A
PRACTICAL FILE
OF
OBJECT ORIENTED PROGRAMMING SYSTEM

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Task-1

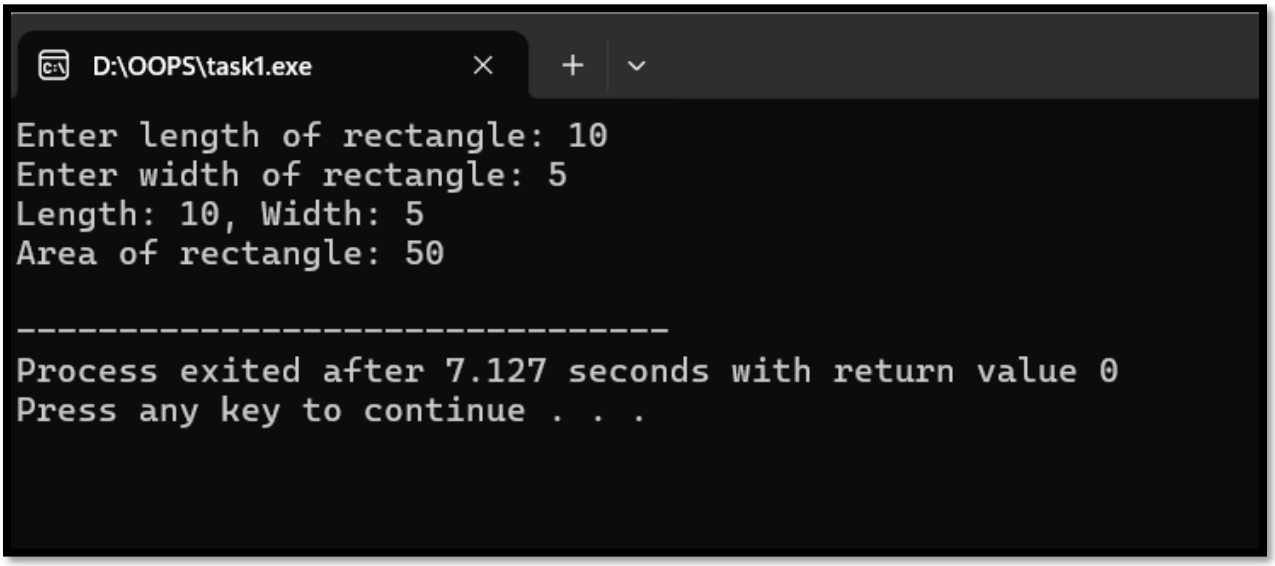
1. INTRODUCTION TO C++

C++ is a powerful, general-purpose programming language developed by Bjarne Stroustrup at Bell Labs in the early 1980s. It originated as an extension of the C programming language, initially known as "C with Classes," and later renamed C++.C++ is widely used in various domains, including operating systems, desktop applications, game development, high-frequency trading systems, and scientific computing.

BASIC STRUCTURE OF C++

```
#include <iostream>
 // Include the iostream header for input/output operations


int main() {
// The main function, where program execution begins
    // This is a single-line comment
    std::cout << "Hello, world!" << std::endl;
 // Output "Hello, world!" to the console
    /*
     * This is a multi-line comment.
     * It explains the purpose of the return statement.
     */
    return 0;
// Indicate successful program execution
}
```

Output of Task-2:



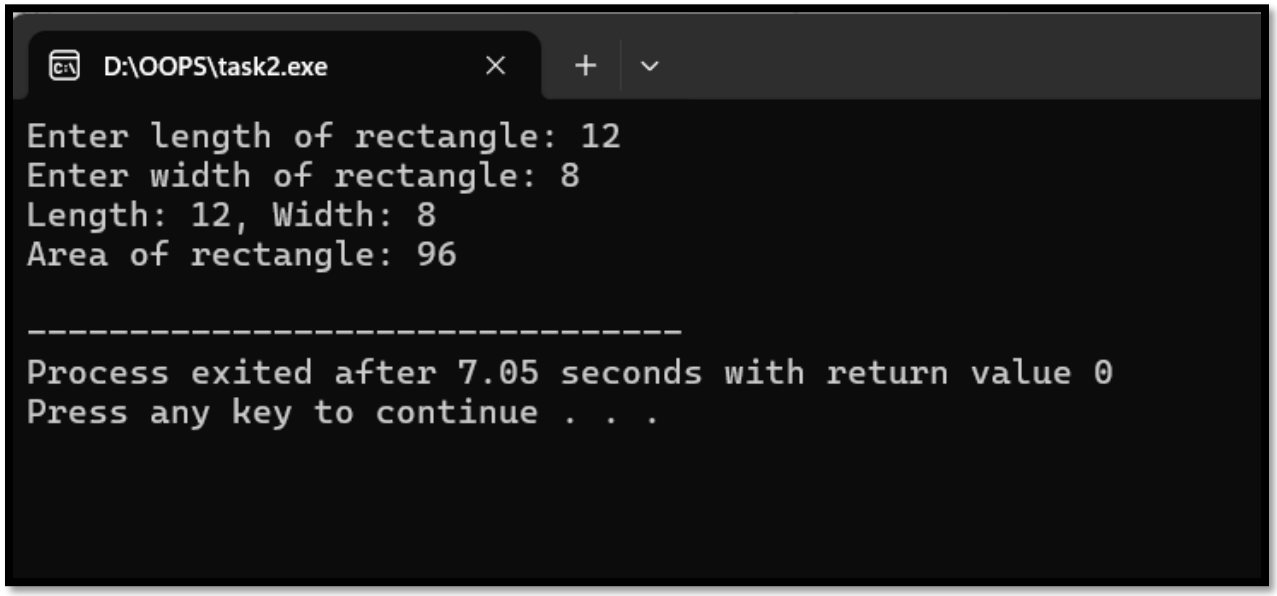
Task-2

2.Write a program that uses a class where member function are defined inside a class.

```
#include <iostream>
using namespace std;
// Define a class with member functions inside the class
class Rectangle {
private:
    double length;
    double width;
public:
    // Member function to set dimensions
    void setDimensions(double l, double w) {
        length = l;
        width = w;
    }
    // Member function to calculate area
    double area() {
        return length * width;
    }
    // Member function to display dimensions
    void display() {
        cout << "Length: " << length << ", Width: " << width << endl;
    }
};
int main() {
    Rectangle rect;
```

```
    double  l, w;
    // Take input from user
    cout << "Enter length of rectangle: ";
    cin >> l;
    cout << "Enter width of rectangle: ";
    cin >> w;
    // Set dimensions
    rect.setDimensions(l, w);
    // Display dimensions and area
    rect.display();
    cout << "Area of rectangle: " << rect.area() << endl;
    return 0;
}
```

Output of Task-3:

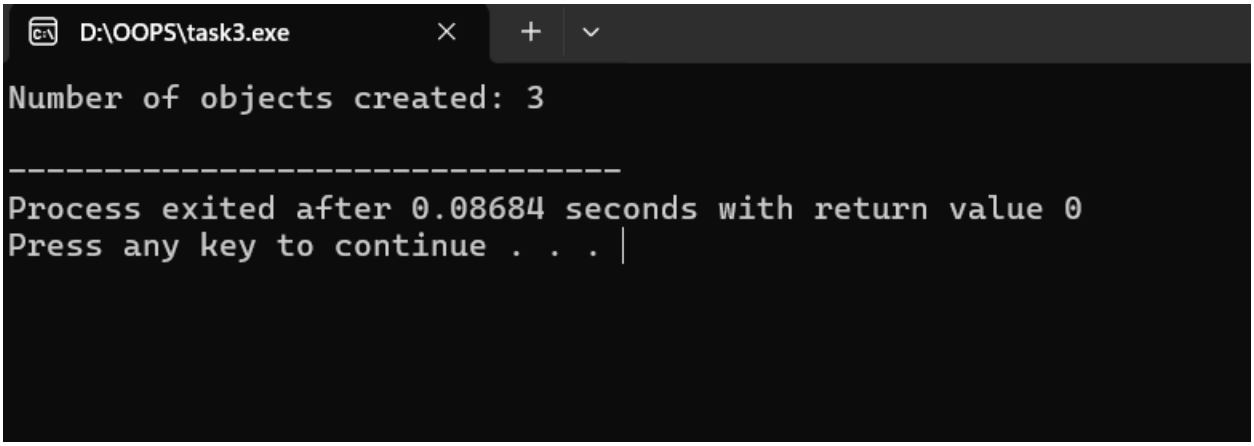


2. Write a program that uses a class where the member function are defined outside a class.

```
#include <iostream>
using namespace std;
// Class declaration
class Rectangle {
private:
    double length;
    double width;
public:
    void setDimensions(double l, double w); // Declaration only
    double area();                  // Declaration only
    void display();                 // Declaration only
};
// Member function definitions outside the class
void Rectangle::setDimensions(double l, double w) {
    length = l;
    width = w;
}
double Rectangle::area() {
    return length * width;
}
void Rectangle::display() {
    cout << "Length: " << length << ", Width: " << width << endl;
}
int main() {
    Rectangle rect;
    double l, w;
```

```
    // Take input from user
    cout << "Enter length of rectangle: ";
    cin >> l;
    cout << "Enter width of rectangle: ";
    cin >> w;
    // Set dimensions
    rect.setDimensions(l, w);
    // Display dimensions and area
    rect.display();
    cout << "Area of rectangle: " << rect.area() << endl;
    return 0;
}
```

Output:


D:\OOPS\task3.exe
Number of objects created: 3

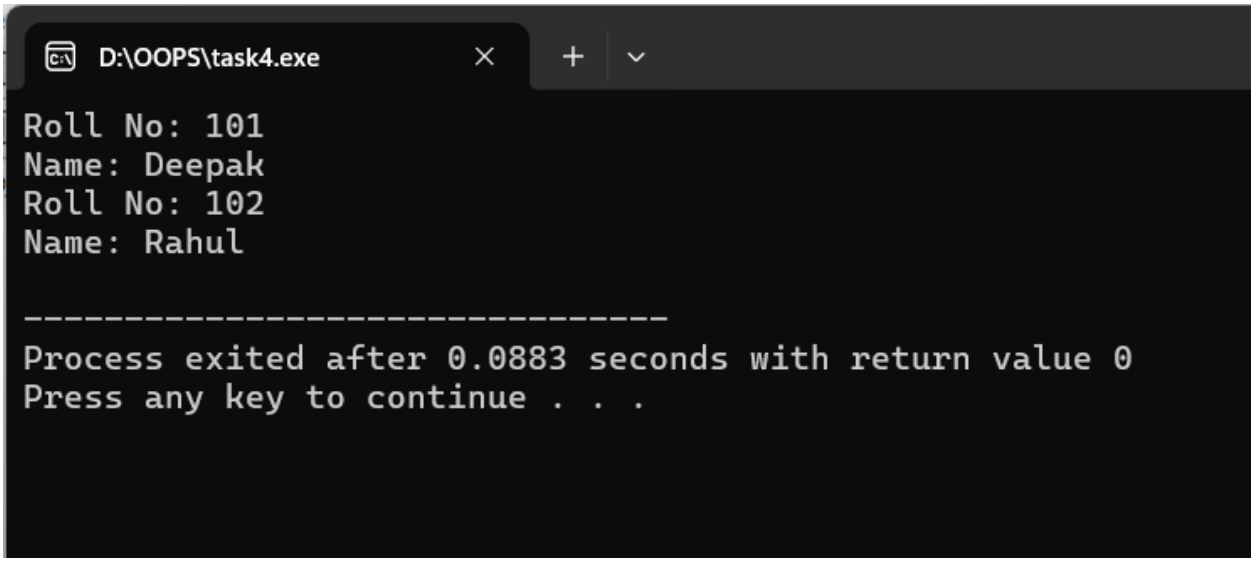
Process exited after 0.08684 seconds with return value 0
Press any key to continue . . .

Task 3: Write a program to demonstrate the use of static data members.

Input:

```
#include <iostream>
using namespace std;
class Counter {
private:
   static int count; // Static data member
public:
   Counter() {
      count++; // Increment count whenever an object is created
   }
     static void showCount() {
      cout << "Number of objects created: " << count << endl;
   }
};

// Initialize static member outside the class
int Counter::count = 0;

int main() {
   Counter c1;
   Counter c2;
   Counter c3;

   // Call static function to display count
   Counter::showCount();
 return 0;
}
```

Output:


D:\OOPS\task4.exe
Roll No: 101
Name: Deepak
Roll No: 102
Name: Rahul

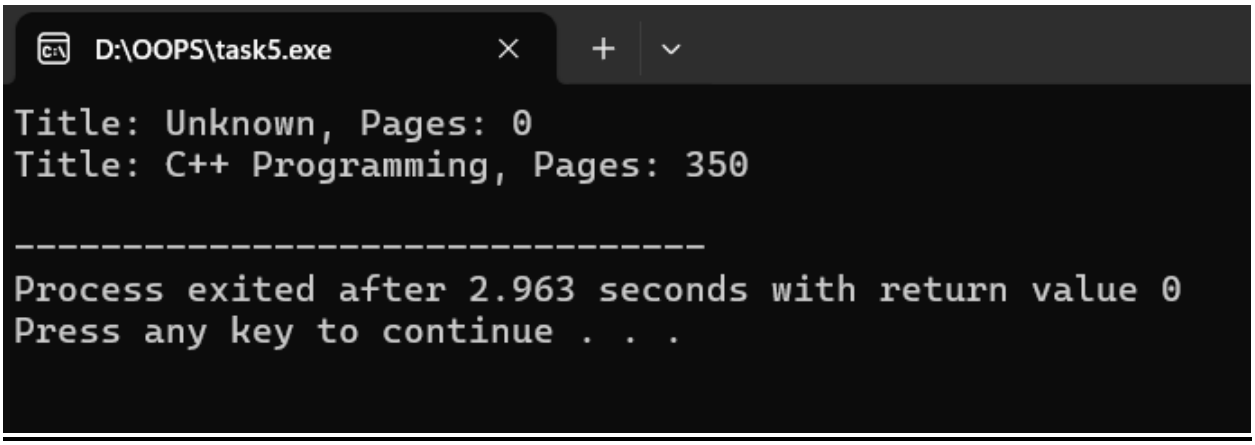
Process exited after 0.0883 seconds with return value 0
Press any key to continue . . .

4. Write a program to demonstrate the use of const data members.

Input:

```
#include <iostream>
using namespace std;
class Student {
    const int rollNo;   // const data member
    string name;

public:
    // Constructor to initialize const data member using initializer list
    Student(int r, string n) : rollNo(r), name(n) {}

    void display() const {
        cout << "Roll No: " << rollNo << endl;
        cout << "Name: " << name << endl;
    }
};

int main() {
    Student s1(101, "Deepak");
    s1.display();

    Student s2(102, "Rahul");
    s2.display();

    return 0;
}
```

Output:


D:\OOPS\task5.exe
Title: Unknown, Pages: 0
Title: C++ Programming, Pages: 350

Process exited after 2.963 seconds with return value 0
Press any key to continue . . .

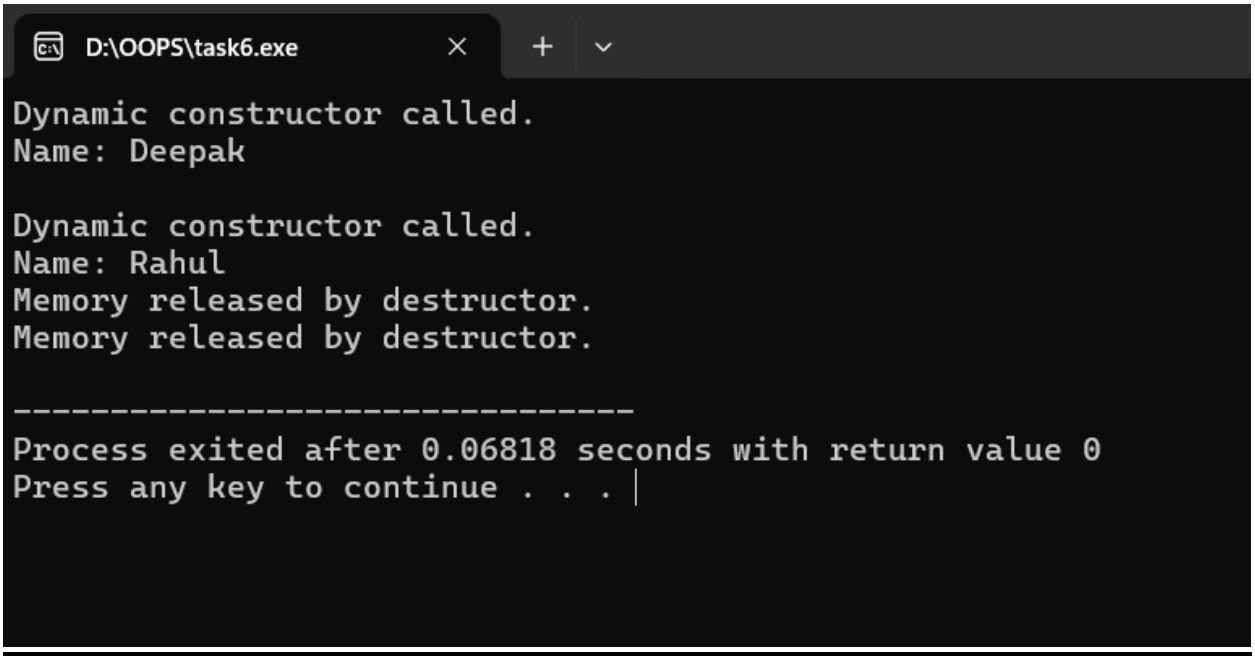
5. Write a program to demonstrate the use of zero argument and parameterized constructors.

Input:

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

class Book {
private:
    string title;
    int pages;

public:
    // Zero-argument constructor
    Book() {
        title = "Unknown";
        pages = 0;
    }

    // Parameterized constructor
    Book(string t, int p) {
        title = t;
        pages = p;
    }

    void display() const {
        cout << "Title: " << title << ", Pages: " << pages << endl;
    }
```

```
};

int main() {
    Book b1; // Calls zero-argument constructor
    Book b2("C++ Programming", 350); // Calls parameterized constructor

    b1.display();
    b2.display();

    return 0;
}
```

Output:


D:\OOPS\task6.exe
Dynamic constructor called.
Name: Deepak
Dynamic constructor called.
Name: Rahul
Memory released by destructor.
Memory released by destructor.

Process exited after 0.06818 seconds with return value 0
Press any key to continue . . .

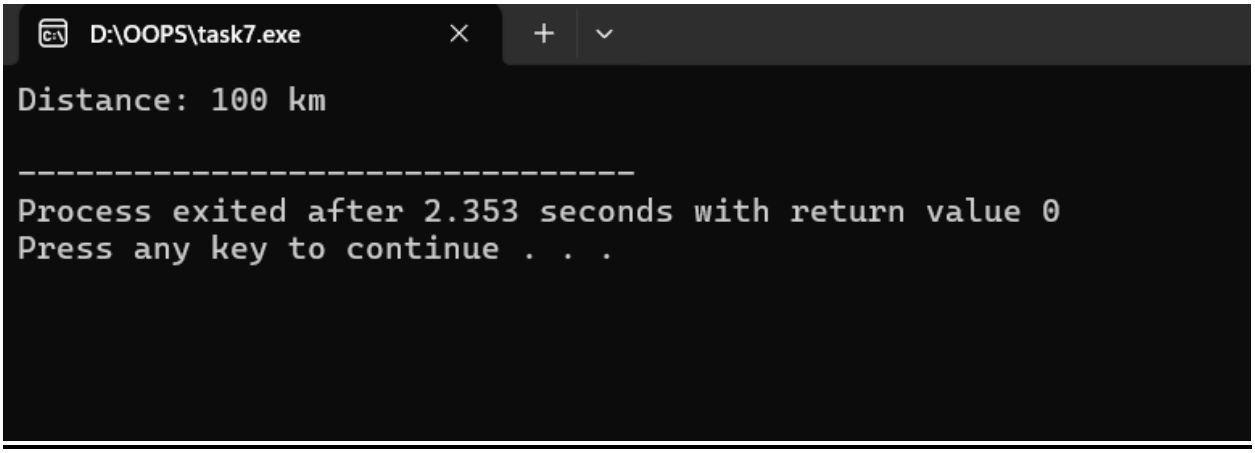
Task 6: Write a program to demonstrate the use of dynamic constructor

Input:

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

class Student {
    char *name;   // pointer to hold name dynamically
    int length;

public:
    // Dynamic constructor
    Student(const char *n) {
        length = strlen(n);
        name = new char[length + 1];  // dynamic memory allocation
        strcpy(name, n);
        cout << "Dynamic constructor called." << endl;
    }

    void display() {
        cout << "Name: " << name << endl;
    }

    // Destructor to free dynamically allocated memory
    ~Student() {
        delete[] name;
        cout << "Memory released by destructor." << endl;
    }
```

```
};

int main() {
    Student s1("Deepak");
    s1.display();

    cout << endl;

    Student s2("Rahul");
    s2.display();

    return 0;
}
```

Output:


D:\OOPS\task7.exe
Distance: 100 km

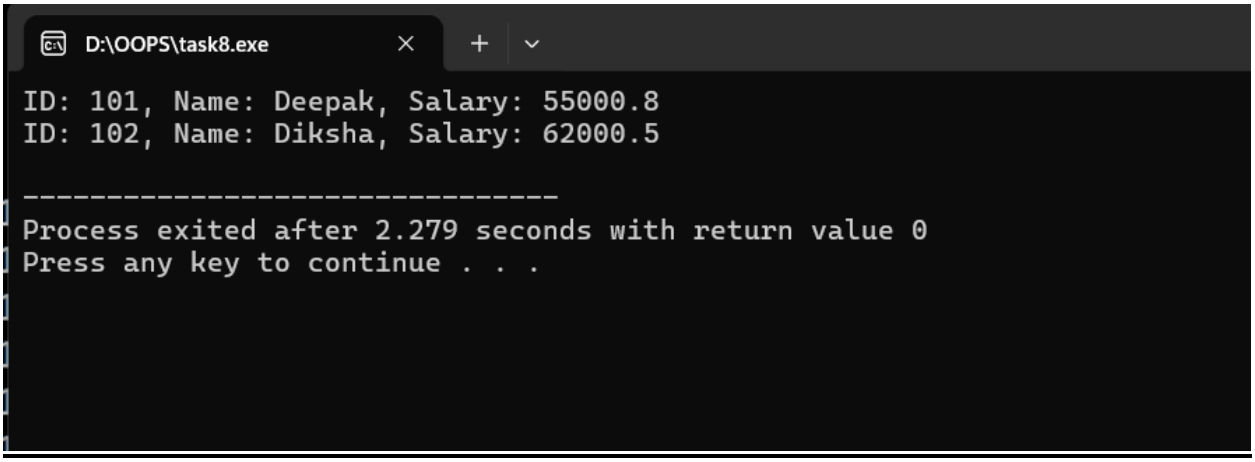
Process exited after 2.353 seconds with return value 0
Press any key to continue . . .

Task 7: Write a program to demonstrate the use of explicit constructor.

Input:

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

class Distance {
private:
    int km;

public:
    // Explicit constructor
    explicit Distance(int d) {
        km = d;
    }

    void show() const {
        cout << "Distance: " << km << " km" << endl;
    }
};

int main() {
    Distance d1(100);      // ? OK: direct initialization
    // Distance d2 = 200;  // ? Error: implicit conversion not allowed due to 'explicit'

    d1.show();

    return 0;
}
```

Output:


D:\OOPS\task8.exe
ID: 101, Name: Deepak, Salary: 55000.8
ID: 102, Name: Diksha, Salary: 62000.5

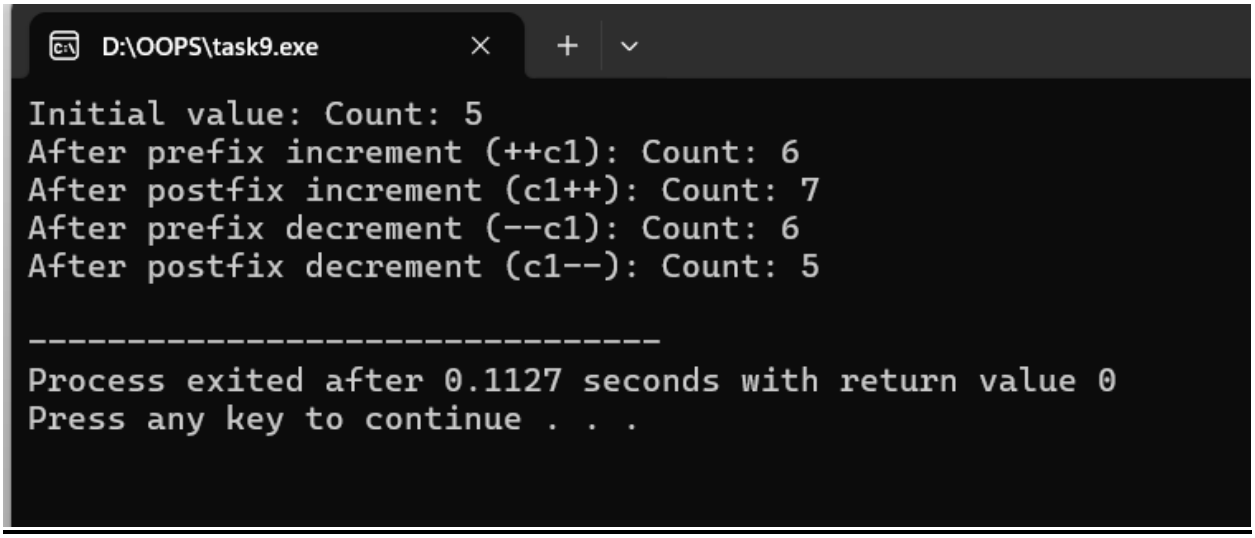
Process exited after 2.279 seconds with return value 0
Press any key to continue . . .

Task 8: Write a program to demonstrate the use of initializer list.

Input:

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

class Employee {
private:
    const int id;       // Must be initialized via initializer list
    string name;
    double salary;

public:
    // Constructor using initializer list
    Employee(int i, string n, double s) : id(i), name(n), salary(s) {}

    void display() const {
        cout << "ID: " << id << ", Name: " << name << ", Salary: " << salary << endl;
    }
};
int main() {
    Employee e1(101, "Deepak", 55000.75);
    Employee e2(102, "Diksha", 62000.50);

    e1.display();
    e2.display();

    return 0;
}
```

Output:


D:\OOPS\task9.exe
Initial value: Count: 5
After prefix increment (++c1): Count: 6
After postfix increment (c1++): Count: 7
After prefix decrement (--c1): Count: 6
After postfix decrement (c1--): Count: 5

Process exited after 0.1127 seconds with return value 0
Press any key to continue . . .

Task 9: Write a program to demonstrate the overloading of increment and decrement operators.

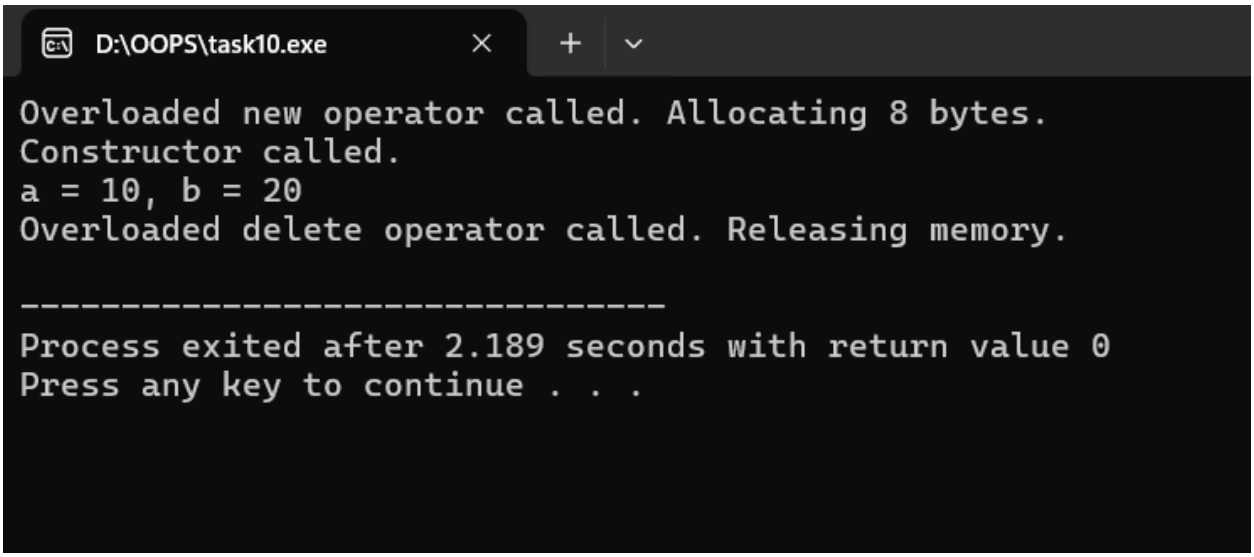
Input:

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

class Counter {
   int count;

public:
   // Constructor
   Counter(int c = 0) {
      count = c;
   }

   // Overload prefix increment operator (++obj)
   Counter operator++() {
      ++count;
      return *this;
   }

   // Overload postfix increment operator (obj++)
   Counter operator++(int) {
      Counter temp = *this;
      count++;
      return temp;
   }
```

```
    // Overload prefix decrement operator (--obj)
    Counter operator--() {
        --count;
        return *this;
    }

    // Overload postfix decrement operator (obj--)
    Counter operator--(int) {
        Counter temp = *this;
        count--;
        return temp;
    }

    void display() {
        cout << "Count: " << count << endl;
    }
};

int main() {
    Counter c1(5);

    cout << "Initial value: ";
    c1.display();

    ++c1;  // prefix increment
    cout << "After prefix increment (++c1): ";
    c1.display();
```

```
    c1++;  // postfix increment
    cout << "After postfix increment (c1++): ";
    c1.display();

    --c1;  // prefix decrement
    cout << "After prefix decrement (--c1): ";
    c1.display();

    c1--;  // postfix decrement
    cout << "After postfix decrement (c1--): ";
    c1.display();

    return 0;
}
```

Output:


D:\OOPS\task10.exe
Overloaded new operator called. Allocating 8 bytes.
Constructor called.
a = 10, b = 20
Overloaded delete operator called. Releasing memory.

Process exited after 2.189 seconds with return value 0
Press any key to continue . . .

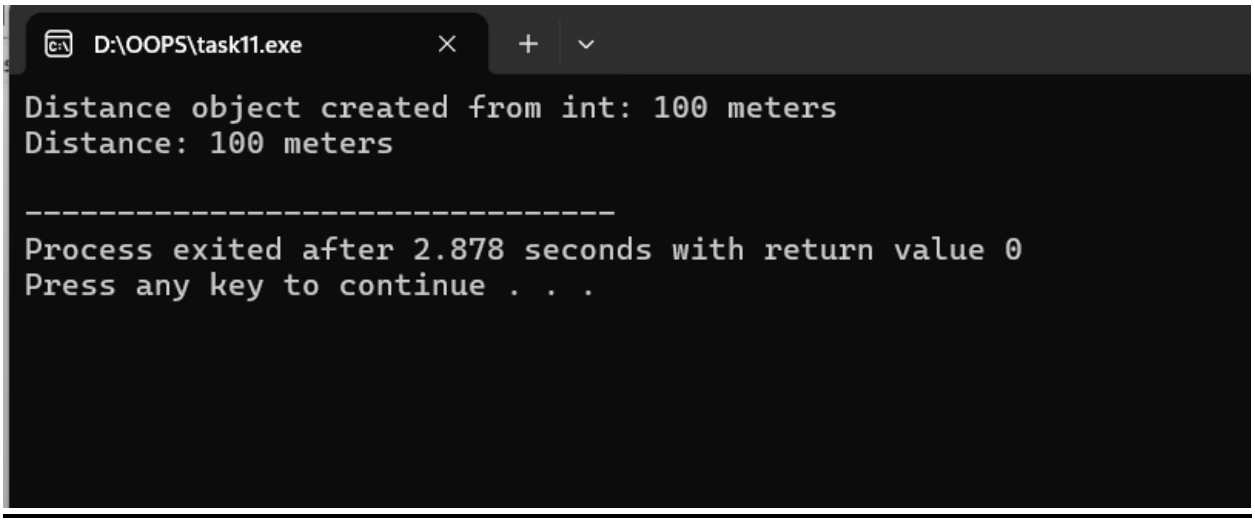
Task 10: Write a program to demonstrate the overloading of memory management operators.

Input:

```
#include <iostream>
#include <cstdlib>  // for malloc() and free()
using namespace std;

class Demo {
   int a, b;

public:
   // Constructor
   Demo(int x = 0, int y = 0) {
      a = x;
      b = y;
      cout << "Constructor called.\n";
   }

   // Overloading new operator
   void* operator new(size_t size) {
      cout << "Overloaded new operator called. Allocating " << size << " bytes.\n";
      void* ptr = malloc(size); // allocate memory
      if (!ptr) {
         cout << "Memory allocation failed!\n";
         exit(1);
      }
      return ptr;
   }
```

```
    // Overloading delete operator
    void operator delete(void* ptr) {
        cout << "Overloaded delete operator called. Releasing memory.\n";
        free(ptr); // deallocate memory
    }

    void display() {
        cout << "a = " << a << ", b = " << b << endl;
    }
};

int main() {
    // Using overloaded new operator
    Demo* d1 = new Demo(10, 20);
    d1->display();

    // Using overloaded delete operator
    delete d1;

    return 0;
}
```

Output:


D:\OOPS\task11.exe
Distance object created from int: 100 meters
Distance: 100 meters

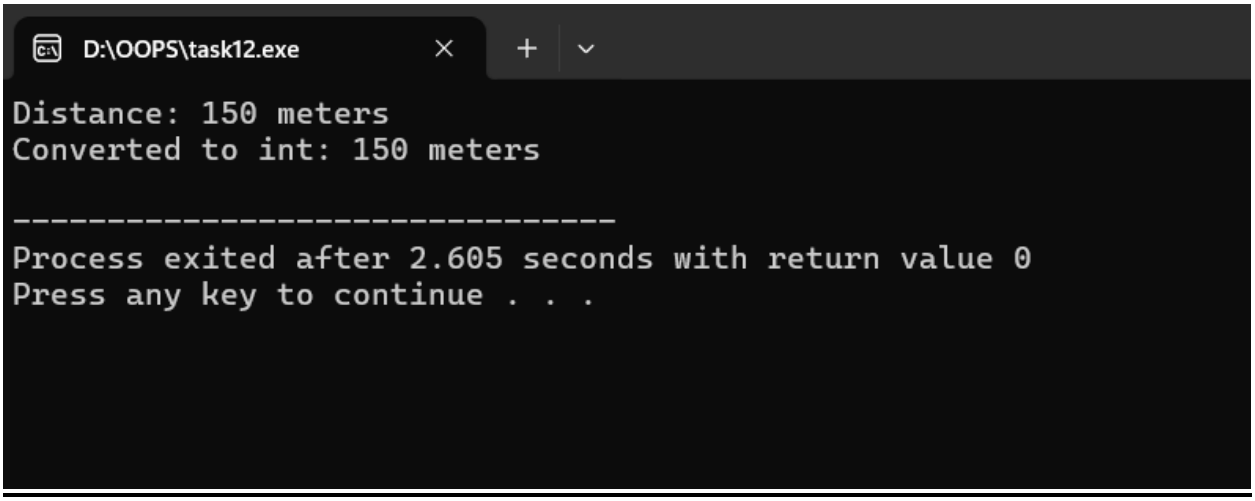
Process exited after 2.878 seconds with return value 0
Press any key to continue . . .

Task 11: Write a program to demonstrate the typecasting of basic type to class type.

Input:

```
#include <iostream>
using namespace std;
class Distance {
private:
   int meters;
public:
   // Constructor to convert int to Distance
   Distance(int m) {
      meters = m;
      cout << "Distance object created from int: " << meters << " meters\n";
   }
    void display() const {
      cout << "Distance: " << meters << " meters" << endl;
   }
};

int main() {
   int length = 100;

   // Typecasting int to class type using constructor
   Distance d = length; // Implicit conversion
    d.display();

   return 0;
}
```

Output:


D:\OOPS\task12.exe
Distance: 150 meters
Converted to int: 150 meters

Process exited after 2.605 seconds with return value 0
Press any key to continue . . .

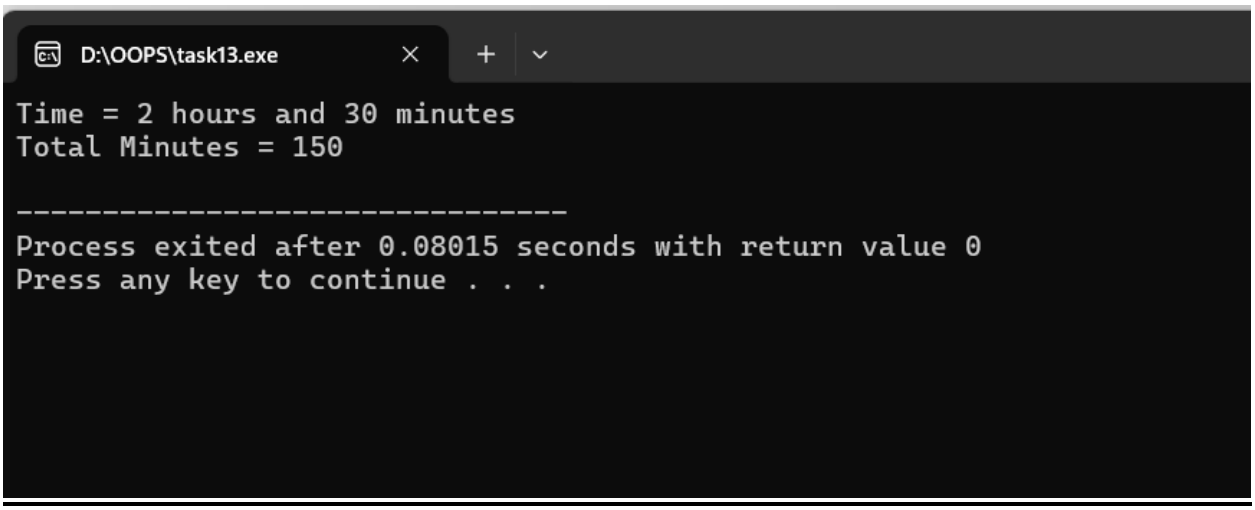
Task 12: Write a program to demonstrate the typecasting of class type to basic type.

Input:

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

class Distance {
private:
   int meters;

public:
   Distance(int m) : meters(m) {}

   // Conversion function: class to int
   operator int() const {
      return meters;
   }

   void display() const {
      cout << "Distance: " << meters << " meters" << endl;
   }
};

int main() {
   Distance d(150);

   d.display();
```

```
    // Typecasting class object to int
    int length = d; // Implicit conversion
    cout << "Converted to int: " << length << " meters" << endl;

    return 0;
}
```

Output:


D:\OOPS\task13.exe
Time = 2 hours and 30 minutes
Total Minutes = 150

Process exited after 0.08015 seconds with return value 0
Press any key to continue . . .

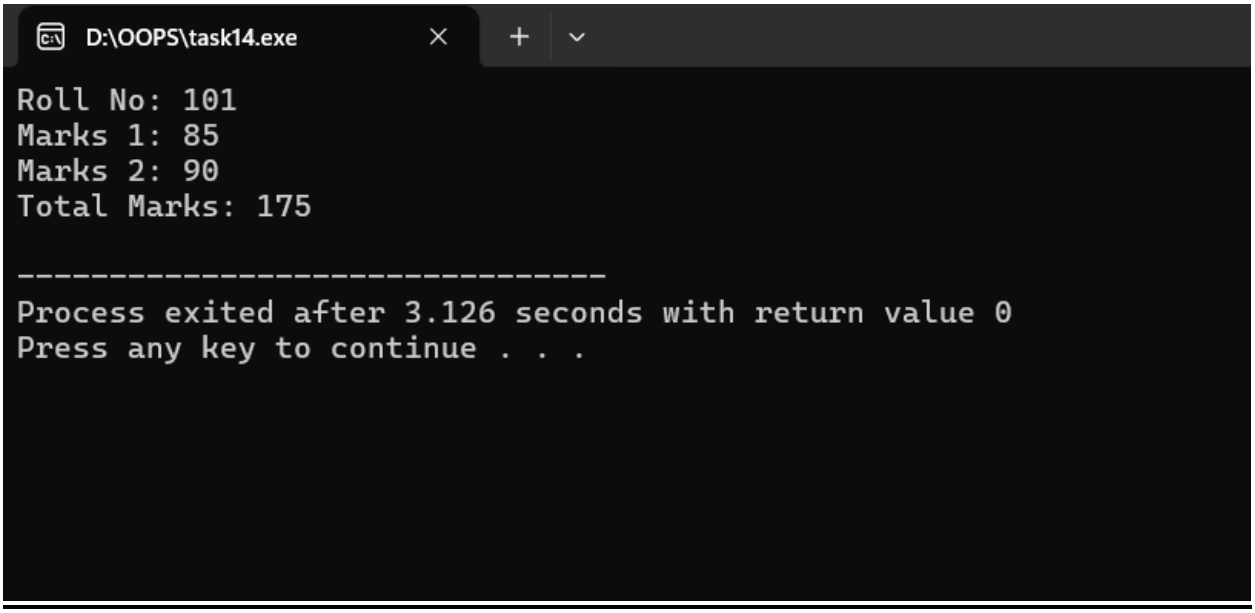
Task 13: Write a program to demonstrate the typecasting of class type to class type

Input:

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

// Source class
class Time {
    int hours;
    int minutes;

public:
    Time(int h = 0, int m = 0) {
        hours = h;
        minutes = m;
    }

    int getHours() const { return hours; }
    int getMinutes() const { return minutes; }

    void display() const {
        cout << "Time = " << hours << " hours and " << minutes << " minutes" << endl;
    }
};

// Destination class
class Minute {
    int minutes;
```

```
public:
    Minute() { minutes = 0; }

    // Conversion constructor: convert Time ? Minute
    Minute(Time t) {
        minutes = (t.getHours() * 60) + t.getMinutes();
    }

    void display() const {
        cout << "Total Minutes = " << minutes << endl;
    }
};

int main() {
    Time t1(2, 30);   // 2 hours 30 minutes
    t1.display();

    // Typecasting: class type (Time) ? class type (Minute)
    Minute m1;
    m1 = t1;   // invokes Minute(Time) conversion constructor

    m1.display();

    return 0;
}
```

Output:


D:\OOPS\task14.exe
Roll No: 101
Marks 1: 85
Marks 2: 90
Total Marks: 175

Process exited after 3.126 seconds with return value 0
Press any key to continue . . .

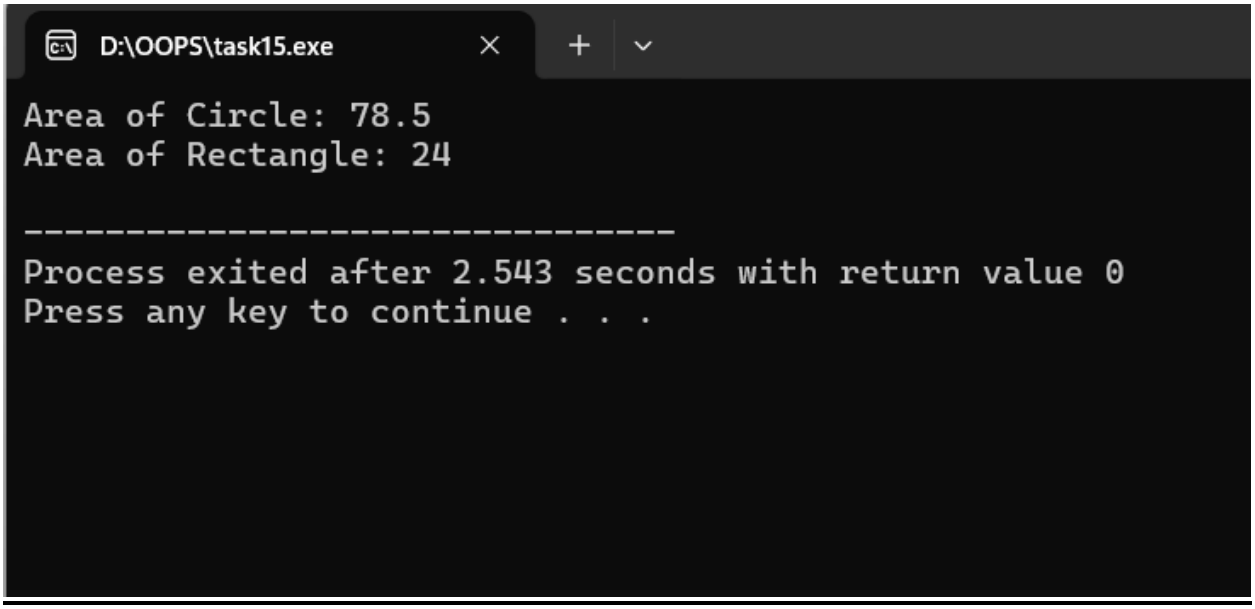
Task 14: Write a program to demonstrate the multiple inheritances.

Input:

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

// Base class 1
class Student {
protected:
   int rollNo;
public:
   void getStudentData(int r) {
      rollNo = r;
   }
};

// Base class 2
class Marks {
protected:
   int m1, m2;
public:
   void getMarks(int a, int b) {
      m1 = a;
      m2 = b;
   }
};

// Derived class inheriting from both Student and Marks
class Result : public Student, public Marks {
```

```
    int total;
public:
    void calculate() {
        total = m1 + m2;
    }
    void display() {
        cout << "Roll No: " << rollNo << endl;
        cout << "Marks 1: " << m1 << endl;
        cout << "Marks 2: " << m2 << endl;
        cout << "Total Marks: " << total << endl;
    }
};

int main() {
    Result r1;
    r1.getStudentData(101);
    r1.getMarks(85, 90);
    r1.calculate();
    r1.display();

    return 0;
}
```

Output:


D:\OOPS\task15.exe
Area of Circle: 78.5
Area of Rectangle: 24

Process exited after 2.543 seconds with return value 0
Press any key to continue . . .

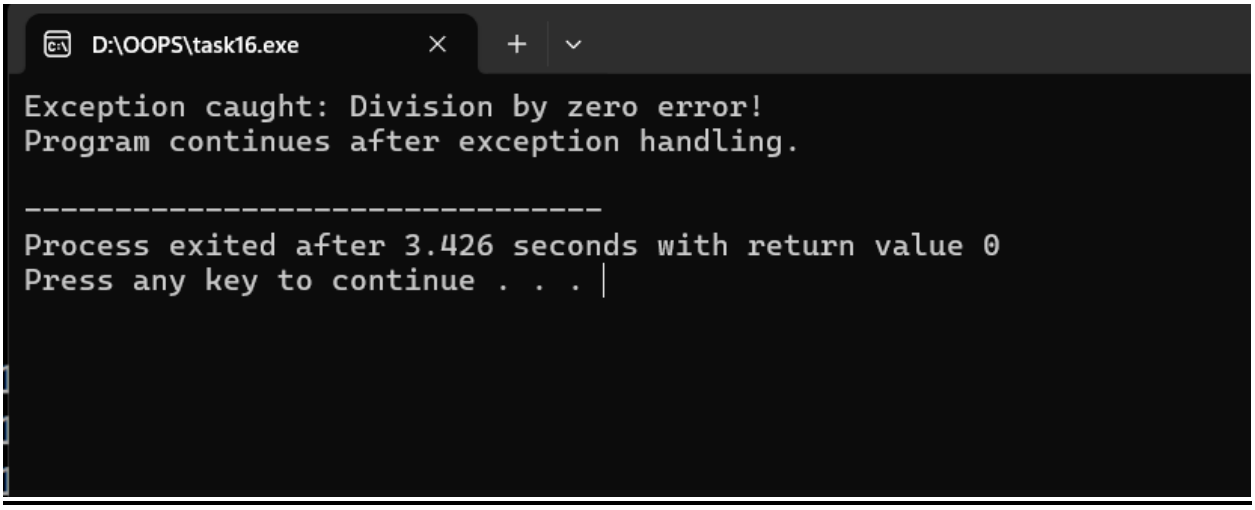
Task 15: Write a program to demonstrate the runtime polymorphism

Input:

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

class Shape {
public:
    // Virtual function for runtime polymorphism
    virtual void area() {
        cout << "This is a generic shape." << endl;
    }
};

class Circle : public Shape {
    float radius;
public:
    Circle(float r) {
        radius = r;
    }
    void area() override {   // overriding base class function
        cout << "Area of Circle: " << 3.14 * radius * radius << endl;
    }
};

class Rectangle : public Shape {
    float length, breadth;
public:
    Rectangle(float l, float b) {
```

```
        length = l;
        breadth = b;
    }
    void area() override {
        cout << "Area of Rectangle: " << length * breadth << endl;
    }
};

int main() {
    Shape *shapePtr;   // base class pointer

    Circle c1(5);
    Rectangle r1(4, 6);

    // Pointing base class pointer to derived class objects
    shapePtr = &c1;
    shapePtr->area();  // Calls Circle's area() ? runtime binding

    shapePtr = &r1;
    shapePtr->area();  // Calls Rectangle's area() ? runtime binding

    return 0;
}
```

Output:


D:\OOPS\task16.exe
Exception caught: Division by zero error!
Program continues after exception handling.

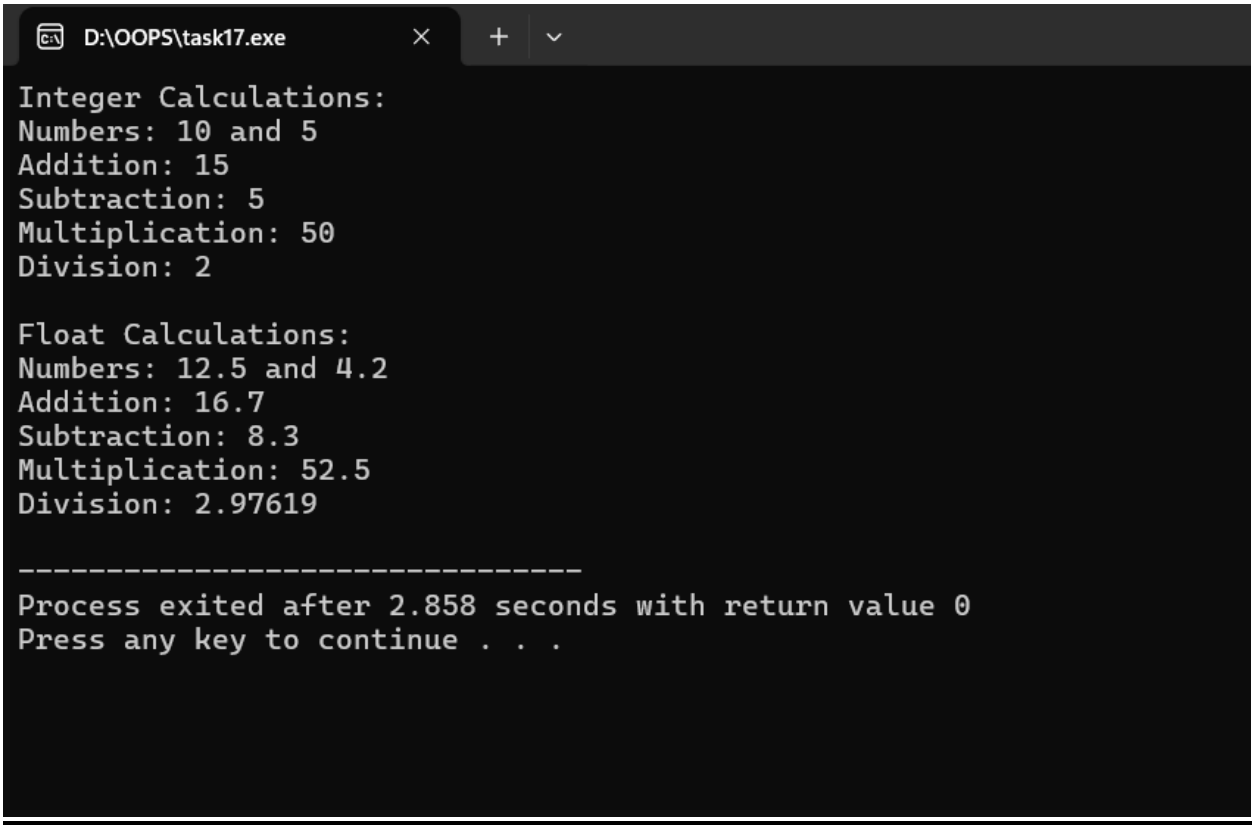
Process exited after 3.426 seconds with return value 0
Press any key to continue . . .

Task 16: Write a program to demonstrate the exception handling

Input:

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

int divide(int a, int b) {
   if (b == 0)
      throw "Division by zero error!"; // Throwing a string literal
   return a / b;
}

int main() {
   int x = 10, y = 0;

   try {
      int result = divide(x, y);
      cout << "Result: " << result << endl;
   } catch (const char* msg) {
      cout << "Exception caught: " << msg << endl;
   }

   cout << "Program continues after exception handling." << endl;

   return 0;
}
```

Output:


D:\OOPS\task17.exe
Integer Calculations:
Numbers: 10 and 5
Addition: 15
Subtraction: 5
Multiplication: 50
Division: 2
Float Calculations:
Numbers: 12.5 and 4.2
Addition: 16.7
Subtraction: 8.3
Multiplication: 52.5
Division: 2.97619

Process exited after 2.858 seconds with return value 0
Press any key to continue . . .

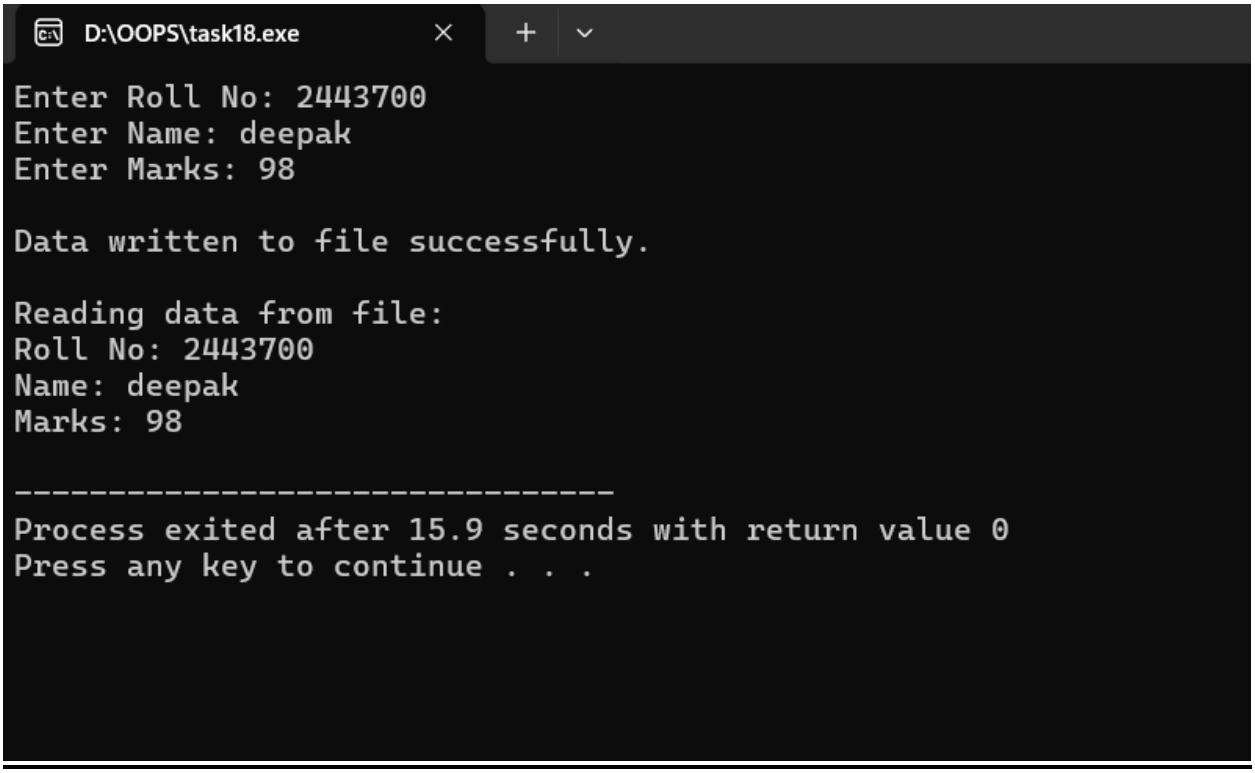
Task 17: Write a program to demonstrate the use of class template.

Input:

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

// Class template with one type parameter
template <class T>
class Calculator {
   T num1, num2;

public:
   // Constructor
   Calculator(T n1, T n2) {
      num1 = n1;
      num2 = n2;
   }

   void displayResults() {
      cout << "Numbers: " << num1 << " and " << num2 << endl;
      cout << "Addition: " << num1 + num2 << endl;
      cout << "Subtraction: " << num1 - num2 << endl;
      cout << "Multiplication: " << num1 * num2 << endl;
      cout << "Division: " << num1 / num2 << endl;
   }
};

int main() {
```

```
    // Creating object of Calculator with int type
    Calculator<int> intCalc(10, 5);
    cout << "Integer Calculations:\n";
    intCalc.displayResults();

    cout << "\n";

    // Creating object of Calculator with float type
    Calculator<float> floatCalc(12.5, 4.2);
    cout << "Float Calculations:\n";
    floatCalc.displayResults();

    return 0;
}
```

Output:


D:\OOPS\task18.exe
Enter Roll No: 2443700
Enter Name: deepak
Enter Marks: 98
Data written to file successfully.
Reading data from file:
Roll No: 2443700
Name: deepak
Marks: 98

Process exited after 15.9 seconds with return value 0
Press any key to continue . . .

Task 18: Write a program to demonstrate the reading and writing of mixed type of data.

Input:

```
#include <iostream>
#include <fstream>   // for file handling
using namespace std;

int main() {
    // Variables of mixed data types
    int rollNo;
    string name;
    float marks;

    // --- Writing data to a file ---
    ofstream outFile("student.txt");  // open file for writing

    if (!outFile) {
        cout << "Error opening file for writing!" << endl;
        return 1;
    }

    cout << "Enter Roll No: ";
    cin >> rollNo;
    cout << "Enter Name: ";
    cin >> name;
    cout << "Enter Marks: ";
    cin >> marks;
```

```
    // Write mixed type data to file
    outFile << rollNo << " " << name << " " << marks << endl;

    outFile.close(); // close file after writing
    cout << "\nData written to file successfully.\n" << endl;

    // --- Reading data from file ---
    ifstream inFile("student.txt");  // open file for reading

    if (!inFile) {
        cout << "Error opening file for reading!" << endl;
        return 1;
    }

    cout << "Reading data from file:\n";

    // Read mixed type data from file
    inFile >> rollNo >> name >> marks;

    // Display read data
    cout << "Roll No: " << rollNo << endl;
    cout << "Name: " << name << endl;
    cout << "Marks: " << marks << endl;

    inFile.close(); // close file after reading
    return 0;
}
```