DATA STRUCTURES & ALGORITHMS LAB

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SEPTEMBER 14, 2024

SAP ID: 55412

Lab 03

Write a program in C++ that takes integer type 2D array from user, calculate sum multiplication and average of all numbers.

```
#include <iostream>
using namespace std;
int main()
{

	int w[2][2]{}, a[2][2]{}, sum, mul, avg;
	for (int i = 0; i < 2; i++)
	{
		for (int j = 0; j < 2; j++)
		{
			cout << "\n Enter element [" << i + 1 << "] Enter element [" << j + 1 << "] in the first array = ";
			cin >> w[i][j];
		}
	}
	for (int i = 0; i < 2; i++)
	{
		for (int j = 0; j < 2; j++)
		{
			cout << "\n Enter element [" << i + 1 << "] Enter element [" << j + 1 << "] in the second array = ";
			cin >> a[i][j];
		}
```

```
    }
    for (int i = 0; i < 2; i++)
    {
        for (int j = 0; j < 2; j++)
        {
            sum = w[i][j] + a[i][j];
            mul = w[i][j] * a[i][j];
            avg = sum / 4;
        }
    }
    cout << "\n Sum = " << sum << endl;
    cout << "\n Multiplication = " << mul << endl;
    cout << "\n Average = " << avg << endl;
    return 0;
}
```

Output

```
Enter element [1] Enter element [1] in the first array = 1
Enter element [1] Enter element [2] in the first array = 2
Enter element [2] Enter element [1] in the first array = 3
Enter element [2] Enter element [2] in the first array = 4
Enter element [1] Enter element [1] in the second array = 5
Enter element [1] Enter element [2] in the second array = 6
Enter element [2] Enter element [1] in the second array = 7
Enter element [2] Enter element [2] in the second array = 8
Sum = 12
Multiplication = 32
```

Write a program in C++ to swap values of two variables using pointers.

```
#include <iostream>
using namespace std;
int main()
{
        int a = 10, b = 20, temp = 0;
        int* ptrx = &a, * ptry = &b;
        cout << "\n Before Swapping a = " << a << " and b = " << b <<
endl;
        temp = *ptrx;
        *ptrx = *ptry;
        *ptry = temp;
        cout << "\n After Swapping a = " << a << " and b = " << b << endl;
```

```
    return 0;
}
```

Output

```
Before Swapping a = 10 and b = 20

After Swapping a = 20 and b = 10
```

Write a program that lets the user to enter the 10 values into the array. The program should then display the largest and the smallest value stored in the array.

```
#include <iostream>
using namespace std;
int main()
{
    int a[10]{}, min, max = 0;
    for (int i = 0; i < 10; i++)
    {
        cout << "\n Enter elements [" << i + 1 << "] in the array = ";
        cin >> a[i];
    }
    for (int i = 0; i < 10; i++)
    {
        if (a[i] > max)
        {
```

```
                max = a[i];
        }
    }
    min = a[0];
    for (int i = 0; i < 10; i++)
    {
        if (a[i] < min)
        {
            min = a[i];
        }
    }
    cout << "\n Maximum value = " << max << endl;
    cout << "\n Minimum value = " << min << endl;
    return 0;
}
```

Output

```
Enter elements [1] in the array = 9
Enter elements [2] in the array = 8
Enter elements [3] in the array = 6
Enter elements [4] in the array = 12
Enter elements [5] in the array = 12
Enter elements [6] in the array = 44
Enter elements [7] in the array = 9
Enter elements [8] in the array = 3
Enter elements [9] in the array = 10
Enter elements [10] in the array = 19
Maximum value = 44
Minimum value = 3
```

Write a program that lets the user to enter the total rainfall for each of 12 months into an array of doubles. The program should calculate and display the total rainfall of the year, the average monthly rainfall and the month with the highest and lowest rainfall.

```
#include <iostream>
using namespace std;
int main()
{
```

```
    const int Months = 12;
    double rainfall[Months]{}, totalRainfall = 0, averageRainfall,
highestRainfall = 0, lowestRainfall = 0;
    int highestMonth = 0, lowestMonth = 0;
    cout << "\n Enter the total rainfall for each of the 12 Months: " <<
endl;
    for (int i = 0; i < Months; i++)
    {
        cout << " Month " << (i + 1) << " = ";
        cin >> rainfall[i];
        totalRainfall = totalRainfall + rainfall[i];
        if (i == 0 || rainfall[i] > highestRainfall)
        {
            highestRainfall = rainfall[i];
            highestMonth = i;
        }
        if (i == 0 || rainfall[i] < lowestRainfall)
        {
            lowestRainfall = rainfall[i];
            lowestMonth = i;
        }
    }
    averageRainfall = totalRainfall / Months;
    cout << "\n Total rainfall for the year = " << totalRainfall << endl;
    cout << " Average monthly rainfall = " << averageRainfall << endl;
    cout << " Month with the Highest Rainfall = Month " <<
(highestMonth + 1) << " (" << highestRainfall <<")" << endl;
    cout << " Month with the Lowest Rainfall = Month " << (lowestMonth
+ 1) << " (" << lowestRainfall <<")" << endl;
```

```
    return 0;
}
```

Output

```
Enter the total rainfall for each of the 12 Months:
Month 1 = 10.4
Month 2 = 10.98
Month 3 = 11.34
Month 4 = 12.43
Month 5 = 13.45
Month 6 = 15.9
Month 7 = 17.01
Month 8 = 16.678
Month 9 = 12.34
Month 10 = 13.54
Month 11 = 13.6
Month 12 = 13.10

Total rainfall for the year = 160.768
Average monthly rainfall = 13.3973
Month with the Highest Rainfall = Month 7 (17.01)
Month with the Lowest Rainfall = Month 1 (10.4)
```

Write a program that creates a two-dimensional array initialized with test data.

Perform the following operations on the array data.

Get total: get total of all the elements in the array.

Get Average: calculate the average of all the values in the array.

Get row total: calculate the total of all the values in the specified row.

Get column total: calculate the total of all the values in the specified column.

Get Highest in row: find the highest value in the specified row.

Get Highest in Column: find the highest value in the specified column.

```
#include <iostream>
using namespace std;
int main()
{
   const int Rows = 3;
   const int Columns = 4;
   int a[Rows][Columns] = {
      {20, 40, 60, 80},
      {100, 120, 140, 160},
      {180, 200, 220, 240}
   };
   int total = 0;
   for (int i = 0; i < Rows; i++)
   {
      for (int j = 0; j < Columns; j++)
      {
         total = total + a[i][j];
      }
   }
```

```
   cout << "\n Total of all elements = " << total << endl;
   double average = static_cast<double>(total) / (Rows *
Columns);//converting total, rows and columns in datatype double
   cout << "\n Average of all elements = " << average << endl;
   int row = 1;
   int rowTotal = 0;
   for (int j = 0; j < Columns; j++)
   {
      rowTotal = rowTotal + a[row][j];
   }
   cout << "\n Total of elements in row " << row << " = " << rowTotal <<
endl;
   int col = 2;
   int colTotal = 0;
   for (int i = 0; i < Rows; i++)
   {
      colTotal = colTotal + a[i][col];
   }
   cout << "\n Total of elements in column " << col << " = " << colTotal
<< endl;
   int HighestInRow = a[row][0];
   for (int j = 1; j < Columns; j++)
   {
      if (a[row][j] > HighestInRow)
      {
         HighestInRow = a[row][j];
      }
   }
```

```
   cout << "\n Highest value in row " << row << " = " << HighestInRow
<< endl;
   int HighestInColumn = a[0][col];
   for (int i = 1; i < Rows; i++)
   {
      if (a[i][col] > HighestInColumn)
      {
         HighestInColumn = a[i][col];
      }
   }
   cout << "\n Highest value in column " << col << " = " <<
HighestInColumn << endl;
   return 0;
        }
```

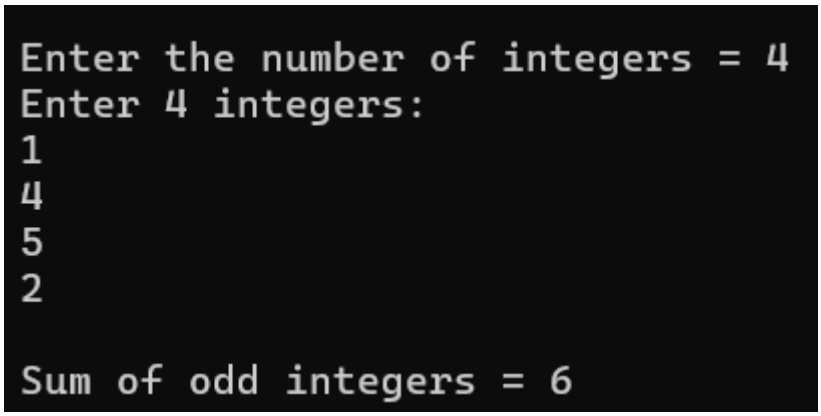
Output

```
Total of all elements = 1560

Average of all elements = 130

Total of elements in row 1 = 520

Total of elements in column 2 = 420

Highest value in row 1 = 160

Highest value in column 2 = 220
```

Write a program that dynamically allocates an array of integers. Read the values from user and calculate the sum of odd integers.

```
#include <iostream>
using namespace std;
int main()
{
   int size;
   cout << "\n Enter the number of integers = ";
   cin >> size;
   int* o = new int[size];
   cout << " Enter " << size << " integers: " << endl;
   for (int i = 0; i < size; i++)
   {
      cout << " ";
      cin >> o[i];
   }
   int OddSum = 0;
   for (int i = 0; i < size; i++)
   {
      if (o[i] % 2 != 0)
      {
         OddSum += o[i];
      }
   }
   cout << "\n Sum of odd integers = " << OddSum << endl;
   delete[] o;
   return 0;
       }
```

Output



Define a pointer variable. Assign the address of variable to a pointer variable and access the value of address variable in the pointer variable.

In C++, pointers are variables that store the memory addresses of other variables.

```
#include <iostream>
using namespace std;
int main()
{
   int num = 4;
   int* ptr = &num;
   cout << "\n The value of num = " << num << endl;
   cout << " The address of num = " << &num << endl;
   cout << " The address stored in pointer variable ptr = " << ptr <<
endl;
```

```
   cout << " The value of num accessed using the pointer = " << *ptr <<
endl;
   return 0;
        }
```

Output

```
The value of num = 4
The address of num = 000000F98119F9D4
The address stored in pointer variable ptr = 000000F98119F9D4
The value of num accessed using the pointer = 4
```

Write a program that asks the user to enter integers as inputs to be stored in the variables 'a' and 'b' respectively. There are also two integer pointers named ptrA and ptrB. Assign the values of 'a' and 'b' to ptrA and ptrB respectively and display them.

```
#include <iostream>
using namespace std;
int main()
{
   int a, b;
   int* ptrA;
   int* ptrB;
   cout << "\n Enter the value for a = ";
   cin >> a;
   cout << " Enter the value for b = ";
   cin >> b;
   ptrA = &a;
   ptrB = &b;
```

```
    cout << "\n The value of a is = " << *ptrA << endl;
    cout << " The value of b is = " << *ptrB << endl;
    return 0;
}
```

Output

```
Enter the value for a = 4
Enter the value for b = 7

The value of a is = 4
The value of b is = 7
```

Write a program for a calculator using functions.

Your program must have the following functions:

a. Menu () telling the user to select from the options

b. Addition (int a, int b) adding two numbers

c. Subtraction (int a, int b)

d. Division (int a, int b)

e. Multiplication (int a, int b)

f. Pow (int number, int pow)

In the main function you will only call the menu () function.

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

```
void Menu();
int Addition(int a, int b);
int Subtraction(int a, int b);
int Multiplication(int a, int b);
double Division(int a, int b);
int Pow(int number, int power);
void Menu()
{
   int choice;
   int num1, num2, result;
   do {
      cout << "\n Calculator Menu:" << endl;
      cout << " 1. Addition" << endl;
      cout << " 2. Subtraction" << endl;
      cout << " 3. Multiplication" << endl;
      cout << " 4. Division" << endl;
      cout << " 5. Power" << endl;
      cout << " 6. Exit" << endl;
      cout << " Enter your choice (1-6) = ";
      cin >> choice;

      switch (choice)
      {
      case 1:
         cout << "\n Enter first integer = ";
         cin >> num1;
         cout << " Enter second integer = ";
         cin >> num2;
         result = Addition(num1, num2);
```

```
    cout << "Result = " << result << endl;
    break;
case 2:
    cout << "\n Enter first integer = ";
    cin >> num1;
    cout << " Enter second integer = ";
    cin >> num2;
    result = Subtraction(num1, num2);
    cout << " Result = " << result << endl;
    break;
case 3:
    cout << "\n Enter first integer =: ";
    cin >> num1;
    cout << "\n Enter second integer = ";
    cin >> num2;
    result = Multiplication(num1, num2);
    cout << " Result = " << result << endl;
    break;
case 4:
    cout << "\n Enter first integer = ";
    cin >> num1;
    cout << "\n Enter second integer = ";
    cin >> num2;
    if (num2 == 0)
    {
       cout << " Error! Division by zero not possible" << endl;
    }
    else
    {
```

```
            double divResult = Division(num1, num2);
            cout << " Result = " << divResult << endl;
        }
        break;
    case 5:
        cout << "\n Enter the base number = ";
        cin >> num1;
        cout << " Enter the power = ";
        cin >> num2;
        result = Pow(num1, num2);
        cout << " Result = " << result << endl;
        break;
    case 6:
        cout << "\n Exiting the calculator..." << endl;
        break;
    default:
        cout << "\n Invalid choice! Please try again." << endl;
    }
  } while (choice != 6);
}
int Addition(int a, int b)
{
  return a + b;
}
int Subtraction(int a, int b)
{
  return a - b;
}
int Multiplication(int a, int b)
```

```
{
   return a * b;
}
double Division(int a, int b)
{
   return static_cast<double>(a) / b;
}
int Pow(int number, int power)
{
   return static_cast<int>(pow(number, power));
}
int main()
{
   Menu();
   return 0;
}
```

Output

```
Calculator Menu:
1. Addition
2. Subtraction
3. Multiplication
4. Division
5. Power
6. Exit
Enter your choice (1-6) = 7

Invalid choice! Please try again.

Calculator Menu:
1. Addition
2. Subtraction
3. Multiplication
4. Division
5. Power
6. Exit
Enter your choice (1-6) = 5

Enter the base number = 2
Enter the power = 4
Result = 16

Calculator Menu:
1. Addition
2. Subtraction
3. Multiplication
4. Division
5. Power
6. Exit
Enter your choice (1-6) = 6

Exiting the calculator...
```