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Q1. Calculate the sum of all natural numbers from 1 to n.
Q2. Count the total number of digits in a given number n.
Q3. Write a program to calculate the area of different shapes using function overloading. Implement overloaded functions to compute the area of a circle, a rectangle, and a triangle.
Q4. Design a program to simulate a banking system using polymorphism. Create a base class Account with a virtual method calculateInterest().Use the derived classes to implement specific interest calculation logic:
- SavingsAccount : Interest = Balance × Rate × Time.
- CurrentAccount : No interest, but includes a maintenance fee deduction.
Q5. Create a C++ program to simulate an employee management system using hierarchical inheritance. Design a base class Employee that stores basic details (name, ID, and salary). Create two derived classes:
- Manager: Add and calculate bonuses based on performance ratings.
- Developer: Add and calculate overtime compensation based on extra hours worked.
The program should allow input for both types of employees and display them total earnings.

Solutions :

A1. Sum of natural numbers upto n.

```
#include <iostream>

int sum(int n) { return n * (n + 1) / 2; }

int main() {
    int n = 0;
    std::cin >> n;
    std::cout << "Sum of " << n << " : " << sum(n);
}
```

Output :

```
10
Sum of 10 : 55
```

A2. Count digits in a number.

```
#include <iostream>

int count_digits(int n) {
    int count = 0;
    while(n) {
        count++;
        n /= 10;
    }
    return count;
}
```

```
int main() {
    int n = 0;
    std::cin >> n;
    std::cout << "Digits in " << n << " : " << count_digits(n);
}
```

Output :

```
1056781
Digits in 1056781 : 7
```

A3. Function Overloading for Calculating Area.

```
#include <iostream>

int area(int l, int b) { return l * b; }

float area(int r) { return 3.14 * r * r; }

float area(float h, float b) { return 0.5 * b * h; }

int main() {
    int r_l, r_b, c_r = 0;
    float t_b, t_h = 0;

    std::cout << "Rectangle  : \n";
    std::cin >> r_l;
    std::cin >> r_b;
    std::cout << "Area : " << area(r_l, r_b) << "\n";
    std::cout << "\nCircle  : \n";
    std::cin >> c_r;
    std::cout << "Area : " << area(c_r) << "\n";
    std::cout << "\nTriangle  : \n";
    std::cin >> t_b;
    std::cin >> t_h;
    std::cout << "Area : " << area(t_b, t_h) << "\n";
}
```

Output :

```
Rectangle  :
5
10
Area : 50

Circle  :
21
Area : 1384.74

Triangle  :
5
8
Area : 20
```

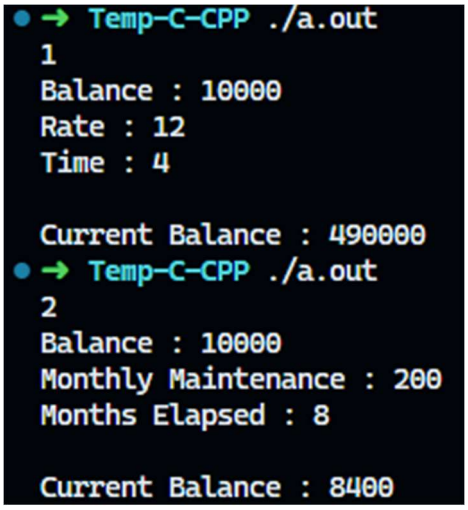
A4. Implement Polymorphism for Banking Transactions

```
#include <iostream>

using namespace std;

typedef unsigned int uint;

class Account {
    protected:
        uint Acc_Id;
        uint Acc_Balance;

    public:
        Account(uint Acc_Id, uint Acc_Balance) {
            this->Acc_Id      = Acc_Id;
            this->Acc_Balance = Acc_Balance;
        }

        virtual ~Account() = default;

        virtual void calculate_interest() = 0;
};

class Savings_Account : public Account {
    private:
        float rate;
        uint  time;

    public:
        Savings_Account(
            uint Acc_Id,
            uint Acc_Balance,
            float rate,
            uint time
        ) : Account(Acc_Id, Acc_Balance) {
            this->rate = rate;
            this->time = time;
        }

        void calculate_interest() {
            float interest = this->rate * this->time * this->Acc_Balance;
            cout << "\nCurrent Balance : " << this->Acc_Balance + interest << "\n";
        }
};

class Current_Account : public Account {
    private:
        uint monthly_maintenance;
        uint months_elapsed;

    public:
        Current_Account(
            uint Acc_Id,
            uint Acc_Balance,
            uint monthly_maintenance,
            uint months_elapsed
```

```
        ) : Account(Acc_Id, Acc_Balance) {
            this->monthly_maintenance = monthly_maintenance;
            this->months_elapsed      = months_elapsed;
        }

        void calculate_interest() {
            float maintenance_charges = months_elapsed * monthly_maintenance;
            if (this->Acc_Balance != 0 && this->Acc_Balance > maintenance_charges)
            {
                cout << "\nCurrent Balance : "
                     << this->Acc_Balance  - maintenance_charges << "\n";
            }
        }
};

int main(int argc, char* argv[]) {
    int n = 0;
    cin >> n;

    switch (n) {
        case 1: {
            uint  Balance = 0;
            float Rate    = 0.0;
            uint  Time    = 0;

            cout << "Balance : ";
            cin >> Balance;
            cout << "Rate : ";
            cin >> Rate;
            cout << "Time : ";
            cin >> Time;

            Savings_Account acc(
                1,
                Balance,
                Rate,
                Time
            );

            acc.calculate_interest();

            break;
        }

        case 2: {
            uint Balance             = 0;
            uint Monthly_Maintenance = 0;
            uint Months_Elapsed      = 0;

            cout << "Balance : ";
            cin >> Balance;
            cout << "Monthly Maintenance : ";
            cin >> Monthly_Maintenance;
            cout << "Months Elapsed : ";
            cin >> Months_Elapsed;
```

```
            Current_Account acc(
                1,
                Balance,
                Monthly_Maintenance,
                Months_Elapsed
            );

            acc.calculate_interest();

            break;
        }

        default:
            cout << "Invalid Choice !";
    }

    return 0;
}
```

Output :



A5. Hierarchical Inheritance for Employee Management System

```
#include <iostream>
#include <limits>

#define BONUS_FOR_RATING 0.1
#define OVERTIME_RATE    500

using namespace std;
typedef unsigned int uint;

class Employee {
    protected:
        uint   Emp_Id;
        string Emp_Name;
        uint   Emp_Salary;
```

```
    public:
        Employee(uint Emp_Id, string& Emp_Name, uint Emp_Salary) {
            this->Emp_Id     = Emp_Id;
            this->Emp_Name   = Emp_Name;
            this->Emp_Salary = Emp_Salary;
        }

        virtual void Display_Employee() = 0;
};

class Manager : public Employee {
    private:
        uint  Rating;
        float Bonus;

    public:
        Manager(uint Emp_Id, string& Emp_Name, uint Emp_Salary, uint Rating)
        : Employee(Emp_Id, Emp_Name, Emp_Salary) {
            if (Rating < MIN_RATING || Rating > MAX_RATING) { this->Rating = 1; }
            else                                           { this->Rating = Rating; }
            this->Bonus  = this->Emp_Salary * this->Rating * BONUS_FOR_RATING;
        }

        void Display_Employee() {
            cout << "Name   : " << this->Emp_Name                << endl
                 << "ID     : " << this->Emp_Id                  << endl
                 << "Salary : " << this->Emp_Salary              << endl
                 << "Bonus  : " << this->Bonus                   << endl
                 << "Total  : " << this->Emp_Salary + this->Bonus << endl;
        }
};

class Developer : public Employee {
    private:
        uint Overtime_Hours;
        uint Overtime_Compensation;

    public:
        Developer(uint Emp_Id, string& Emp_Name, uint Emp_Salary, uint Overtime_Hours) :
        Employee(Emp_Id, Emp_Name, Emp_Salary) {
            this->Overtime_Hours        = Overtime_Hours;
            this->Overtime_Compensation = this->Overtime_Compensation * OVERTIME_RATE;
        }

        void Display_Employee() {
            cout << "Name                  : " << this->Emp_Name << endl
                 << "ID                    : " << this->Emp_Id << endl
                 << "Salary                : " << this->Emp_Salary << endl
                 << "Overtime Compensation : " << this->Overtime_Compensation << endl
                 << "Total                 : " << this->Emp_Salary +
                                                    this->Overtime_Compensation << endl;
        }
};

int main(int argc, char* argv[]) {
    int  n      = 0;
    uint id     = 0;
    uint salary = 0;
    uint rating = 0;
    uint ot_hrs = 0;
    string Name;
```

```
    cin >> n;
    cin.ignore(numeric_limits<streamsize>::max(), '\n');

    switch (n) {
        case 1: {
            cout << "Name : ";
            getline(cin, Name);
            cin.clear();
            cin.sync();
            cout << "Salary : ";
            cin >> salary;
            cout << "Rating (1 - 5) : ";
            cin >> rating;

            Manager mgr(1, Name, salary, rating);
            mgr.Display_Employee();
            break;
        }

        case 2: {
            cout << "Name : ";
            getline(cin, Name);
            cin.clear();
            cin.sync();
            cout << "Salary : ";
            cin >> salary;
            cout << "Overtime Hours : ";
            cin >> ot_hrs;

            Developer dev(1, Name, salary, ot_hrs);
            dev.Display_Employee();
            break;
        }
    }
    return 0;
}
```

Output :