return true;
}

void Calculator::obtainUserInput()   //Ask user to input 1 or 2 number(s)
```

```
{
	switch (getoperation())
	{
		case 1:	//operation=1 or 3, input 2 numbers
		case 3:
			cout << "Please enter a real number: ";
			cin >> input1;
			cout << "Please enter an integer: ";
			cin >> input2;
			break;
		case 2: cout << "Please enter one integer: ";  //operation=2, input 1 integer
			cin >> input2;
			break;	//No default needed becaue menu() has default
	}
}

double Calculator::calculating()	//Calculate different functions
{
	switch (getoperation())
	{
		case 1: obtainUserInput();
			calculate_result=power(getinput1(),getinput2());	//Cal input1^input2
			break;
		case 2: obtainUserInput();
			calculate_result=factorial(getinput2());  //Cal input2!
			break;
		case 3: obtainUserInput();
			calculate_result=exponential(getinput1(),getinput2());	//Cal
exponential function
			break;
		case 4: cout<<"Current result is: "<< getcalculate_result()<<"\n";  //Display
Current result
			return 0;  //As requested
			break;
		case 5: cout<<"Goodbye "<<getuser_number()<<"!\n";  //Say Goodbye!
			return 0;  //As requested
			break;
		default: return 1;  //Basically does nothing.  Return value is arbitrary
	}
	return calculate_result;
}

int Calculator::getuser_number() const
{
	return user_number;
}

double Calculator::getcalculate_result() const
{
	return calculate_result;
}

int Calculator::getoperation() const
{
	return operation;
}

double Calculator::getinput1() const
{
	return input1;
}

int Calculator::getinput2() const
{
	return input2;
}


double Calculator::power(double a, int b) //Added member function to find a to the power
of b
{
	double result = 1.0;
	for (int i = 0; i < b; i++)
		result = a * result;
	return result;
```

```
}

double Calculator::factorial(int a)  // Added member function to find the factorial of a
{
      double result=1.0;
      for (int i = a; i > 0; i--)
            result=result*i;
      return result;
}

double Calculator::exponential(double a, int b)//Added member function to calculate
expontential function
{
      double result=1.0;
      for (int i= 1; i<=b; i++)
            result=result+(power(a,i)/factorial(i));
      return result;
}


//The following should be in the .cpp file that contains main() and uses the library
//************ main program **************************
// Main program for testing the static library
// Usage: HW2c
// Version: 1
// Date: Nov. 2, 2005
// Author: Frank
//*****************************************************
#include <iostream>
#include "Calculator.h"
using namespace std;
int main()
{
      int studentid=0;
      cout<<"Please input your student ID:\n";
      cin>>studentid;
      Calculator Cal(studentid);// Instantiate an object Cal of class Calculator

      bool flag = true; //Leave while loop when flag is false
      while (flag)
      {
            flag = Cal.menu(); //call menu() of the object
            Cal.calculating();
      }
      return 0;
}
```