3/8/2025

Object Oriented Programming

Lab 5

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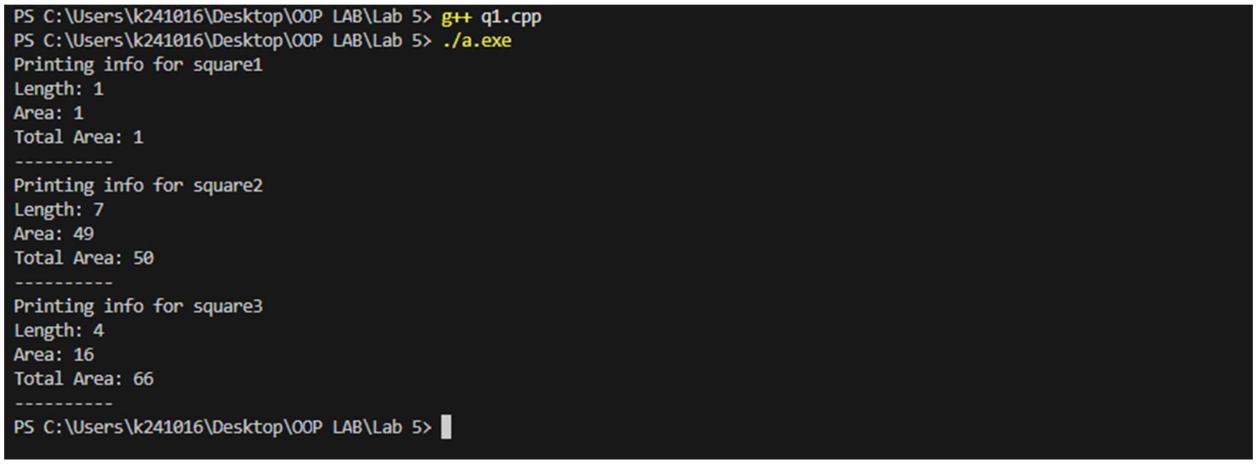
FAST NUCES

Task 1

Source Code:

```cpp
/*
Task-01:
Create a class called Square with the following attributes:
• sideLength – float variable
• area – float variable
• allareas – static float variable
Create the following methods for your class:
• Constructors (default and parameterized (only takes sideLength as input))
• Function to calculate area, the calculated area should always be added to the
allareas
variable each time an area is calculated. (assume it’s called only once for each
object)
• Getters and Setters for all variables
In your main functions create 3 Squares with different sideLength. Call the area
method for each of
those Square objects. After each time the area method is called, call that
square’s getters for area and
allareas to display the updated values.
*/

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

class Square{
    float sideLength, area;
    static float allAreas;

    public:
    //constructor
    Square(float sideLength=0){
        this->sideLength=sideLength;
        area=0;
        if (sideLength!=0){
            calculateArea();
        }
    }
    //destructor
    ~Square(){
        allAreas-=area;
    }
    //Setter
    void setSideLength(float Length){
        sideLength=Length;
        if (area==0){
            calculateArea();
        }
        else{
            allAreas-=area;
            area=0;
            calculateArea();
        }
    }
    void setArea(){
        calculateArea();
    }
    //Getter
    float getSideLength(){
        return sideLength;
    }
    float getArea(){
        return area;
    }
    float getAllAreas(){
        return allAreas;
    }
    //Method
    void calculateArea(){
        if (area==0){ //check if area is being calculated for the first time
            area = sideLength*sideLength;
            allAreas+=area;
        }
    }
};

float Square::allAreas=0;

int main(){
    Square squares[3];
    for (int i=0; i<3; i++){
        squares[i].setSideLength(rand()%10);
        squares[i].calculateArea();
        cout<<"Printing info for square"<<i+1<<endl;
        cout<<"Length: "<<squares[i].getSideLength()<<endl;
        cout<<"Area: "<<squares[i].getArea()<<endl;
        cout<<"Total Area: "<<squares[i].getAllAreas()<<endl;
        cout<<"----------\n";
    }
}
```

Screen Shot:



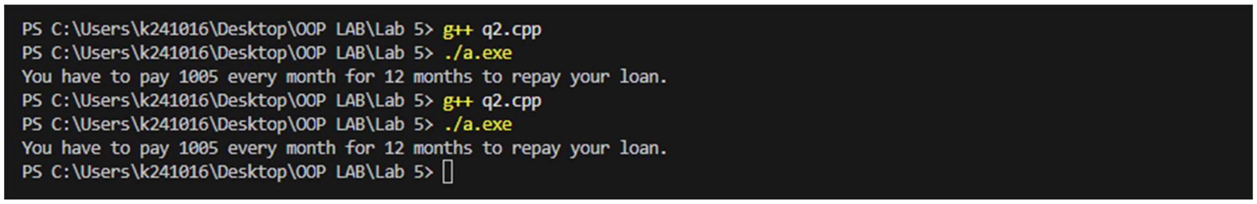
```
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> g++ q1.cpp
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> ./a.exe
Printing info for square1
Length: 1
Area: 1
Total Area: 1
----------
Printing info for square2
Length: 7
Area: 49
Total Area: 50
----------
Printing info for square3
Length: 4
Area: 16
Total Area: 66
----------
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5>
```

Source Code:

```
/*
Task-02:
Create a class called LoanHelper, which helps the user calculate their loan
payments. The class
should have a variable that stores interest rate for the loan as a user defined
constant value. Aside
from the that, it also stores the amount for the loan taken and amount of months
that the user will
repay the loan in. The loan repayment should be calculated on a monthly basis,
and the interest rate
should be applied over the monthly return amount. The output should be something
like:
"You have to pay 999 every month for 12 monthsto repay your loan"
Note: first divide loan amount by number of months, then apply the interest rate
on it. Interest rate
should be a value between 0-0.5%
*/

#include <iostream>
using namespace std;

class LoanHelper{
    float interest_rate;
    float amount_of_loan, amount_of_months;

    public:
    //Constructor
    LoanHelper(float InterestRate=0, float LoanAmount=0, float Months=0){

    }
    //Setter
    void setInterest(float InterestRate){
        if (InterestRate>=0&&InterestRate<=0.5){
            interest_rate=InterestRate;
        }
        else{
            cout<<"ERROR! Interest Rate should be 0-0.5.\n";
        }
    }
    void setLoanAmount(float LoanAmount){
```

```cpp
        if (LoanAmount<0){
            cout<<"ERROR! Loan Amount should be a positive integer.\n";
        }
        else{
            amount_of_loan=LoanAmount;
        }
    }
    void setMonths(float Months){
        if ((Months==0&&amount_of_loan==0)||Months>0){
            amount_of_months=Months;
        }
        else{
            cout<<"Error! Months should be greater than 0\n";
        }
    }
    //Methods
    void calculateLoan(){
        if (amount_of_loan==0){
            cout<<"You have repaid all your loan.\n";
        }
        else{
            if (amount_of_months==0){
                cout <<"MONTHS should be greater than 0.\n";
            }
            else {
                cout <<"You have to pay 
"<<(amount_of_loan*(1+(interest_rate/100)))/amount_of_months<<" every month for 
"<< amount_of_months<<" months to repay your loan.\n";
            }
        }
    }
};

int main(){
    LoanHelper l1;
    l1.setInterest(0.5);
    l1.setLoanAmount(12000);
    l1.setMonths(12);
    l1.calculateLoan();
}
```

Screen Shot:



```
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> g++ q2.cpp
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> ./a.exe
You have to pay 1005 every month for 12 months to repay your loan.
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> g++ q2.cpp
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> ./a.exe
You have to pay 1005 every month for 12 months to repay your loan.
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> 
```

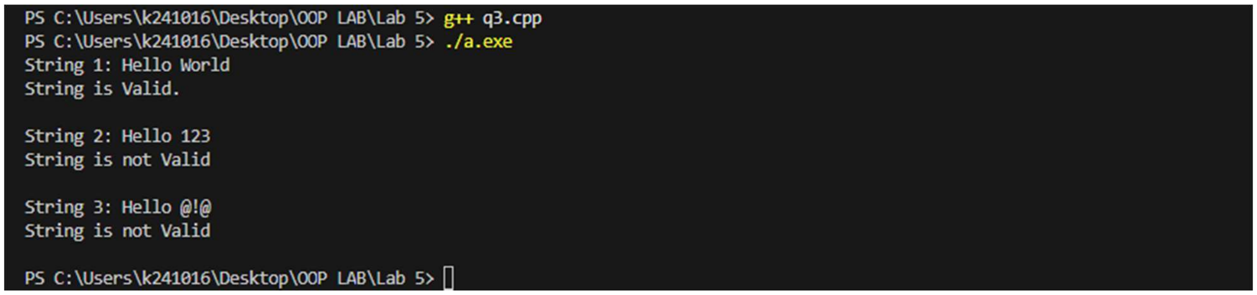
Task 3

Source Code:

```
/*
Create a class called ValidateString. The purpose of this class will be check if
the given characters in a
string are alphabet only. Numbers and symbols will mean that the string is
invalid. By using a
parameterized constructor, create multiple objects for your class that accept
different strings. Create a
constant function that checks whether the string variable is valid or not.
What happens if you do not make your function constant? Add a comment right above
your function
explaining why we make a function constant.
*/

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

class ValidateString{
    string sentence;

    public:
    //Constructor
    ValidateString(string sentence=""){
        this->sentence=sentence;
    }
    //Setter
    void setString(string String){
        sentence=String;
    }
    //Getter
    string getString(){
        return sentence;
    }
    //const make sure that the function don't change the original string
    const bool validate_string(){
        if (sentence==""){
            cout << "Set a string first"; return false;
        }
        for (int i=0; i<sentence.length(); i++){
```

```cpp
            if
((sentence.at(i)>='a'&&sentence.at(i)<='z')||(sentence.at(i)>='A'&&sentence.at(i)
<='Z')||(sentence.at(i)==' ')){}
            else{
                return false;
            }
        }
        return true;
    }
};

int main(){
    ValidateString *Strings=new ValidateString[3];
    Strings[0].setString("Hello World");
    Strings[1].setString("Hello 123");
    Strings[2].setString("Hello @!@");
    for (int i=0; i<3; i++){
        cout << "String "<< i+1<<": "<<Strings[i].getString()<<endl;
        if (Strings[i].validate_string()){
            cout<<"String is Valid.\n\n";
        }
        else{
            cout << "String is not Valid\n\n";
        }
    }
}
```

Screen Shot:



```
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> g++ q3.cpp
PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> ./a.exe
String 1: Hello World
String is Valid.

String 2: Hello 123
String is not Valid

String 3: Hello @!@
String is not Valid

PS C:\Users\k241016\Desktop\OOP LAB\Lab 5> 
```

Task 4

Source Code:

/*

Task-04:

Create a BankAccount class. Which contains following details and functionalties:

Attributes: The BankAccount class has three private member variables: accountNumber, accountHolderName, and balance.

Create Constructor: The class has a constructor that takes parameters to initialize the account details (accountNumber, accountHolderName, and balance).

Create following Member Functions:

• deposit(double amount): Adds the specified amount to the account balance.

• withdraw(double amount): Subtracts the specified amount from the account balance, if sufficient funds are available.

• display(): Displays the account details including the account number, account holder name, and balance.

In the main() function, create an array accounts of BankAccount objects. The array contains three elements, each representing a different bank account.

Initialize Each BankAccount object with specific account details such as account number, holder name, and initial balance.

Perform following operations:

• Iterate through each account in the accounts array.

• For each account, display the account details using the display() function.

• Perform Two Transactions:

• Deposits 500.0 rupees into the account.

• Withdraws 200.0 rupees from the account.

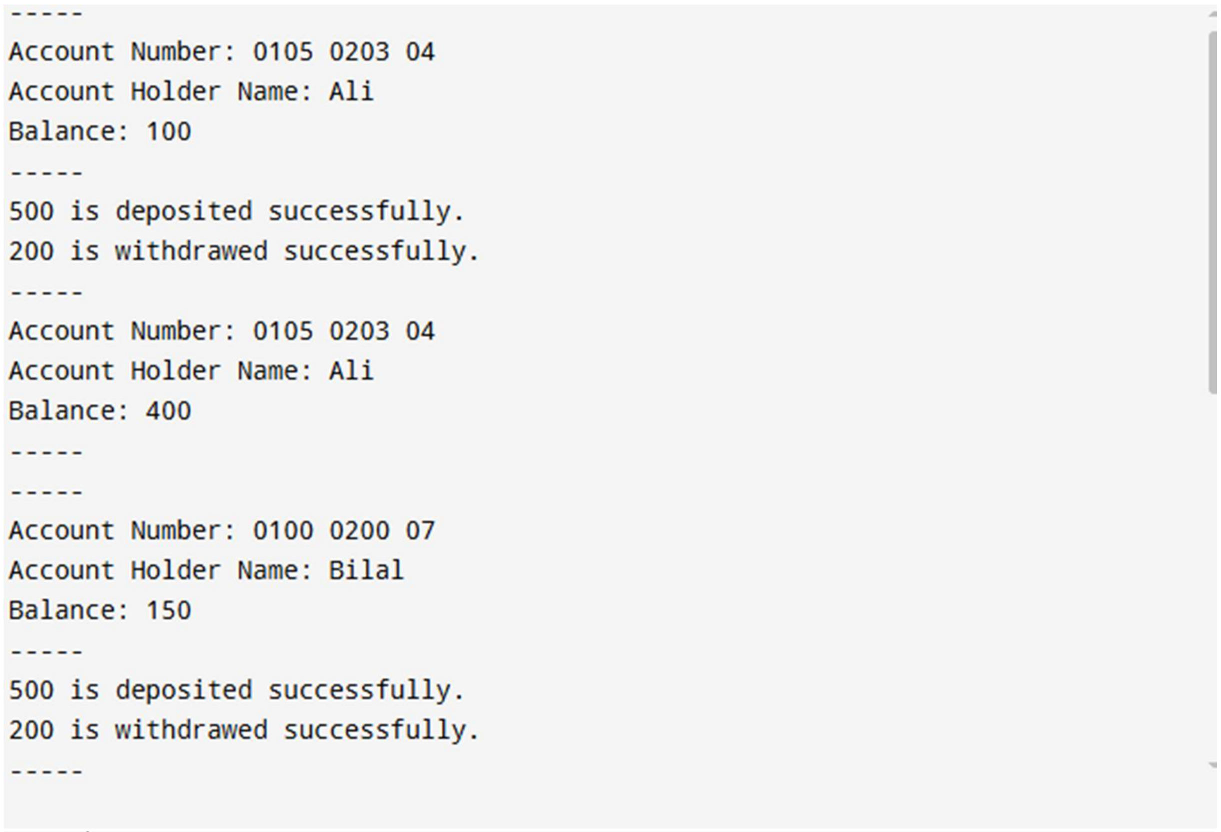
• After each transaction, display the updated account details, including the new balance.

*/

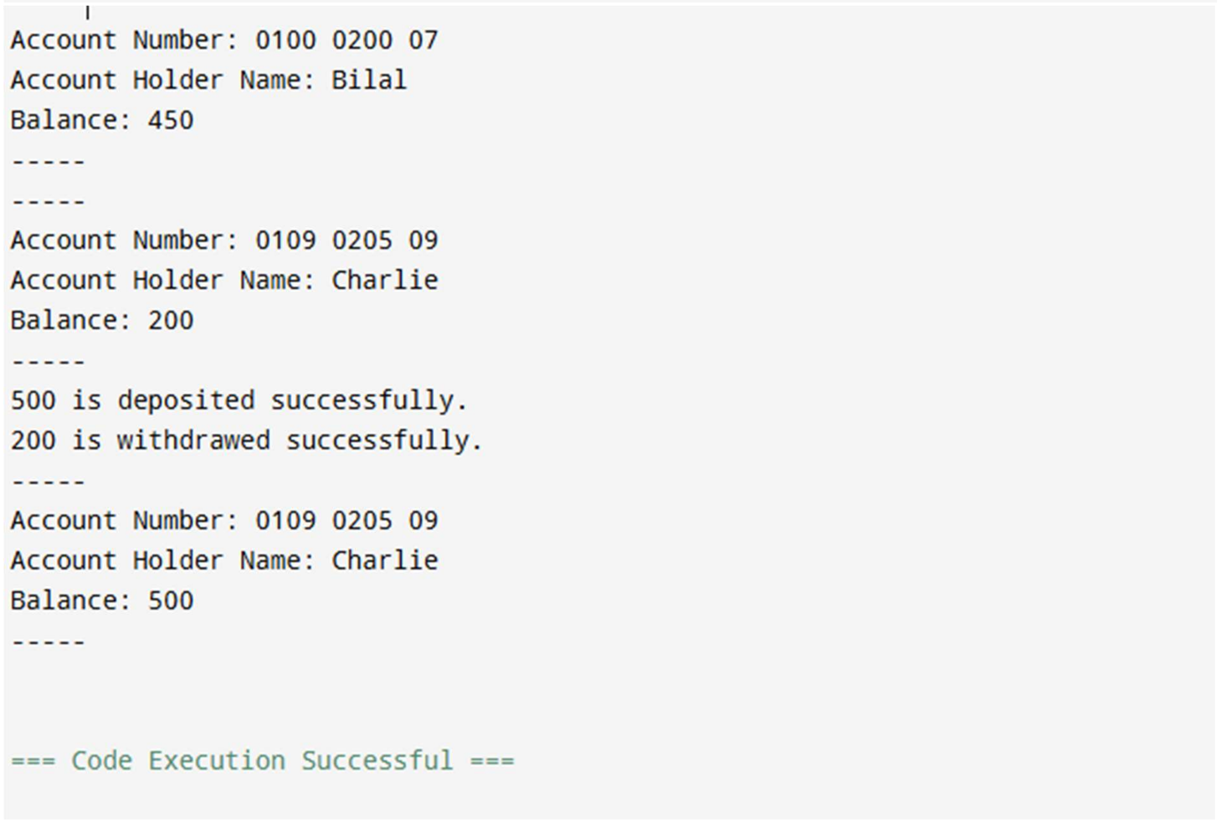
```
#include <iostream>
using namespace std;

class BankAccount{
  string accountNumber, accountHolderName;
  double balance;
  public:
  BankAccount(string AccountNumber="", string AccountHolderName="", double Balance){
    accountHolderName=AccountHolderName;
    accountNumber=AccountNumber;
    balance=Balance;
  }
  void deposit(const double amount){
    balance+=amount;
    cout<<amount<<" is deposited successfully.\n";
  }
  bool withdraw(const double amount){
    if (amount>balance){
      cout<<"Transaction failed! Sufficient balance not available.\n";
      return false;
    }
    balance-=amount;
    cout<<amount<<"is withdrawed successfully.\n";
    return true;
  }
  void display() const{
    cout<<"-----\n";
    cout<<"Account Number: "<<accountNumber<<endl;
```

```
        cout<<"Account Holder Name: "<<accountHolderName<<endl;AC
        cout<<"Balance: "<<balance<<endl;
        cout<<"-----\n";
    }
};
int main() {
    BankAccount bop[]={BankAccount("0105 0203 04", "Ali", 100),
        BankAccount("0100 0200 07", "Bilal", 150),
        BankAccount("0109 0205 09", "Charlie", 200)
    };
    for (int i=0; i<3; i++){
        bop[i].display();
        bop[i].deposit(500.0);
        bop[i].withdraw(200.0);
        bop[i].display();
    }
}
```

Screen Shot:



```
-----
Account Number: 0105 0203 04
Account Holder Name: Ali
Balance: 100
-----
500 is deposited successfully.
200 is withdrawed successfully.
-----
Account Number: 0105 0203 04
Account Holder Name: Ali
Balance: 400
-----
-----
Account Number: 0100 0200 07
Account Holder Name: Bilal
Balance: 150
-----
500 is deposited successfully.
200 is withdrawed successfully.
-----
```



```
Account Number: 0100 0200 07
Account Holder Name: Bilal
Balance: 450
-----
-----
Account Number: 0109 0205 09
Account Holder Name: Charlie
Balance: 200
-----
500 is deposited successfully.
200 is withdrawed successfully.
-----
Account Number: 0109 0205 09
Account Holder Name: Charlie
Balance: 500
-----


=== Code Execution Successful ===
```

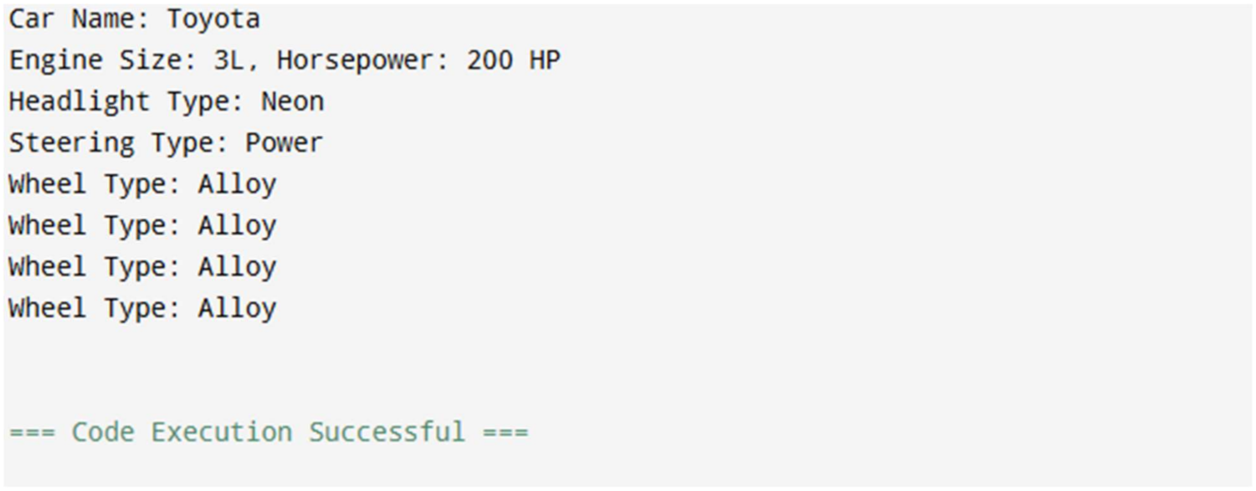
Task 5

Source Code:

```
/*
Keeping in mind our previous car example, write a class that represents a car, and useaggregation and
composition to combine different components like engine, wheels, headlights and steering to create the
car object.

Hint: create the individual classes firstbeforeperforming the composition. Remember
thatfor aggregation, you will need pointers! You�ll be needing constructors and setters to
set these values in case of aggregation. Same hint applies to other questions.
*/

#include <iostream>
using namespace std;

class Engine
{
   int size;
   int horsepower;

public:
   Engine(int Size = 0, int HP = 0)
   {
      size = Size;
      horsepower = HP;
   }
```

```
    void displayEngineInfo()
    {
        cout << "Engine Size: " << size << "L, Horsepower: " << horsepower << " HP" << endl;
    }
};

class Wheel
{
    string type;

public:
    Wheel(string Type = "Alloy")
    {
        type = Type;
    }

    void displayWheelInfo()
    {
        cout << "Wheel Type: " << type << endl;
    }
};

class Headlight
{
    string type;

public:
    Headlight(string Type = "LED")
    {
        type = Type;
    }

    void displayHeadlightInfo()
    {
        cout << "Headlight Type: " << type << endl;
    }
};

class Steering
{
    string type;

public:
    Steering(string Type = "Power")
    {
        type = Type;
    }

    void displaySteeringInfo()
    {
        cout << "Steering Type: " << type << endl;
    }
};

class Car
{
    Engine engine;       // Composition
    Headlight headlight; // Composition
    Steering steering;   // Composition
    Wheel *wheels[4];    // Aggregation
    string name;

public:
    Car()
    {
        engine = Engine();
        headlight = Headlight();
        steering = Steering();
        name = "Car";
        for (int i = 0; i < 4; i++)
        {
            wheels[i] = nullptr;
        }
    }

    Car(string Name, Wheel *Wheels[4], Engine engine, Headlight headlight, Steering steering) :
name(Name), engine(engine), headlight(headlight), steering(steering)
    {
        for (int i = 0; i < 4; i++)
        {
            this->wheels[i] = Wheels[i];
        }
    }

    void displayCarInfo()
    {
        cout << "Car Name: " << name << endl;
        engine.displayEngineInfo();

        headlight.displayHeadlightInfo();

        steering.displaySteeringInfo();

        for (int i = 0; i < 4; i++)

        {

            if (wheels[i] != nullptr)

            {

                wheels[i]->displayWheelInfo();

            }

            else

            {

                cout << "Wheels not set!" << endl;

            }

        }

    }

};


int main()

{

    Wheel bbs_1("Alloy");

    Wheel bbs_2("Alloy");

    Wheel bbs_3("Alloy");

    Wheel bbs_4("Alloy");


    Wheel *carWheels[] = {&bbs_1, &bbs_2, &bbs_3, &bbs_4};


    string carName = "Toyota";

    Car car1(carName, carWheels, Engine(3, 200), Headlight("Neon"), Steering("Power"));
    car1.displayCarInfo();


    return 0;
}
```

Screenshot:



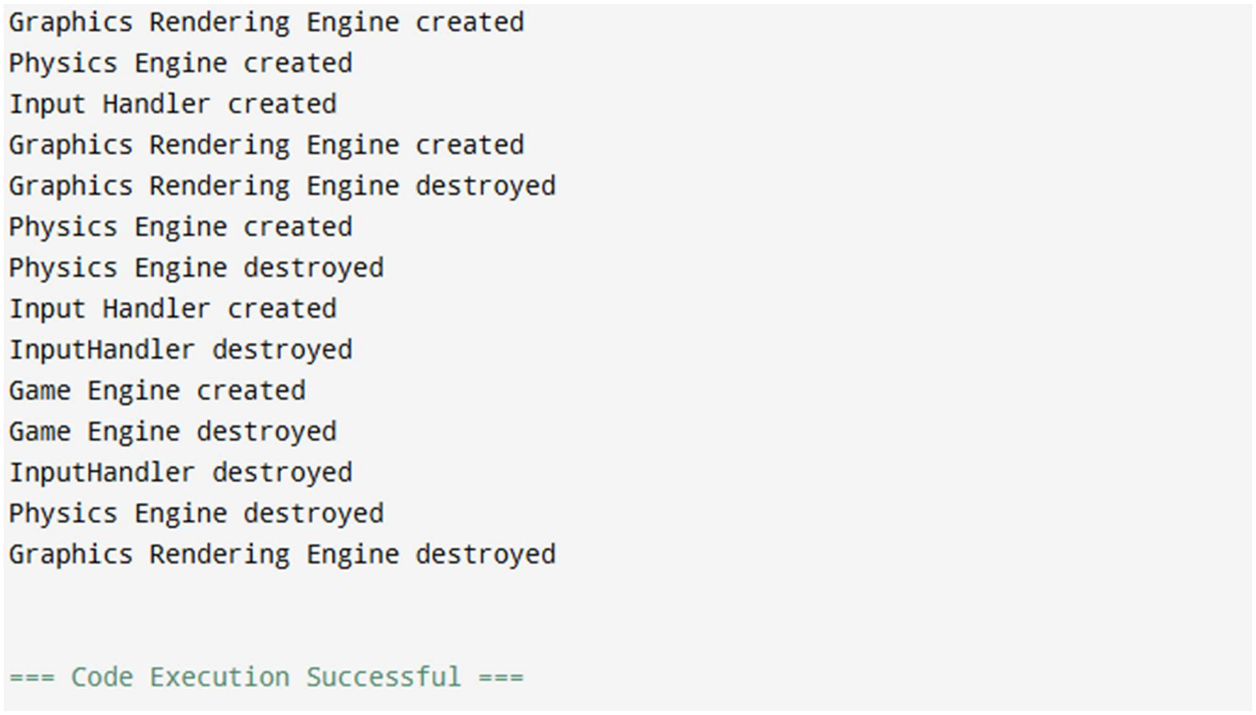
```
Car Name: Toyota
Engine Size: 3L, Horsepower: 200 HP
Headlight Type: Neon
Steering Type: Power
Wheel Type: Alloy
Wheel Type: Alloy
Wheel Type: Alloy
Wheel Type: Alloy


=== Code Execution Successful ===
```

Task 6

Source Code:

```
/*
Keeping in mind our previous car example, write a class that represents a car, and useaggregation and
composition to combine different components like engine, wheels, headlights and steering to create the
car object.

Hint: create the individual classes firstbeforeperforming the composition. Remember
thatfor aggregation, you will need pointers! You'll be needing constructors and setters to
set these values in case of aggregation. Same hint applies to other questions.
*/
#include <iostream>
using namespace std;

class GraphicsRenderingEngine{
  string resolution;
  public:
  GraphicsRenderingEngine(string resolution=""){
    this->resolution=resolution;
    cout<<"Graphics Rendering Engine created\n";
  }
  ~GraphicsRenderingEngine(){
    cout<<"Graphics Rendering Engine destroyed\n";
  }
};

class InputHandler{
  string eventManager;
  public:
  InputHandler(string EventManager=""){
    eventManager=EventManager;
    cout<<"Input Handler created\n";
  }
  ~InputHandler(){
    cout<<"InputHandler destroyed\n";
  }
};

class PhysicsEngine{
  float gravity;
  public:
  PhysicsEngine(float Gravity=0){
    gravity=Gravity;
    cout<<"Physics Engine created\n";
  }
  ~PhysicsEngine(){
    cout<<"Physics Engine destroyed\n";
  }
};

class GameEngine{
  GraphicsRenderingEngine gre;
  PhysicsEngine pe;
  InputHandler ih;
  public:
  GameEngine(string resolution="", string eventManager="", float gravity=0){
    gre=GraphicsRenderingEngine(resolution);

    pe=PhysicsEngine(gravity);

    ih=InputHandler(eventManager);

    cout<<"Game Engine created\n";

  }

  ~GameEngine(){

    cout<<"Game Engine destroyed\n";

  }

};


int main(){

  GameEngine ge("1024x2048", "startGame", 9.812);

}
```

Screen Shot:



```
Graphics Rendering Engine created
Physics Engine created
Input Handler created
Graphics Rendering Engine created
Graphics Rendering Engine destroyed
Physics Engine created
Physics Engine destroyed
Input Handler created
InputHandler destroyed
Game Engine created
Game Engine destroyed
InputHandler destroyed
Physics Engine destroyed
Graphics Rendering Engine destroyed


=== Code Execution Successful ===
```

Source Code:

```
/*
Implement a restaurant ordering system that holds information about the restaurant's menus, menu
items, orders, and payments. Identify the relationship between the five entities mentioned. Keep in
mind the following information as well:
a) Menu Items hold two things: food name and food price.
b) Menu is a class that holds an array of menu items. You can have different functions to add and
remove items, or display the entire menu.
c) Restaurant ordering system has one menu.
d) Any staff member can place an order to the system on behalf of a customer. Theorder class
consists of one or more menu items and a payment.
e) Payment is a class that holds the amount of money that a customer needs to pay.This is
generated when the order is placed.
*/

#include <iostream>
#include <string>

using namespace std;

class MenuItem {
  string name;
  int price;
public:
  MenuItem(string name = "", int price = 0) {
    this->name = name;
```

```
        this->price = price;
    }

    string get_name() const {
        return name;
    }

    int get_price() const {
        return price;
    }

    void update_price(int price) {
        this->price = price;
    }
};

class Menu {
    MenuItem* items;
    int noOfitems;
    int maxitems;
public:
    Menu() {
        items = new MenuItem[50];
        maxitems = 50;
        noOfitems = 0;
    }
    ~Menu() {
        delete[] items;
    }
```

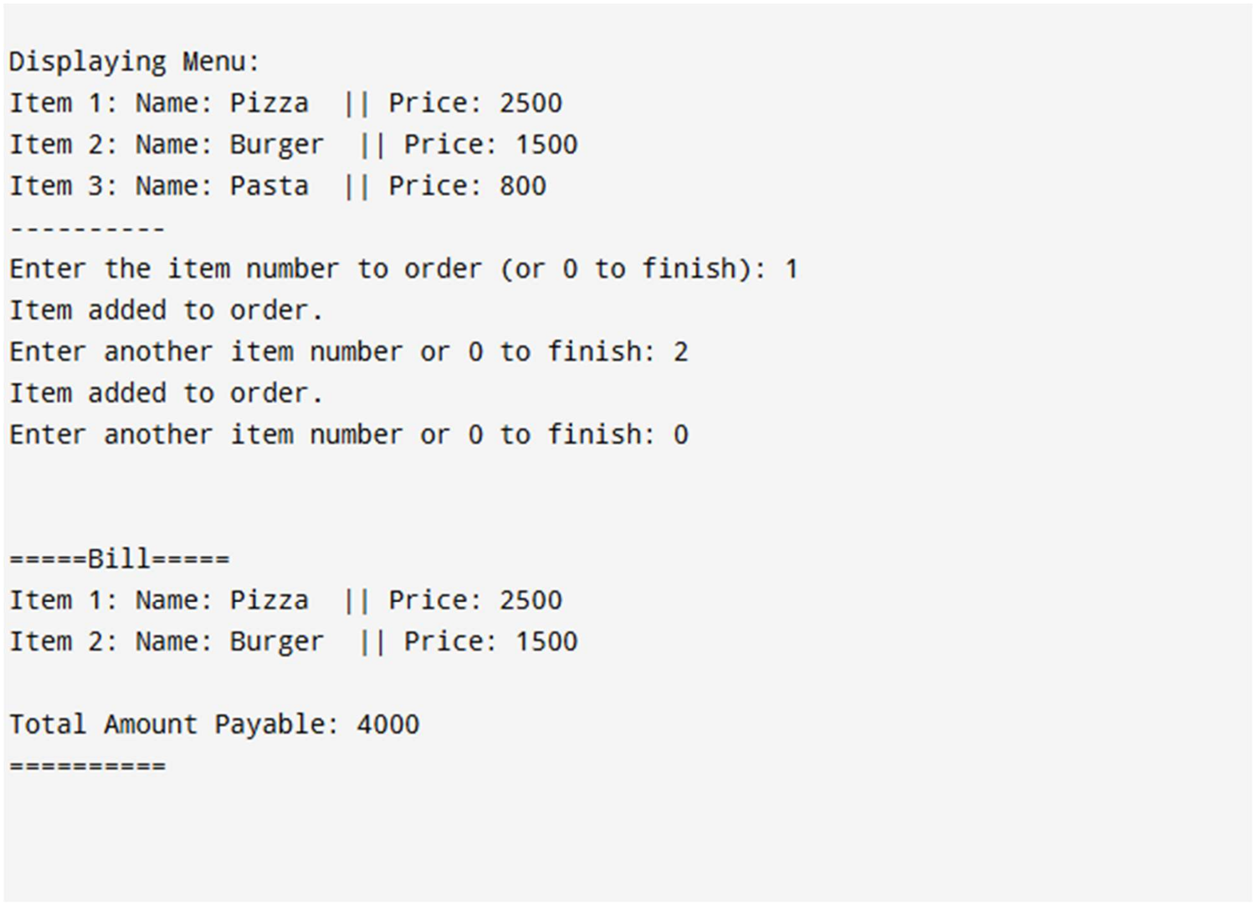
```
MenuItem get_item(int index) const {
   if (index < 1 || index > noOfitems) {
      return MenuItem();
   }
   return items[index - 1];
}
void addItem(const MenuItem& item) {
   if (noOfitems == maxitems) {
      maxitems *= 2;
      MenuItem* temp = new MenuItem[maxitems];
      for (int i = 0; i < noOfitems; i++) {
         temp[i] = items[i];
      }
      delete[] items;
      items = temp;
   }
   items[noOfitems] = item;
   noOfitems++;
}
void removeItem(const string& name) {
   bool found = false;
   for (int i = 0; i < noOfitems; i++) {
      if (items[i].get_name() == name) {
         found = true;
      }
      if (found && i < noOfitems - 1) {
         items[i] = items[i + 1];
      }
   }
```

```
        if (found) {
            noOfitems--;
            cout << "Item removed successfully\n";
        } else {
            cout << "Error! Item not found\n";
        }
    }
    void displayMenu() const {
        cout << "\nDisplaying Menu:\n";
        for (int i = 0; i < noOfitems; i++) {
            cout << "Item " << i + 1 << ": Name: " << items[i].get_name() << "  || Price: " <<
items[i].get_price() << endl;
        }
        cout << "----------\n";
    }
    int get_noOfitems() const {
        return noOfitems;
    }
};

class Payment {
    mutable int bill;  // Declare bill as mutable so it can be modified in const functions
public:
    Payment() : bill(0) {}

    int generate_bill(MenuItem* items, int noOfitems) const {
        bill = 0;  // Now this is allowed because bill is mutable
        cout << "\n\n=====Bill=====\n";
        for (int i = 0; i < noOfitems; i++) {
            cout << "Item " << i + 1 << ": Name: " << items[i].get_name() << "  || Price: " <<
items[i].get_price() << endl;

            bill += items[i].get_price();

        }

        cout << "\nTotal Amount Payable: " << bill << endl;

        cout << "==========\n";

        return bill;

    }

};


class Order {

    Menu* menu;

    MenuItem* items;

    int noOfitems;

    Payment p;


    void addItem(const MenuItem& item) {

        MenuItem* temp = new MenuItem[noOfitems + 1];

        for (int i = 0; i < noOfitems; i++) {

            temp[i] = items[i];

        }

        temp[noOfitems++] = item;

        delete[] items;

        items = temp;

    }


    void placeOrder() const {

        p.generate_bill(items, noOfitems);

    }
```

```
public:
    Order() {
        items = nullptr;
        noOfitems = 0;
    }

    ~Order() {
        delete[] items;
    }

    void OrderFood() {
        int itemIndex;
        menu->displayMenu();
        cout << "Enter the item number to order (or 0 to finish): ";
        while (true) {
            cin >> itemIndex;
            if (itemIndex == 0) break;
            if (itemIndex > 0 && itemIndex <= menu->get_noOfitems()) {
                addItem(menu->get_item(itemIndex));
                cout << "Item added to order.\n";
            }
            else {
                cout << "Invalid item number.\n";
            }
            cout << "Enter another item number or 0 to finish: ";
        }
        placeOrder();
    }
    void setMenu(Menu* menu) {
        this->menu = menu;
    }
};

class Restaurant {
    Menu menu;
    Order order;

public:
    void addMenuItem(const MenuItem& item) {
        menu.addItem(item);
    }

    void removeMenuItem(const string& name) {
        menu.removeItem(name);
    }

    void displayMenu() {
        menu.displayMenu();
    }

    void OrderFood() {
        order.setMenu(&menu);
        order.OrderFood();
    }
};
```

```
int main() {
    Restaurant restaurant;
    restaurant.addMenuItem(MenuItem("Pizza", 2500));
    restaurant.addMenuItem(MenuItem("Burger", 1500));
    restaurant.addMenuItem(MenuItem("Pasta", 800));
    restaurant.OrderFood();
}
```

Screen Shot:



```
Displaying Menu:
Item 1: Name: Pizza  || Price: 2500
Item 2: Name: Burger  || Price: 1500
Item 3: Name: Pasta  || Price: 800
----------
Enter the item number to order (or 0 to finish): 1
Item added to order.
Enter another item number or 0 to finish: 2
Item added to order.
Enter another item number or 0 to finish: 0


=====Bill=====
Item 1: Name: Pizza  || Price: 2500
Item 2: Name: Burger  || Price: 1500

Total Amount Payable: 4000
==========
```