NATIONAL UNIVERSITY OF COMPUTER & EMERGING SCIENCES ISLAMABAD

Object Oriented Programming (CS 217)

Spring 2020 ASSIGNMENT # 3

Due Date: March 6, 2020 (5:00 PM)

Instructions:

- *Make sure that you read and understand each and every instruction. If you have any questions or comments you are encouraged to discuss with your colleagues and instructors on Piazza (https://piazza.com/nu.edu.pk/spring2020/cs217/home).*
- *Create each problem solution in three separate files (ClassName.h, ClassName.cpp and main file for each question as:* ***Q1 as 'q1.cpp', Q2 as 'q2.cpp' and Q3 as 'q3.cpp'.*** *Specific instructions are given with each question.*
- *In main file of each question (e.g. q1.cpp, q2.cpp etc.) you have to implement the code to test each functionality*
- *Combine all your work in one .zip file.*
- *Name the .zip file as ROLL-NUM SECTION.zip (e.g. 19i-0001 B.zip).*
- *Submit the .zip file on Google Classroom within the deadline.*
- *Start early otherwise you will struggle with the assignment.*
- *You must follow the submission instructions to the letter, as failing to do so will get you a zero in the assignment.*
- ***All the submitted evaluation instruments (quizzes, assignments, lab work, exams, and the project) will be checked for plagiarism. If found plagiarized, both the involved parties will be marked***

Q 1: **Vehicle Class –** A class called Vehicle is required by a programmer who is writing software for a car dealer. An object of the class Vehicle will consist of a registration number, the make of the vehicle, the year of manufacture and the current financial value of the vehicle. The first three of these will need to be set only at the time an object is created. The current value will also be set at the time of creation, but may need to be changed during the vehicle's lifetime. You will need to write three files (Vehicle.h, Vehicle.cpp and Q1.cpp)

Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

```
class Vehicle{
  private:
    // think about the private data members...
  public:
    // provide definitions of following functions...
```

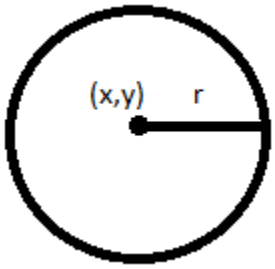
```
    Vehicle();// default constructor
    Vehicle(char *str);
    Vehicle(double);
    Vehicle(const Vehicle &);

    //implement mutators for all private data members
    //implement accessors for all private data members

    //you have to implement the following functions
    // think about the parameters required and return type of the following functions
    addVehicle();//adds a new vechile
    ageOfVehicle();//returns age of vehicle on the basis of year passed
    getVehicleDetails();//return detail of vehicle
    getVehicleDetailsAtIndex();//return detail of vehicle stored at certain index
    isMatching();//returns true if passed vehicle matches with it
    returnByMake();//returns the array of vehicles of specific make
    returnByValue();//returns the array of vehicles of specific value
    returnByYear();//returns the array of vehicles of specific year
    vehicleSold();//deletes the specific vehicle once its sold
    ~Vehicle();
};

int main(){
    /you to create N vehicles objects for the car dealer
}
```

Q 2: Circle Class – A circle is identified by its center coordinates and its radius, as shown in the figure below. In the main file create N circles and implement a circle class whose specification is given below. You will need to write three files (Circle.h, Circle.cpp and Q2.cpp)



Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

```
class Circle{
  private:
    // think about the private data members...
  public:
    // provide definitions of following functions...
    Circle();// default constructor
    Circle(int x, int y);
    Circle(int x, int y, int radius);
```

```
    //you have to implement the following functions
    // think about the parameters required and return type of the following functions
    setCenter();//set center of a circle
    setRadius();//set radius of a circle
    getArea();//prints area of a circle
    returnLargestCircle();//return the largest circle from the array of circles
    overlapping();//determines of two circles are overlapping or not
    overlappingCircles();//returns an array of circles overlapping the largest circle
    ~Circle();
};

int main(){
    /you to create N circle objects and give user options to initialize them
}
```

Q 3: Scheduler Class – In order to generate schedule of a project, key information is of tasks/activities to do in that project. You have to implement a class which takes the task information from the user and generate different information related to schedule of the project. You will need to write three files (Scheduler.h, Scheduler.cpp and Q3.cpp). The program should first ask the total number of tasks in the project.

Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

You will have to learn Critical Path Method here: https://www.workamajig.com/blog/critical-path-method

```
struct task{
  int id;
  int dur;
  int s_Time; //start time of each task
  int e_Time; //end time of each task
  int* dep; /*list of predecessors of this task - To simplify we assume that a higher
  number task will depend on a lower number task e.g. T2 can depend on T1 OR T4 can
  depend on T2 but the opposite is not true.*/

};

class Scheduler{
  private:
    // think about the private data members...
  public:
    // provide definitions of following functions...
    Scheduler();// default constructor
    Scheduler(task* ts, int n);//initialized the project with n tasks

    //you have to implement the following functions
    // think about the parameters required and return type of the following functions

    setTaskDuration();//change task duration of all tasks
```

```
    set_nth_TaskDuration();//change duration of a specific task
    printTaskDependencyList();//print dependencies of a specific task
    completionTime();//print completion time of the project
    printCriticalTasks();/*returns array of critical tasks and displays them – sum of
    their duration should be equal to project completion time*/

    ~Scheduler();//destructor
};
```

Q 4: Implementation of Integer Class – Your goal is to implement "Integer" class. You will need to write three files (Integer.h, Integer.cpp and Q4.cpp). Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

```
class Integer{
  // think about the private data members...
  public:
    //include all the necessary checks before performing the operations in the
    functions
    Integer();// a default constructor
    Integer(int);// a parametrized constructor
    Integer(String); // a parametrized constructor
    void set(int);//set value
    int get()const;//get value at (i,j)
    int bitCount(); //Returns the number of one-bits in the 2's complement binary
    int compareTo(Integer); //Compares two Integer objects numerically.
    double doubleValue(); //Returns the value of this Integer as a double.
    float floatValue(); //Returns the value of this Integer as a float.
    Integer plus(const Integer&); //adds two Integers and return the result
    Integer minus(const Integer&); // subtracts two Integers and return the result
    Integer multiple(const Integer&); //multiplies two Integers and return the result
    Integer divide(const Integer&); //divides two Integers and return the result
    static int numberOfLeadingZeros(int i); /*Returns the number of zero bits
    preceding the highest-order ("leftmost") one-bit in the two's complement binary
    representation of the specified int value.*/
    static int numberOfTrailingZeros(int i); /*Returns the number of zero bits
    following the lowest-order ("rightmost") one-bit in the two's complement binary
    representation of the specified int value.*/
    static String toBinaryString(int i); //Returns string representation of i
    static String toHexString(int i); //Returns string representation of i in base16
    static String toOctString(int i); //Returns string representation of i in base 8
};
```

Q 5: Implementation of String Class – Implementation of String Class Your goal is to implement a generic "String" class using cstring, i.e. you will need to write three files (string.h, string.cpp and Q5.cpp). Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

```
class String{
```

```
  private:
    // think about the private data members...
  public:
    // provide definitions of following functions...
    String();// default constructor
    String(char *str);// initializes the string with constant cstring
    String(const String &);// copy constructor
    String(int x);// initializes a string of pre-defined size
    char getAt(int i);// returns the character at index [x]
    void setAt(int i, char c);// set the character at index [x]
    String substr(int pos, int len);// returns a substring of length len from 'pos'
    String substr(int pos);// returns substring from the given position to the end.
    void append(char a);// append a char at the end of string
    void append(String str );// append a String at the end of string
    void append(char *str );// append a constant c string at the end of string
    int length();// returns the length of string
    char * tocstring();// converts a String to c-string
    void display();// displays the string ..
    bool isEmpty();// returns true if string is empty..
    void copy(const String&);// Copy one string to another ...
    void copy(const char *);// copy cstring to String...
    int find(char);// returns the index of character being searched.
    bool equal(String);// should return true if both strings are same
    int stoi();// function for converting a string to integer.
    ~String();// destructor...
};
```

Q 6: Implementation of True Dynamic Array Class – Your goal is to implement a generic "TrueDynamicArray" class. You will need to write three files (TrueDynamicArray.h, TrueDynamicArray.cpp and Q6.cpp). Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

```
struct node{
  int value;
  node* next;
};

class TrueDynamicArray{
  private:
    // think about the private data members...
  public:
    // provide definitions of following functions...
    TrueDynamicArray();// a default constructor
    TrueDynamicArray (int size);// a parametrized constructor initializing an Array
    TrueDynamicArray (int *arr, int size);// initializes the Array with an existing
    TrueDynamicArray (const TrueDynamicArray &);// copy constructor
    int getAt(int i);// returns the integer at index [i]
    void setAt(int i, int val);// set the value at index [i]
    TrueDynamicArray subArr(int pos, int siz);// returns subArray of 'siz' from 'pos'
    TrueDynamicArray subArr(int pos);// returns a sub-Array from 'pos' to end
    void push_back(int a);// adds an element to the end of the array
```

```
    int pop_back();// removes and returns the last element of the array
    int insert(int idx, int val);// inserts the value val at idx
    int erase(int idx, int val);// erases the value val at idx
    int length();// returns the size of the Array
    void clear();//clears the contents of the Array
    int value(int idx);//returns the value at idx
    void assign(int idx, int val);//assigns the value val to the element at index idx
    void display();// displays the Array
    bool isEmpty();// returns true if the Array is empty
    bool equal(TrueDynamicArray);// should return true if both Arrays are same
    int sort();// sorts the Array. Returns true if the array is already sorted
    void reverse():// reverses the contents of the array
    ~TrueDynamicArray();
};
```

Q 7: Implementation of Matrix Class – Your goal is to implement a generic “Matrix" class. You will need to write three files (matrix.h, matrix.cpp and Q7.cpp). Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

```
class Matrix{
  // think about the private data members...
  // the matrix should store real numbers
  public:
    //include all the necessary checks before performing the operations in the
    functions
    Matrix();// a default constructor
    Matrix(int, int);// a parametrized constructor
    Matrix(const Matrix &);// copy constructor
    void set(int i, int j, float val);//set value at (i,j)
    float get(int i, int j)const;//get value at (i,j)
    Matrix& assign(const Matrix &);//assigns (copies) a Matrix. Returns the same
    Matrix add(const Matrix &);//adds two Matrices and returns the result
    Matrix subtract(const Matrix &);//subtracts two Matrices and returns the result
    Matrix multiply(const Matrix &);//multiplies two Matrices and returns the result
    Matrix multiplyElement(const Matrix &);//Elementwise multiplies two Matrices and
    returns the result
    Matrix add(float );//assigns a constant to every element
    Matrix multiply(float);//multiplies every element with a constant
    void input(); // takes input in every element of matrix
    void display(); // prints every element
    ~Matrix();
};
```

Q 8: LudoPlayer – Your goal is to implement a the Ludo game. You will need to write three files (LudoPlayer.h, LudoPlayer.cpp and Q8.cpp). When game begins ask how many players the user wants to simulate, assign different colors to each user or ask his/her preference. By default all tokens will be at position 0 and depending on the dice roll will move to next position. A token reaches the destination when it has crossed all positions on the board.

Your implemented class must fully provide the definitions of following class (interface) functions. Please also write down the test code to drive your class implementation. Please note that we will be running your code against our test code and any segmentation faults or incorrect result will result in loss of marks.

```
class LudoPlayer{
  // think about the private data members...
  // the matrix should store real numbers
  public:
    LudoPlayer();// a default constructor, to initialize position of each token
    LudoPlayer();/* a parametrized constructor (color chosen by the player) – use
    integers for different colors*/

    //you have to implement the following functions
    // think about the parameters required and return type of the following functions

    movePlayer();
    rollDice();
    checkPosition();
    displayActiveToken();
    displayAllTokens();

    ~LudoPlayer();
};

int main(){
    /*You need to simulate the Ludo game here. Ask for the number of players who want
    to play the game. After each turn display the position of each token of player
    playing the game*/
}
```