SEN909. Midterm Exam. (25%)

Due Date: 03/22/2015
PLEASE UPLOAD ALL FILES TO EMS IN A SINGLE .ZIP FILE (Midterm.zip)

PART I. (20 points)
Deliverables: A maximum of 7 files should be submitted.

(main_usps.cpp, Mail.[h/cpp], PriorityMail.[h/cpp], Data.[h/cpp])

USPS (United States Postal Service)

You have been hired to write a program, which allows to control the postage in a USPS office. You will have to use classes, inheritance and polymorphism.

The program will allow to introduce to the system first-class mail and priority mail, which have a different cost. And the letter can be sent inside the States or to another country. The main program will have a menu with 4 options:

1. Insert first-class mail.
2. Insert priority mail
3. Print postage
4. Exit

Options 1 and 2 are asking for the data: addressee and sender (which will be of the class Data, see below) plus any additional information needed (weight, urgent, zone).

```
class Data
{ private:
       char name[20];
       char address[30];
       char city[15];
       long zip;
  public:
       friend istream& operator>>(/* complete arguments*/);
       friend ostream& operator<<(/* complete arguments */);
};
```

Specifications:

- This class has no constructor or member function, the information will be introduce and request through the operator >> and << overloading, respectively.

To calculate the postage of a normal letter, the class Letter has been defined:

```
class Mail
{
protected:
       Data sender;
       Data addressee;
       static double postage;
public:
       friend istream& operator>>(/* poner argumentos */);
       virtual double calculatePostage();
       void seePostage();
     };
```

Specifications:

- It has 3 protected variables. One of them is static.
- `virtual double calculatePostage()`: It is the getter for the variable postage. The postage value for a first class mail is $0.48
- `void seePostage()`: It prints all the information: sender, addressee and price.

- The operator >> must be overloaded to introduce all the information about addressee and sender.

To calculate the postage of a priority mail, the following derived class has been defined:

```
enum Zone { national, international};

class PriorityMail : public Mail
{
protected:
       bool urgent;
       Zone area;
       double weight,price;
public:
       PriorityMail(Zone z, double w, bool urg);
       friend istream& operator>>(/* complete arguments */);
       double calculatePostage();
};
```

Specifications:

- It has a constructor where zone, weight and urgent are set.
- `double calculatePostage()`: It calculates the price of the postage following the values in the table below.

	w<1lb no urgent	w<1lb urgent	w>= 1lb no urgent	w>= 1lb urgent
National	$5	$9	6$/lb	10$/lb
International	$8	$15	8.5$/lb	16$/lb

- Addressee and sender information are introduced through the operator >> overloading.

Option 3 print data (addresse, sender and postage) on the screen through member function `seePostage`.
Option 4 frees memory and exits the program.

The main bellow shows a possible main(), the Mail* list[15] is mantadory, we are going to work with pointers to the objects:

```
int main()
{
Mail* list[15]; //array of Mail pointers of the class
int opc,num=0;    //más variables necesarias
while(1){
       opc = Menu();
       if (opc==1){
       //declare a Mail and add to the List
       }
       else if(opc== 2){
       //declare a PriorityMail and add to the class
       }
       else if(opc== 3){
       //Print all data in list
       }
      else if(opc== 4){
       //free memory and exit
       }
}
```

You can create more functions if you need it, for example menu() if you decide to do it in the same way as the example above, but you can NOT change any of the specifications or code already written.

All the classes must be implemented and they have to be used in the main().

The output screen should look like that:

```
Enter an option:
        (1) Introduce First mail
        (2) Introduce Priority mail
        (3) Print all mail information
        (4) Exit
1
Addressee:
Name :? John Smith
Address:? Coloma 612
City:? Sausalito
ZIP Code:? 94940

Sender:
Name :? Sarah Connor
Address:? Miller Av 503
City:? Mill Valley
ZIP Code:? 94941

Enter an option:
        (1) Introduce First mail
        (2) Introduce Priority mail
        (3) Print all mail information
        (4) Exit
2
urgent (1/0):? 1
Weight:?
3.2
Zone (national/ international):?
national
Addressee:
Name :? Clint East
Address:? seaver Dr. 39
City:? San rafael
ZIP Code:? 94913

Sender:
Name :? Paquita Gonzalez
Address:? Camino Alto 3
City:? Palo alto
ZIP Code:? 35009

Enter an option:
        (1) Introduce First mail
        (2) Introduce Priority mail
        (3) Print all mail information
        (4) Exit
3
Mail nr: 0
Addressee:
Name : John Smith
Address: Coloma 612
City: Sausalito
```

```
ZIP Code: 94940
Sender:
Name : Sarah Connor
Address: Miller Av 503
City: Mill Valley
ZIP Code: 94941
Postage: 0.48

Mail nr: 1
Addressee:
Name : Clint East
Address: seaver Dr. 39
City: San rafael
ZIP Code: 94913
Sender:
Name : Paquita Gonzalez
Address: Camino Alto 3
City: Palo alto
ZIP Code: 35009
Postage: 32

Enter an option:
        (1) Introduce First mail
        (2) Introduce Priority mail
        (3) Print all mail information
        (4) Exit
4
Program ended with exit code: 0
```

Points:
Option 1 (+ Mail): 4
Option 2 (+ Priority Mail): 5
Option 3: 3
Option 4: 4
main() plus extra functions if needed: 4

Hint: If needed look for info about cin.clear() and cin.ignore().

PART II. (5 points)
Deliverables: <u>One</u> file should be submitted.

Select **<u>one</u>** of the following topics and write about it. Please, express it in your own words. No more than a page.

1. Discuss the concept of Object-Oriented Programming. What are the components, elements and idea behind this methodology? How are objects, inheritance, encapsulation, re-use and other OOP features used in C++?

2. What is recursion in C++? Why is it used? How does it differ from looping or iteration? Is there a reason you would want to use it instead of a loop? Try to provide an example for when recursion can be used effectively. What happens if you don't use it correctly?
3. What are common programming problems associated with the use of Pointer variables? How are pointers used in C++? Why are they used? Provide an example of how to use pointers in C++.
4. What is a linked list and how is it implemented in C++. What are some common uses of it? Why would you want to use a linked list instead of an array? What benefits does it provide over using an array?
5. Pick an Object-Oriented or C++ topic of your choice and write an essay on it. You select the topic as long as it's relevant to OOP in C++. This is a good opportunity for you to do some research and learn about some topics that you might not be familiar with.