DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING
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Assignment Day 1

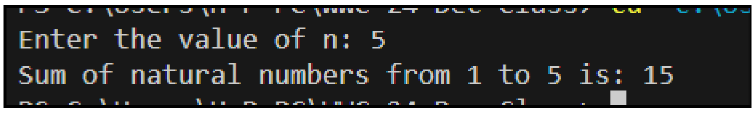
VERY EASY

1) Sum of Natural Numbers up to N

Sol-

```
#include  <iostream>
using namespace std;
int main() {
    int n, sum = 0;
    cout << "Enter the value of n: ";
    cin >> n;
    sum = (n*(n+1)/2);
    cout << "Sum of natural numbers from 1 to " << n << " is: " << sum << endl;
    return 0;
}
```

Output –



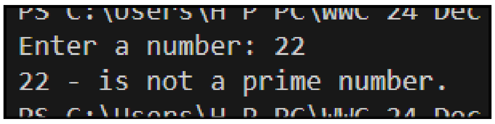
```
Enter the value of n: 5
Sum of natural numbers from 1 to 5 is: 15
```

2) Check if a Number is Prime

Sol-

```
#include <iostream>
#include<math.h>
using namespace std;
bool isPrime(int num) {
    if (num <= 1)
        return false;
    for (int i = 2; i <= sqrt(num); i++) {
        if (num % i == 0)
            return false;
    }
    return true;
}
int main() {
    int num;
    cout << "Enter a number: ";
    cin >> num;
    if (isPrime(num))
    cout << num << " - is a prime number.";
    else
    cout << num << " - is not a prime number.";
    return 0;
}
```

Output-



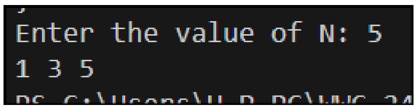
```
PS C:\Users\H P PC\WWC 24 Dec
Enter a number: 22
22 - is not a prime number.
PS C:\Users\H P PC\WWC 24 Dec
```

3) Print Odd Numbers up to N

Sol-

```
#include<iostream>
using namespace std;
int main() {
    int N, i;
    cout << "Enter the value of N: ";
    cin >> N;

    for(i=1; i<=N; i+=2) {
        cout << i << " ";
    }
    return 0;
}
```

Output-



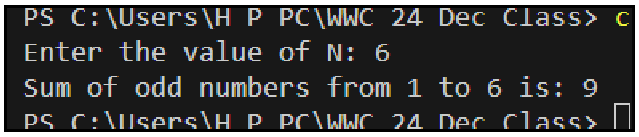
```
Enter the value of N: 5
1 3 5
PS C:\Users\H P PC\HWC 24
```

4) Sum of Odd Numbers up to N

Sol-

```
#include<iostream>
using namespace std;
int main() {
    int N, i, sum = 0;
    cout << "Enter the value of N: ";
    cin >> N;
    for(i=1; i<=N; i+=2) {
        sum += i;
    }
    cout << "Sum of odd numbers from 1 to " << N << " is: " << sum << endl;
    return 0;
}
```

Output-



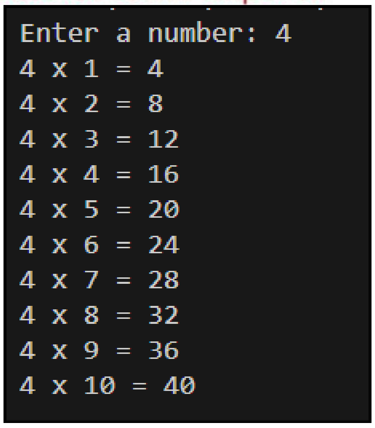
```
PS C:\Users\H P PC\WWC 24 Dec Class> c
Enter the value of N: 6
Sum of odd numbers from 1 to 6 is: 9
PS C:\Users\H P PC\WWC 24 Dec Class>
```

5) Print Multiplication Table of a Number

Sol-

```
 #include<iostream>
using namespace std;
int main() {
    int num, i, j;
    cout << "Enter a number: ";
    cin >> num;
    for (i = 1; i <= 10; i++) {
        for (j = 1; j <= 10; j++) {
            cout << num << " x " << j << " = " << num * j << endl;
        }
        cout << endl;
    }
    return 0;
}
```

Output –



```
Enter a number: 4
4 x 1 = 4
4 x 2 = 8
4 x 3 = 12
4 x 4 = 16
4 x 5 = 20
4 x 6 = 24
4 x 7 = 28
4 x 8 = 32
4 x 9 = 36
4 x 10 = 40
```

EASY

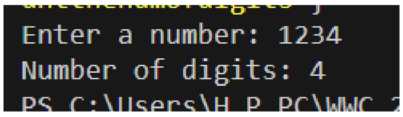
1)Count Digits in a Number

Sol –

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

int countDigits(int n) {
if (n == 0) return 1;
n = abs(n);

int count = 0;
while (n != 0) {
    n = n / 10;
    count++;
}
return count;
}
int main() {
    int num;
    cout << "Enter a number: ";
```

```
        cin >> num;
        cout << "Number of digits: " << countDigits(num) << endl;
        return 0;
    }
```

Output –

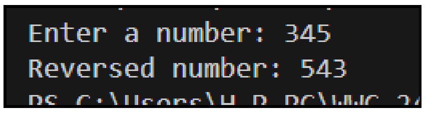


```
Enter a number: 1234
Number of digits: 4
```

2) **Reverse a Number**

Sol –

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

int reverseNumber(int num) {
    int reverse = 0;
    while(num != 0) {
        reverse = reverse * 10 + num % 10;
        num /= 10;
    }
    return reverse;
}

int main() {
    int num;
    cout << "Enter a number: ";
    cin >> num;
    cout << "Reversed number: " << reverseNumber(num) << endl;
```

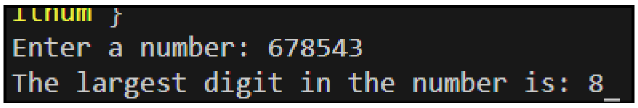


```
Enter a number: 345
Reversed number: 543
```

3)Find the Largest Digit in a Number

Sol –

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

int main() {
   int num, maxDigit = 0;

   cout << "Enter a number: ";
   cin >> num;

    while (num != 0) {
       int digit = num % 10;
       if (digit > maxDigit) {
          maxDigit = digit;
       }
       num /= 10;
   }

    cout << "The largest digit in the number is: " << maxDigit << endl;
```



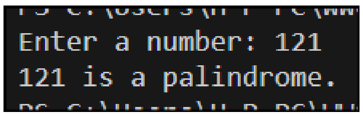
```
Enter a number: 678543
The largest digit in the number is: 8_
```

4)Check if a Number is a Palindrome

Sol-

```
#include <iostream>
using namespace std;
bool isPalindrome(int num) {
    int originalNum = num;
    int reverseNum = 0;
    while (num != 0) {
        int digit = num % 10;
        reverseNum = reverseNum * 10 + digit;
        num /= 10;
    }
    return originalNum == reverseNum;
}
int main() {
    int num;
    cout << "Enter a number: ";
    cin >> num;

    if (isPalindrome(num)) {
        cout << num << " is a palindrome." << endl;
    } else {
        cout << num << " is not a palindrome." << endl;
        }
    return 0;
}
```

Output –



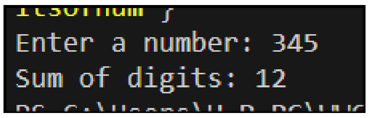
```
Enter a number: 121
121 is a palindrome.
```

5) Find the Sum of Digits of a Number

Sol –

```
#include<iostream>
using namespace std;
int sumOfDigits(int n) {
int sum = 0;
while (n != 0) {
    sum += n % 10;
    n /= 10;
}
return sum;
}
int main() {
    int num;
    cout << "Enter a number: ";
    cin >> num;
    cout << "Sum of digits: " << sumOfDigits(num) << endl;
    return 0;
    }
```

Output-



```
Enter a number: 345
Sum of digits: 12
```

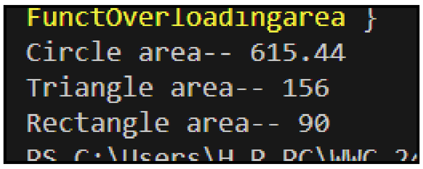
<u>MEDIUM</u>

1) **Function Overloading for Calculating Area.**

Sol –

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

double area(double radius) {
    return 3.14 *radius * radius;
}
double area(double base, double height) {
    return 0.5 * base * height;
}

int area(int length, int width) {
    return length * width;
}
int main() {
    cout << "Circle area-- " << area(14) << endl;
    cout << "Triangle area-- " << area(13,12) << endl;
    cout << "Rectangle area-- " << area(15, 6) << endl;
    return 0;
}
```

Output -



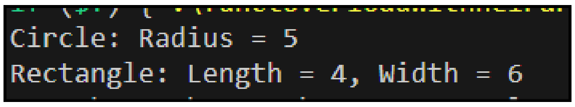
```
FunctOverloadingarea }
Circle area-- 615.44
Triangle area-- 156
Rectangle area-- 90
PS C:\Users\H P PC\WWC 24
```

2) **Function Overloading with Hierarchical Structure.**
Sol –

```
#include  <iostream>
using namespace std;
class Shape {
    public:
        virtual void print() = 0;
};
class Circle : public Shape {
    private:
    int radius;
    public:
    Circle(int r) : radius(r) {}
    void print() {
        cout << "Circle: Radius = " << radius << endl;
    }
};
```

```
class Rectangle : public Shape {
    private:
    int length, width;
    public:
    Rectangle(int l, int w) : length(l), width(w) {}
    void print() {
        cout << "Rectangle: Length = " << length << ", Width = " << width <<
endl;
    }
};
int main() {
    Shape* shapes[] = {new Circle(5), new Rectangle(4, 6)};
    int nShapes = sizeof(shapes) / sizeof(shapes[0]);
    for (int i = 0; i < nShapes; i++) {
        shapes[i]->print();
        delete shapes[i];
    }
    return 0;
}
```

Output -



```
Circle: Radius = 5
Rectangle: Length = 4, Width = 6
```

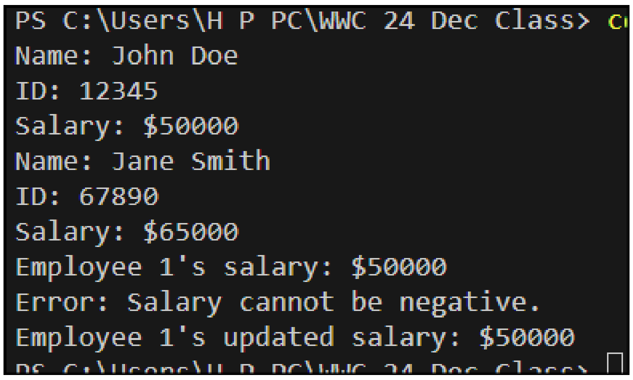
3) Encapsulation with Employee Details

Sol –

```
#include <iostream>
```

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

class Employee {
    private:
    string name;
    int id;
    float salary;

    public:

    Employee(string n, int i, float s) {
        name = n;
        id = i;
        setSalary(s);
    }

    void setSalary(float s) {
        if (s >= 0) {
            salary = s;
        } else {
            cout << "Error: Salary cannot be negative." << endl;
        }
    }

    float getSalary() {
        return salary;
    }

    void displayEmployeeDetails() {
        cout << "Name: " << name << endl;
        cout << "ID: " << id << endl;
        cout << "Salary: $" << salary << endl;
    }



    string getName() {
        return name;
        }
        };

int main() {
    Employee emp1("John Doe", 12345, 50000.0);
    emp1.displayEmployeeDetails();

    Employee emp2("Jane Smith", 67890, 65000.0);
    emp2.displayEmployeeDetails();

    cout << "Employee 1's salary: $" << emp1.getSalary() << endl;
    emp1.setSalary(-10000.0);
    cout << "Employee 1's updated salary: $" << emp1.getSalary() << endl;

    return 0;
}
```

Output –



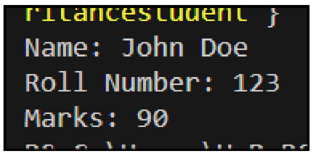
```
PS C:\Users\H P PC\WWC 24 Dec Class> c
Name: John Doe
ID: 12345
Salary: $50000
Name: Jane Smith
ID: 67890
Salary: $65000
Employee 1's salary: $50000
Error: Salary cannot be negative.
Employee 1's updated salary: $50000
PS C:\Users\H P PC\WWC 24 Dec Class>
```

4) Inheritance with Student and Result Classes.

Sol –

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

class Result {
    int marks;

public:
    void setMarks(int m) {
        marks = m;
    }

    int getMarks() {
        return marks;
    }
};

class Student {
    string name;
    int rollNumber;
    Result result;


public:
void setName(string n) {
    name = n;
 }
 string getName() {
    return name;
 }
 void setRollNumber(int r) {
    rollNumber = r;
 }
 int getRollNumber() {
    return rollNumber;
 }
 void setResult(Result res) {
    result = res;
 }
 Result getResult() {
    return result;
 }
 };
 int main() {
    Student  s;
    Result r;
    s.setName("John Doe");
    s.setRollNumber(123);
    r.setMarks(90);
    s.setResult(r);
    cout << "Name: " << s.getName() << endl;
    cout << "Roll Number: " << s.getRollNumber() << endl;
    cout << "Marks: " << s.getResult().getMarks() << endl;
    return 0;
 }
```

Output –

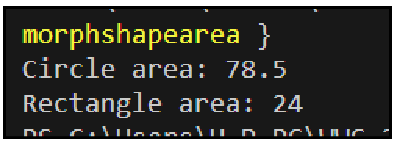


```
Name: John Doe
Roll Number: 123
Marks: 90
```

5) **Polymorphism with Shape Area Calculation.**
Sol –

```
#include <iostream>
class Shape {
public:
    virtual double area() const = 0;
};
class Circle : public Shape {
    double radius;
public:
    Circle(double r) : radius(r) {}

    double area() const override {
        return 3.14* radius * radius;
    }
    void display() const {
        std::cout << "Circle area: " << area() << std::endl;
    }
};
class Rectangle : public Shape {
    double length, width;
public:
    Rectangle(double l, double w) : length(l), width(w) {}

    double area() const override {
        return length * width;
    }
    void display() const {
        std::cout << "Rectangle area: " << area() << std::endl;
    }
};
int main() {
    Circle circle(5);
    circle.display();
    Rectangle rectangle(4, 6);
    rectangle.display();
    return 0;
}
```

Output –



```
morphshapearea }
Circle area: 78.5
Rectangle area: 24
```

HARD

1) Implementing Polymorphism for Shape Hierarchies.

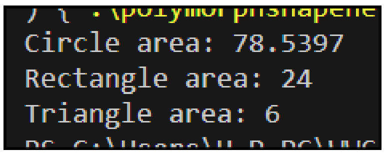
Sol –

```
#include <iostream>
#include <cmath>

using namespace std;

class Shape {
public:
    virtual double area() const = 0;
};

class Circle : public Shape {
    double radius;

public:
    Circle(double r) : radius(r) {}

    double area() const override {
        return 3.14159 * radius * radius;
    }

    double circumference() const {
        return 2 * 3.14159 * radius;
    }
    };
```

```
class Rectangle : public Shape {
    double length, breadth;

public:
Rectangle(double l, double b) : length(l), breadth(b) {}

    double area() const override {
        return length * breadth;
    }
    double perimeter() const {
        return 2 * (length + breadth);
    }
};
    class Triangle : public Shape {
        double base, height;

    public:
    Triangle(double b, double h) : base(b), height(h) {}

    double area() const override {
        return 0.5 * base * height;
    }
    double perimeter() const {
        return base + 2 * sqrt(base * base + height * height);
    }
    };
```

```
int main() {
    Circle c(5);
    Rectangle r(4, 6);
    Triangle t(3, 4);
    cout << "Circle area: " << c.area() << std::endl;
    cout << "Rectangle area: " << r.area() << std::endl;
    cout << "Triangle area: " << t.area() << std::endl;
    return 0;
}
```

Output –



```
Circle area: 78.5397
Rectangle area: 24
Triangle area: 6
```

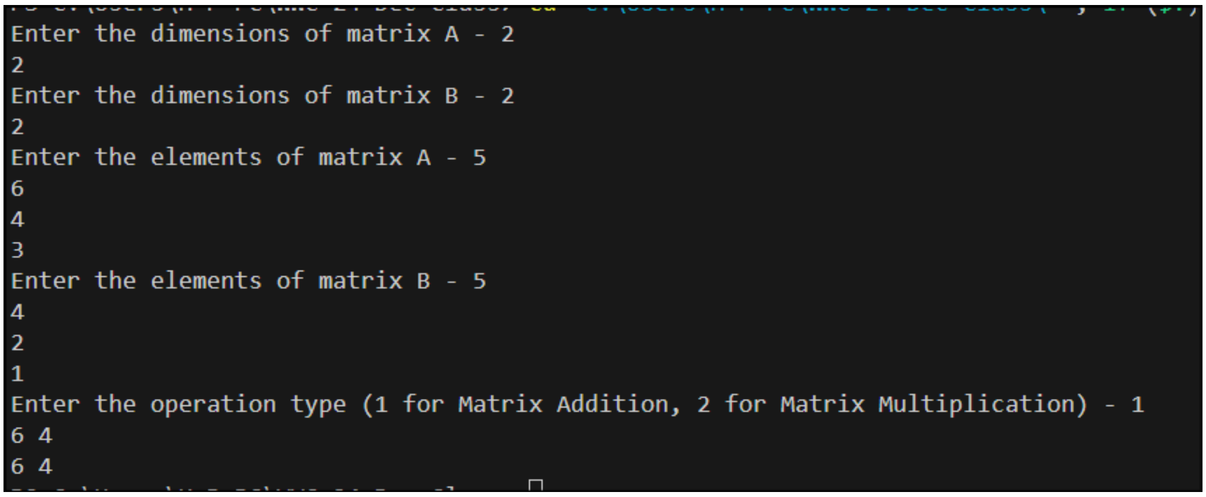
2) Matrix Multiplication Using Function Overloading

Sol –

```
#include  <iostream>
using namespace std;
int main() {
    int m =0 , n=0 , p=0 ;
    int A[m][n];
    cout << "Enter the dimensions of matrix A - ";
    cin >> m >> n;
    int B[n][p];
    cout << "Enter the dimensions of matrix B - ";
    cin >> n >> p;
    int C[m][p];
    cout << "Enter the elements of matrix A - ";
    for (int i = 0; i < m; i++) {
        for (int j = 0; j < n; j++) {
            cin >> A[i][j];
        }
    }
    cout << "Enter the elements of matrix B - ";
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < p; j++) {
            cin >> B[i][j];
        }
    }
    int operation;
    cout << "Enter the operation type (1 for Matrix Addition, 2 for Matrix
Multiplication) - ";
    cin >> operation;
    if (operation == 1) {
        if (n != m) {
            cout << "Invalid dimensions for operation." << endl;
            return 0;
        }
        for (int i = 0; i < m; i++) {
            for (int j = 0; j < n; j++) {
                C[i][j] = A[i][j] + B[i][j];
            }
        }
        for (int i = 0; i < m; i++) {
```

```
        for (int j = 0; j < n; j++) {
            cout << C[i][j] << " ";
        }
        cout << endl;
    }
    }
    else if (operation == 2) {
        if (m != n) {
            cout << "Invalid dimensions for operation." << endl;
            return 0;
        }
        for (int i = 0; i < m; i++) {
            for (int j = 0; j < p; j++) {
                C[i][j] = 0;
                for (int k = 0; k < n; k++) {
                    C[i][j] += A[i][k] * B[k][j];
                }
            }
        }
        for (int i = 0; i < m; i++) {
            for (int j = 0; j < p; j++) {
                cout << C[i][j] << " ";
            }
            cout << endl;
        }

        } else {
            cout << "Invalid operation type." << endl;
        }
        return 0;
    }
```

Output –



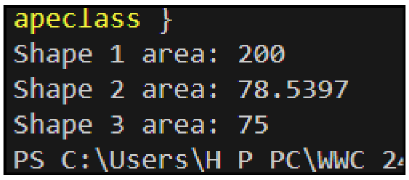
```
Enter the dimensions of matrix A - 2
2
Enter the dimensions of matrix B - 2
2
Enter the elements of matrix A - 5
6
4
3
Enter the elements of matrix B - 5
4
2
1
Enter the operation type (1 for Matrix Addition, 2 for Matrix Multiplication) - 1
6 4
6 4
```

3) **Polymorphism in Shape Classes**
Sol –

```
#include  <iostream>
using namespace std;
class Shape {
public:
    virtual double getArea() = 0;
};
class Rectangle : public Shape {
    int length, breadth;
public:
Rectangle(int l, int b) {
    length = l;
    breadth = b;
}
    double getArea() override {
       return length * breadth;
    }
    };
    class Circle : public Shape {
       int radius;
    public:
    Circle(int r) {
       radius = r;
    }
    double getArea() override {
       return 3.14159 * radius * radius;
    }
    };

    class Triangle : public Shape {
       int base, height;
    public:
    Triangle(int b, int h) {
       base = b;
       height = h;
    }
    double getArea() override {
       return 0.5 * base * height;
    }
    };
```

```
int main() {
    Rectangle r(10, 20);
    Circle c(5);
    Triangle t(10, 15);
    Shape* shapes[] = {&r, &c, &t};
    for (int i = 0; i < 3; i++) {
        cout << "Shape " << i + 1 << " area: " << shapes
        [i]->getArea() << std::endl;
    }
    return 0;
}
```

Output –

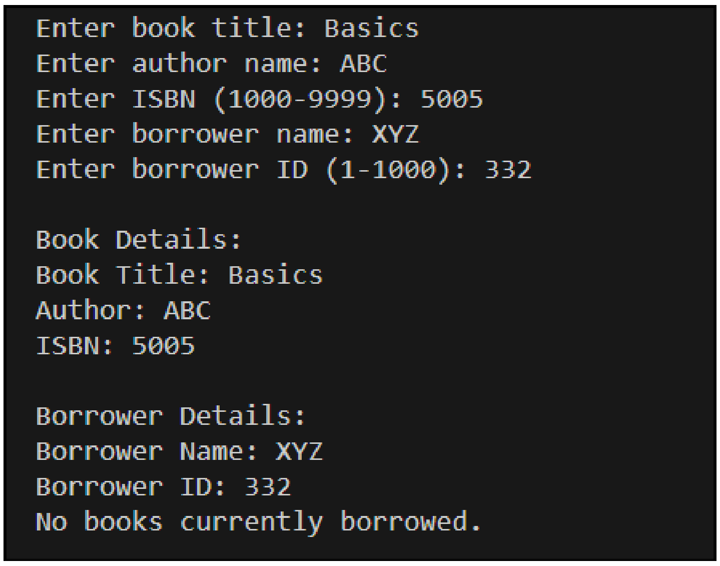


```
apeclass }
Shape 1 area: 200
Shape 2 area: 78.5397
Shape 3 area: 75
PS C:\Users\H P PC\WWC 24
```

4) **Implement Multiple Inheritance to Simulate a Library System**
Sol –

```
#include <iostream>
#include <string>
using namespace std;
class Book {
protected:
    string title;
    string author;
    int isbn;
public:
    void setBookDetails(const string& t, const string& a, int i) {
        title = t;
        author = a;
        isbn = i;
    }
    void displayBookDetails() const {
        cout << "Book Title: " << title << endl;
        cout << "Author: " << author << endl;
        cout << "ISBN: " << isbn << endl;
    }
};
class Borrower {
protected:
    string name;
    int id;
    string borrowedBook;
public:
    void setBorrowerDetails(const string& n, int i) {
        name = n;
        id = i;
        borrowedBook = "";
    }

    void displayBorrowerDetails() const {
        cout << "Borrower Name: " << name << endl;
        cout << "Borrower ID: " << id << endl;
        if (!borrowedBook.empty()) {
            cout << "Currently Borrowed Book: " << borrowedBook << endl;
        } else {
            cout << "No books currently borrowed." << endl;
        }
    }
    void borrowBook(const string& bookTitle) {
        borrowedBook = bookTitle;
    }
    void returnBook() {
        borrowedBook = "";
    }
};
class Library : public Book, public Borrower {
public:
    void borrowBookFromLibrary() {
        if (borrowedBook.empty()) {
            cout << "Enter the book title to borrow: ";
            string bookTitle;
            cin.ignore();
            getline(cin, bookTitle);
            borrowBook(bookTitle);
            cout << "You have borrowed: " << bookTitle << endl;
        } else {
            cout << "You already have a borrowed book: " << borrowedBook <<
endl;
        }
    }
    void returnBookToLibrary() {
        if (!borrowedBook.empty()) {
            cout << "You have returned: " << borrowedBook << endl;
            returnBook();
        } else {
            cout << "You have no borrowed books to return." << endl;
        }
    }
};
int main() {
    Library library;
    string title, author, name;
    int isbn, id, action;
    cout << "Enter book title: ";
    getline(cin, title);
    cout << "Enter author name: ";
    getline(cin, author);
    cout << "Enter ISBN (1000-9999): ";
    cin >> isbn;
    while (isbn < 1000 || isbn > 9999) {
        cout << "Invalid ISBN. Please enter a valid ISBN (1000-9999): ";
        cin >> isbn;
    }
    library.setBookDetails(title, author, isbn);
    cout << "Enter borrower name: ";
    cin.ignore();
    getline(cin, name);
    cout << "Enter borrower ID (1-1000): ";
    cin >> id;
    while (id < 1 || id > 1000) {
        cout << "Invalid ID. Please enter a valid ID (1-1000): ";
        cin >> id;
    }
    library.setBorrowerDetails(name, id);
    cout << "\nBook Details:\n";
    library.displayBookDetails();
    cout << "\nBorrower Details:\n";
    library.displayBorrowerDetails();
    do {
        cout << "\nEnter action (1 to borrow a book, 2 to return a book, 0 to exit):
";
        cin >> action;

        switch (action) {
            case 1:
                library.borrowBookFromLibrary();
                break;
            case 2:
                library.returnBookToLibrary();
                break;
            case 0:
                cout << "Exiting the library system." << endl;
                break;
            default:
                cout << "Invalid action. Please try again." << endl;
        }
    } while (action != 0);
    return 0;
}
```

Output –



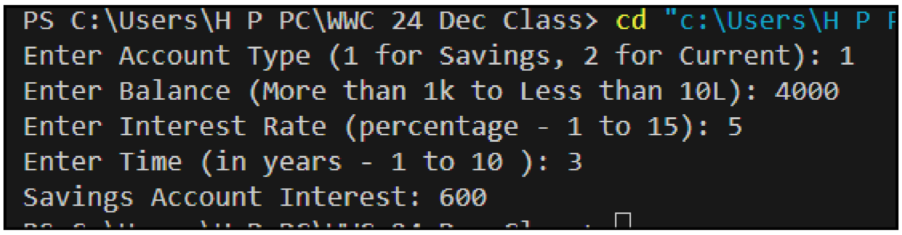
```
Enter book title: Basics
Enter author name: ABC
Enter ISBN (1000-9999): 5005
Enter borrower name: XYZ
Enter borrower ID (1-1000): 332

Book Details:
Book Title: Basics
Author: ABC
ISBN: 5005

Borrower Details:
Borrower Name: XYZ
Borrower ID: 332
No books currently borrowed.
```

5) **Implement Polymorphism for Banking Transactions**
Sol –

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


class Account {
protected:
    int balance;


public:
    Account(int b) : balance(b) {}


    virtual void display() const = 0;
    virtual ~Account() {}
};

class SavingsAccount : public Account {
    double rate;
    int time;

public:
    SavingsAccount(int b, double r, int t) : Account(b), rate(r), time(t) {}

    void display() const override {
        double interest = balance * rate * time / 100.0;
        cout << "Savings Account Interest: " << interest << endl;
    }
};

class CurrentAccount : public Account {
    int fee;

public:
    CurrentAccount(int b, int f) : Account(b), fee(f) {}

    void display() const override {
        cout << "Balance after fee deduction (Between 15 to 500): " << balance -
fee << endl;
    }
};
```

```
int main() {
    int type, balance;

    cout << "Enter Account Type (1 for Savings, 2 for Current): ";
    cin >> type;

    if (type == 1) {
        double  rate;
        int time;

        cout << "Enter Balance (More than 1k to Less than 10L): ";
        cin >> balance;
        cout << "Enter Interest Rate (percentage - 1 to 15): ";
        cin >> rate;
        cout << "Enter Time (in years - 1 to 10 ): ";
        cin >> time;

        if (balance >= 1000 && balance <= 1000000 && rate >= 1 && rate <= 15
&& time >= 1 && time <= 10) {
            SavingsAccount account(balance, rate, time);
            account.display();
        } else {
            cout << "Invalid input constraints." << endl;
        }
    } else if (type == 2) {
        int fee;

        cout << "Enter Balance: ";
        cin >> balance;
        cout << "Enter Monthly Maintenance Fee: ";
        cin >> fee;

        if (balance >= 1000 && balance <= 1000000 && fee >= 50 && fee <=
500) {
            CurrentAccount account(balance, fee);
            account.display();
        } else {
            cout << "Invalid input constraints." << endl;
        }
    } else {
        cout << "Invalid account type." << endl;
    }

    return 0;
}
```

Output –



```
PS C:\Users\H P PC\WWC 24 Dec Class> cd "c:\Users\H P
Enter Account Type (1 for Savings, 2 for Current): 1
Enter Balance (More than 1k to Less than 10L): 4000
Enter Interest Rate (percentage - 1 to 15): 5
Enter Time (in years - 1 to 10 ): 3
Savings Account Interest: 600
```

<u>VERY HARD</u>

1) Hierarchical Inheritance for Employee Management System
Sol –

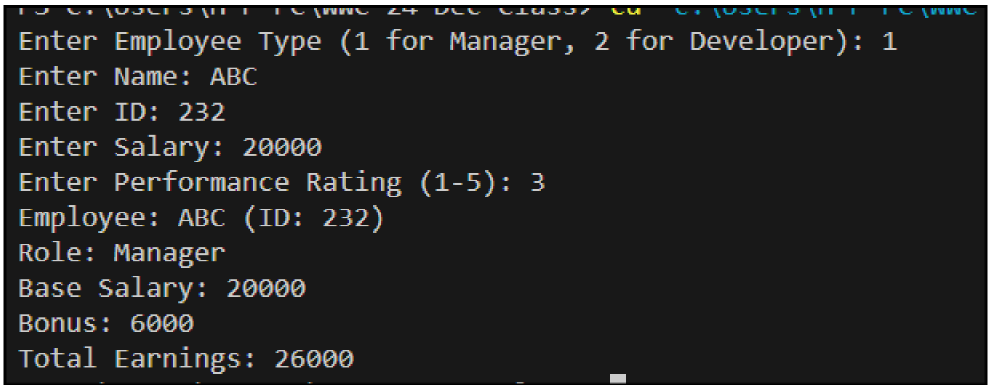
```
#include <iostream>
```

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

class Employee {
protected:
    string name;
    int id;
    int salary;

public:
    Employee(string n, int i, int s) : name(n), id(i), salary(s) {}

    virtual void display() = 0;
};

class Manager : public Employee {
private:
    int rating;

public:
    Manager(string n, int i, int s, int r) : Employee(n, i, s), rating(r) {}

    void display() override {
        double bonus = 0.1 * salary * rating;
        double totalEarnings = salary + bonus;

        cout << "Employee: " << name << " (ID: " << id << ")" << endl;
        cout << "Role: Manager" << endl;
        cout << "Base Salary: " << salary << endl;
        cout << "Bonus: " << bonus << endl;
        cout << "Total Earnings: " << totalEarnings << endl;
    }
};

class Developer : public Employee {
private:
    int extraHours;

public:
    Developer(string n, int i, int s, int hours) : Employee(n, i, s),
extraHours(hours) {}

    void display() override {
        double overtimeCompensation = 500 * extraHours;
        double totalEarnings = salary + overtimeCompensation;

        cout << "Employee: " << name << " (ID: " << id << ")" << endl;
        cout << "Role: Developer" << endl;
        cout << "Base Salary: " << salary << endl;
        cout << "Overtime Compensation: " << overtimeCompensation << endl;
        cout << "Total Earnings: " << totalEarnings << endl;
    }
};

int main() {
```

```
int employeeType;
cout << "Enter Employee Type (1 for Manager, 2 for Developer): ";
cin >> employeeType;

if (employeeType < 1 || employeeType > 2) {
    cout << "Invalid employee type." << endl;
    return 0;
}

string name;
int id, salary;

cout << "Enter Name: ";
cin >> name;
cout << "Enter ID: ";
cin >> id;
cout << "Enter Salary: ";
cin >> salary;

if (salary < 10000 || salary > 1000000) {
    cout << "Invalid salary." << endl;
    return 0;
}

if (employeeType == 1) { // Manager
    int rating;
    cout << "Enter Performance Rating (1-5): ";
```

```
        cin >> rating;

        if (rating < 1 || rating > 5) {
            cout << "Invalid rating." << endl;
            return 0;
        }

        Manager manager(name, id, salary, rating);
        manager.display();
    }

    else if (employeeType == 2) { // Developer
        int extraHours;
        cout << "Enter Extra Hours Worked: ";
        cin >> extraHours;

        if (extraHours < 0 || extraHours > 100) {
            cout << "Invalid extra hours." << endl;
            return 0;
        }

        Developer developer(name, id, salary, extraHours);
        developer.display();
    }

    return 0;
}
```

Output –



```
Enter Employee Type (1 for Manager, 2 for Developer): 1
Enter Name: ABC
Enter ID: 232
Enter Salary: 20000
Enter Performance Rating (1-5): 3
Employee: ABC (ID: 232)
Role: Manager
Base Salary: 20000
Bonus: 6000
Total Earnings: 26000
```

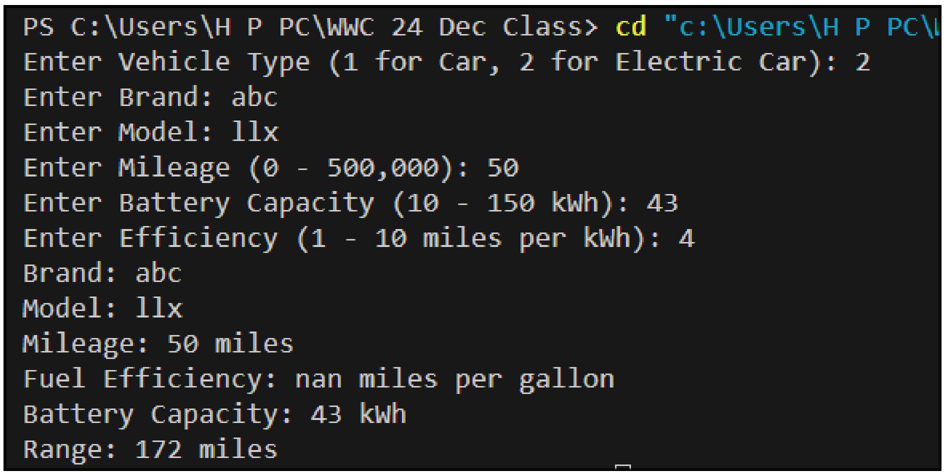
2) Multi-Level Inheritance for Vehicle Simulation

Sol –

```
#include <string>
#include <iostream>

using namespace std;

class Vehicle {
protected:
    string brand;
    string model;
    double mileage;

public:
    Vehicle(const string& b, const string& m, double mil) : brand(b), model(m),
mileage(mil) {}

    virtual void displayDetails() const {
        cout << "Brand: " << brand << endl;
        cout << "Model: " << model << endl;
        cout << "Mileage: " << mileage << " miles" << endl;
    }
};

class Car : public Vehicle {
protected:
    double fuel;
    double distanceCovered;

public:
    Car(const string& b, const string& m, double mil, double f, double d)
        : Vehicle(b, m, mil), fuel(f), distanceCovered(d) {}

    double calculateFuelEfficiency() const {
        return distanceCovered / fuel;
    }

    void displayDetails() const override {
        Vehicle::displayDetails();
        cout << "Fuel Efficiency: " << calculateFuelEfficiency() << " miles per
gallon" << endl;
    }
};

class ElectricCar : public Car {
private:
    double batteryCapacity;
    double efficiency;
```

```
public:
    ElectricCar(const string& b, const string& m, double mil, double cap, double
eff)
        : Car(b, m, mil, 0, 0), batteryCapacity(cap), efficiency(eff) {}

    double calculateRange() const {
        return batteryCapacity * efficiency;
    }

    void displayDetails() const override {
        Car::displayDetails();
        cout<< "Battery Capacity: " << batteryCapacity << " kWh" <<endl;
        cout << "Range: " << calculateRange() << " miles" << endl;
    }
};

int main() {
    int vehicleType;
    string brand, model;
    double mileage, fuel, distance, batteryCapacity, efficiency;

    cout<< "Enter Vehicle Type (1 for Car, 2 for Electric Car): ";
    cin>> vehicleType;

    cout << "Enter Brand: ";
    cin.ignore();
    getline(cin, brand);
    cout << "Enter Model: ";
    getline(cin, model);
    cout << "Enter Mileage (0 - 500,000): ";
    cin >> mileage;

    while (mileage < 0 || mileage > 500000) {
        cout << "Invalid mileage. Please enter a mileage between 0 and 500,000: ";
        cin >> mileage;
    }

    if (vehicleType == 1) {
        cout << "Enter Fuel (1 - 100 gallons): ";
        cin >> fuel;

        while (fuel < 1 || fuel > 100) {
            cout << "Invalid fuel. Please enter a fuel amount between 1 and 100
gallons: ";
            cin >> fuel;
        }

        cout << "Enter Distance Covered (1 - 1,000 miles): ";
        cin >> distance;

        while (distance < 1 || distance > 1000) {
            cout << "Invalid distance. Please enter a distance between 1 and 1,000
miles: ";
            cin >> distance;
        }
        Car car(brand, model, mileage, fuel, distance);
        car.displayDetails();

    } else if (vehicleType == 2) {
        cout << "Enter Battery Capacity (10 - 150 kWh): ";
        cin >> batteryCapacity;

        while (batteryCapacity < 10 || batteryCapacity > 150) {
            cout << "Invalid battery capacity. Please enter a capacity between 10
and 150 kWh: ";
            cin >> batteryCapacity;
        }

        cout << "Enter Efficiency (1 - 10 miles per kWh): ";
        cin >> efficiency;

        while (efficiency < 1 || efficiency > 10) {
            cout << "Invalid efficiency. Please enter an efficiency between 1 and 10
miles per kWh: ";
            cin >> efficiency;
        }

        ElectricCar electricCar(brand, model, mileage, batteryCapacity,
efficiency);
        electricCar.displayDetails();

    } else {
        cout << "Invalid vehicle type." <<endl;
    }

    return 0;
}
```

Output –



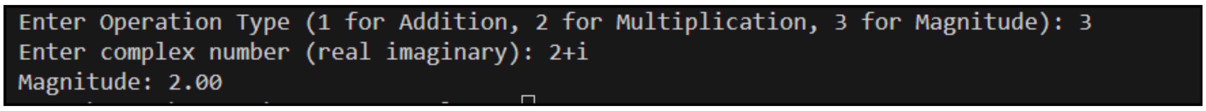
```
PS C:\Users\H P PC\WWC 24 Dec Class> cd "c:\Users\H P PC\
Enter Vehicle Type (1 for Car, 2 for Electric Car): 2
Enter Brand: abc
Enter Model: llx
Enter Mileage (0 - 500,000): 50
Enter Battery Capacity (10 - 150 kWh): 43
Enter Efficiency (1 - 10 miles per kWh): 4
Brand: abc
Model: llx
Mileage: 50 miles
Fuel Efficiency: nan miles per gallon
Battery Capacity: 43 kWh
Range: 172 miles
```

3) Function Overloading for Complex Number Operations.
Sol –

```
#include <iostream>

#include <cmath>

#include <iomanip>


using namespace std;


class Complex {

private:

    double real;

    double imaginary;
```

```
public:
    Complex(double r = 0, double i = 0) : real(r), imaginary(i) {}

    Complex operator+(const Complex& other) const {
        return Complex(real + other.real, imaginary + other.imaginary);
    }

    Complex operator*(const Complex& other) const {
        return Complex(real * other.real - imaginary * other.imaginary,
                       real * other.imaginary + imaginary * other.real);
    }

    double magnitude() const {
        return sqrt(real * real + imaginary * imaginary);
    }

    void display() const {
        if (imaginary >= 0) {
            cout << real << " + " << imaginary << "i" << endl;
        } else {
            cout << real << " - " << -imaginary << "i" << endl;
        }
    }
};

int main() {
    int operationType;
    cout << "Enter Operation Type (1 for Addition, 2 for Multiplication, 3 for
Magnitude): ";
    cin >> operationType;

    if (operationType == 1 || operationType == 2) {
        double real1, imaginary1, real2, imaginary2;
        cout << "Enter first complex number (real1 imaginary1): ";
        cin >> real1 >> imaginary1;
        cout << "Enter second complex number (real2 imaginary2): ";
        cin >> real2 >> imaginary2;

        Complex c1(real1, imaginary1);
        Complex c2(real2, imaginary2);

        if (operationType == 1) {
            Complex result = c1 + c2;
            cout << "Result of Addition: ";
            result.display();
        } else if (operationType == 2) {
            Complex result = c1 * c2;
            cout << "Result of Multiplication: ";
            result.display();
        }
    } else if (operationType == 3) {
        double real, imaginary;
        cout << "Enter complex number (real imaginary): ";
        cin >> real >> imaginary;
        Complex c(real, imaginary);
        double result = c.magnitude();
        cout << "Magnitude: " << fixed << setprecision(2) << result << endl;
    } else {
        cout << "Invalid operation type." << endl;
    }

    return 0;
}
```

Output –



```
Enter Operation Type (1 for Addition, 2 for Multiplication, 3 for Magnitude): 3
Enter complex number (real imaginary): 2+i
Magnitude: 2.00
```

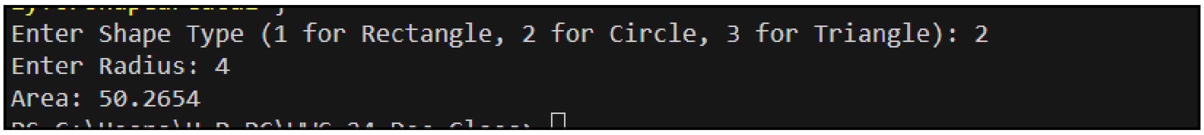
4) Polymorphism for Shape Area Calculations

Sol –

```
#include <iostream>
#include <memory>

using namespace std;

class Shape {
public:
    virtual float calculateArea() const = 0;
    virtual ~Shape() {}
};
```

```
class Rectangle : public Shape {
private:
    float length;
    float width;

public:
    Rectangle(float l, float w) : length(l), width(w) {}

    float calculateArea() const override {
        return length * width;
    }
};

class Circle : public Shape {
private:
    float radius;

public:
    Circle(float r) : radius(r) {}

    float calculateArea() const override {
        return 3.14159f * radius * radius;
    }
};

class Triangle : public Shape {
private:
    float base;
    float height;

public:
    Triangle(float b, float h) : base(b), height(h) {}

    float calculateArea() const override {
        return 0.5f * base * height;
    }
};

int main() {
    int shapeType;
    cout << "Enter Shape Type (1 for Rectangle, 2 for Circle, 3 for Triangle): ";
    cin >> shapeType;

    unique_ptr<Shape> shape;

    if (shapeType == 1) {
        float length, width;
        cout << "Enter Length and Width: ";
        cin >> length >> width;
        shape = make_unique<Rectangle>(length, width);
    } else if (shapeType == 2) {
        float radius;
        cout << "Enter Radius: ";
        cin >> radius;
        shape = make_unique<Circle>(radius);
    } else if (shapeType == 3) {
        float base, height;
        cout << "Enter Base and Height: ";
        cin >> base >> height;
        shape = make_unique<Triangle>(base, height);
    } else {
        cout << "Invalid shape type." << endl;
        return 1;
    }
    cout << "Area: " << shape->calculateArea() << endl;

    return 0;
}
```

Output –

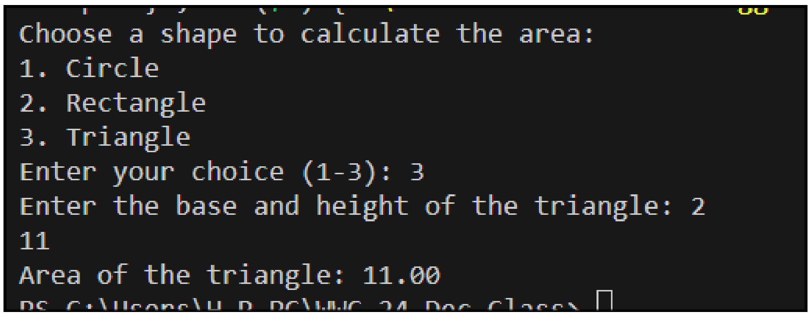


```
Enter Shape Type (1 for Rectangle, 2 for Circle, 3 for Triangle): 2
Enter Radius: 4
Area: 50.2654
```

5) Advanced Function Overloading for Geometric Shapes
Sol –

```
#include <iostream>
#include <iomanip>

using namespace std;

float calculateArea(float radius) {
    return 3.14159f * radius * radius;
}

float calculateArea(float length, float breadth) {
    return length * breadth;
}

float calculateArea(float base, float height, bool isTriangle) {
    return 0.5f * base * height;
}

int main() {
    int choice;
    cout << "Choose a shape to calculate the area:\n";
    cout << "1. Circle\n";
    cout << "2. Rectangle\n";
    cout << "3. Triangle\n";
    cout << "Enter your choice (1-3): ";
    cin >> choice;

    if (choice < 1 || choice > 3) {
        cout << "Invalid choice. Please enter a number between 1 and 3." << endl;
        return 1;
    }

    if (choice == 1) {
        float radius;
        cout << "Enter the radius of the circle: ";

        cin >> radius;

        if (radius <= 0) {

            cout << "Invalid input. Radius must be a positive number." << endl;

            return 1;

        }

        cout << "Area of the circle: " << fixed << setprecision(2) <<
calculateArea(radius) << endl;


    } else if (choice == 2) {

        float length, breadth;

        cout << "Enter the length and breadth of the rectangle: ";

        cin >> length >> breadth;

        if (length <= 0 || breadth <= 0) {

            cout << "Invalid input. Length and breadth must be positive numbers."
<< endl;

            return 1;

        }

        cout << "Area of the rectangle: " << fixed << setprecision(2) <<
calculateArea(length, breadth) << endl;


    } else if (choice == 3) {

        float base, height;

        cout << "Enter the base and height of the triangle: ";

        cin >> base >> height;

        if (base <= 0 || height <= 0) {

            cout << "Invalid input. Base and height must be positive numbers." <<
endl;

            return 1;
        }
        cout << "Area of the triangle: " << fixed << setprecision(2) <<
calculateArea(base, height, true) << endl;
    }

    return 0;
}
```

Output –



```
Choose a shape to calculate the area:
1. Circle
2. Rectangle
3. Triangle
Enter your choice (1-3): 3
Enter the base and height of the triangle: 2
11
Area of the triangle: 11.00
```