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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:

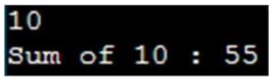
- SavingsAccount : Interest = Balance × Rate × Time.
- CurrentAccount : No interest, but includes a maintenance fee deduction. Q5. Create a C++ program to simulate an employee management system using hierarchical inheritance. Design a base class Employee that stores basic details (name, ID, and salary). 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 :

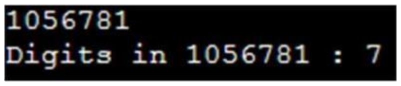


```
10
Sum of 10 : 55
```

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 :

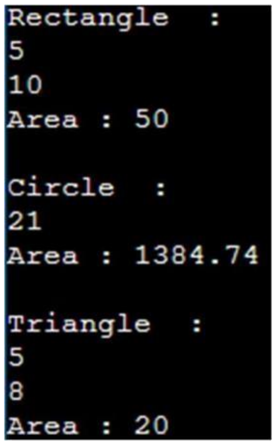


```
1056781
Digits in 1056781 : 7
```

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 :



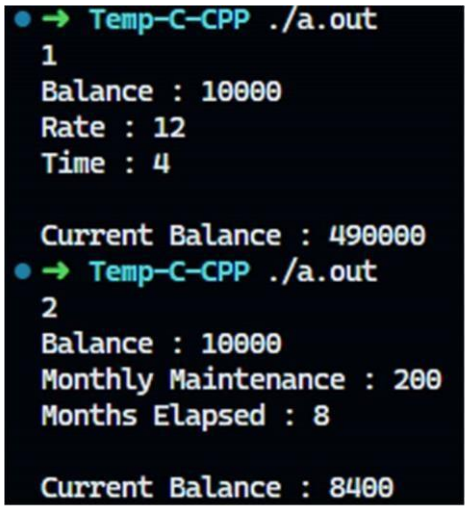
```
Rectangle  :
5
10
Area : 50

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 :



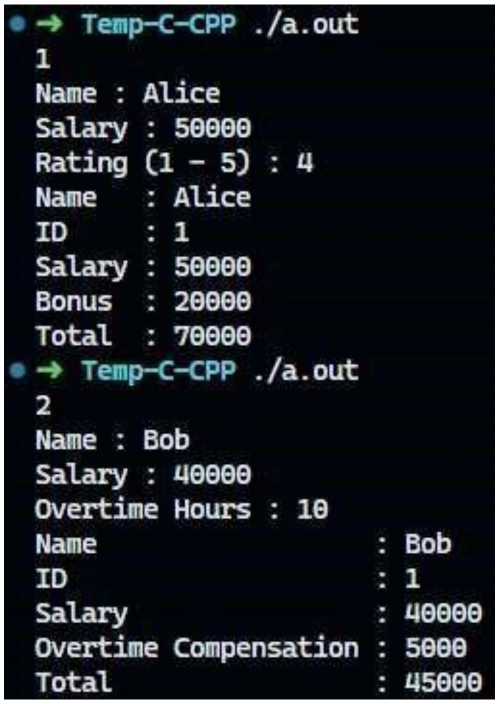
```
● → Temp-C-CPP ./a.out
  1
  Balance : 10000
  Rate : 12
  Time : 4

  Current Balance : 490000
● → Temp-C-CPP ./a.out
  2
  Balance : 10000
  Monthly Maintenance : 200
  Months Elapsed : 8

  Current Balance : 8400
```

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 :



```
● → Temp-C-CPP ./a.out
  1
  Name : Alice
  Salary : 50000
  Rating (1 - 5) : 4
  Name   : Alice
  ID     : 1
  Salary : 50000
  Bonus  : 20000
  Total  : 70000
● → Temp-C-CPP ./a.out
  2
  Name : Bob
  Salary : 40000
  Overtime Hours : 10
  Name                  : Bob
  ID                    : 1
  Salary                : 40000
  Overtime Compensation : 5000
  Total                 : 45000
```