MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY
“KHARKIV POLYTECHNIC INSTITUTE”
DEPARTMENT OF SOFTWARE ENGINEERING AND MANAGEMENT
INFORMATION TECHNOLOGIES”

Report of laboratory work № 2
Discipline «Software Engineering»

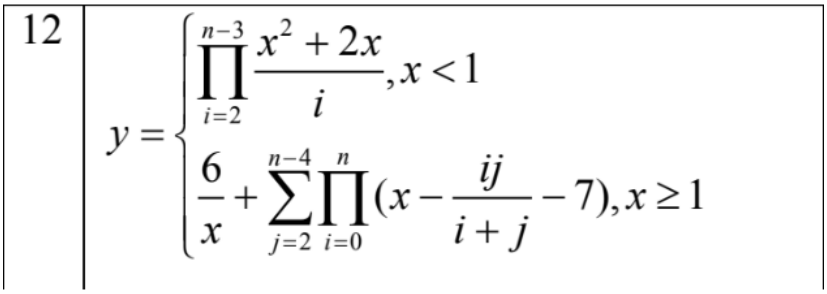
Executed by: Student of group KN-224a.e
Kirichok O.
Checked by: Associate professor
Melnyk K.V.

Kharkiv
2021

**Theme**: Coding of domain

**Work objective**: Learn principles of C++

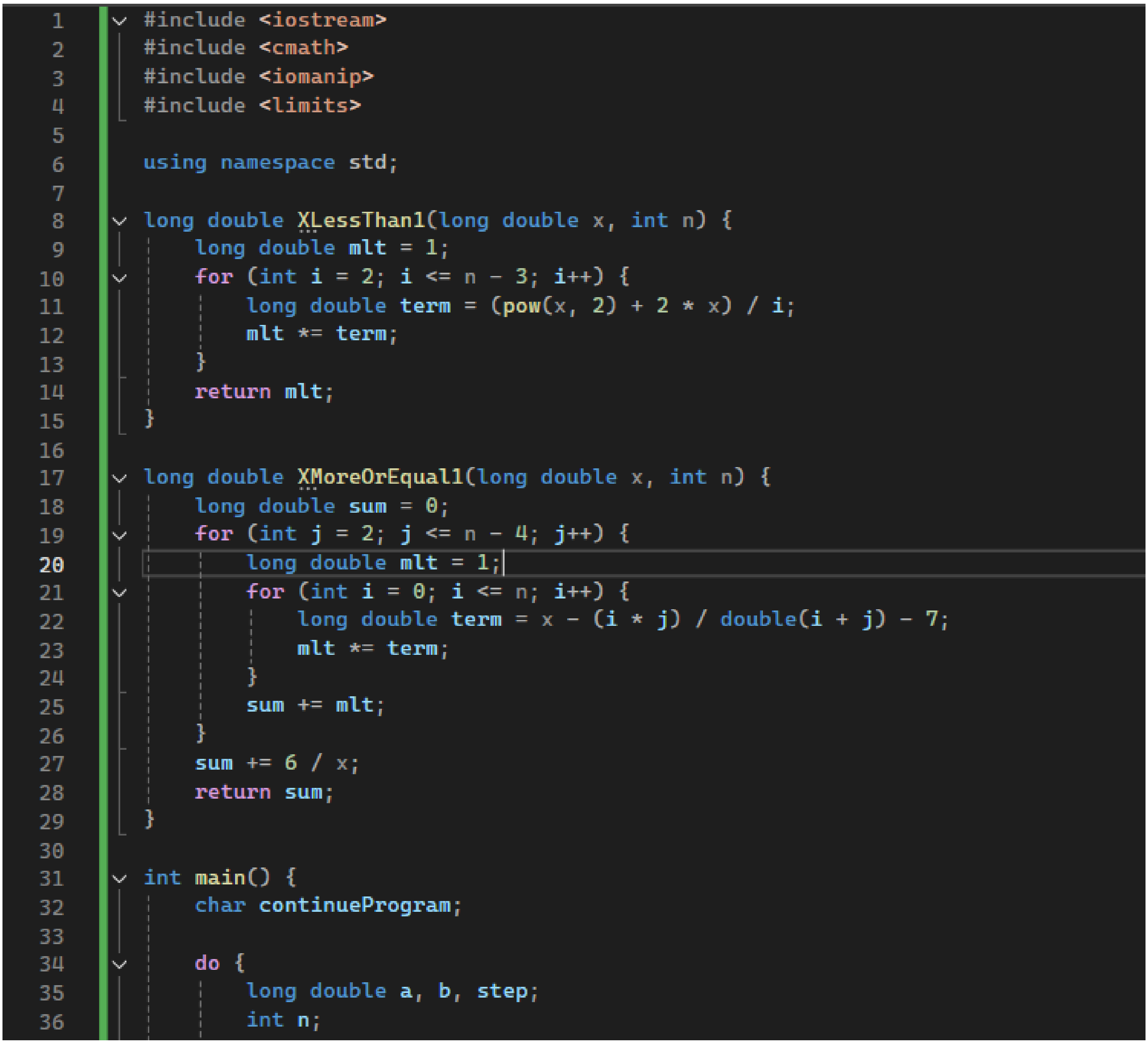
**Task**:



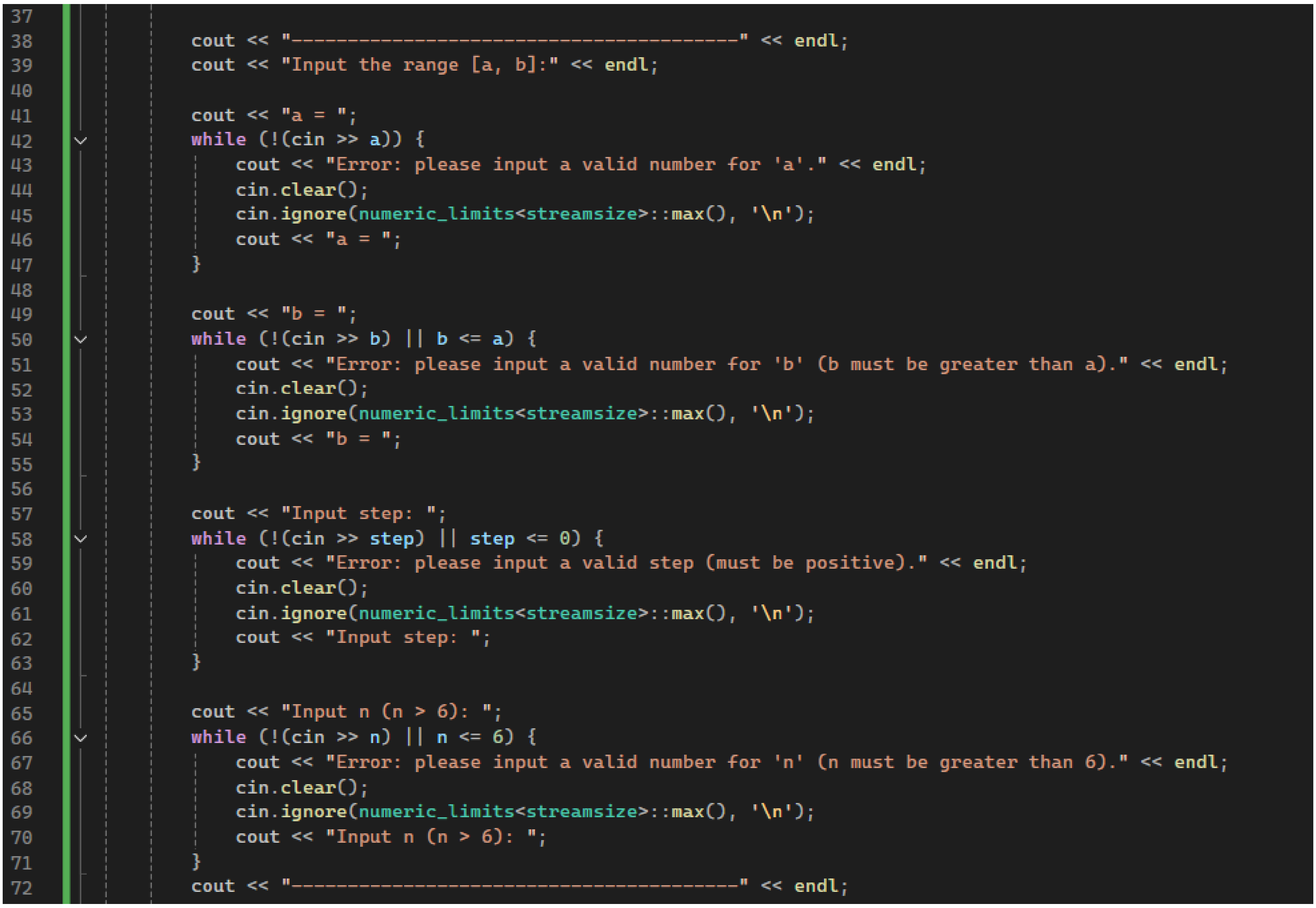
| | |
|---|---|
| 12 | $y=\begin{cases}\prod_{i=2}^{n-3}\frac{x^2+2x}{i}, x<1\\ \frac{6}{x}+\sum_{j=2}^{n-4}\prod_{i=0}^{n}(x-\frac{ij}{i+j}-7), x\geq 1\end{cases}$ |

## Progress of work:

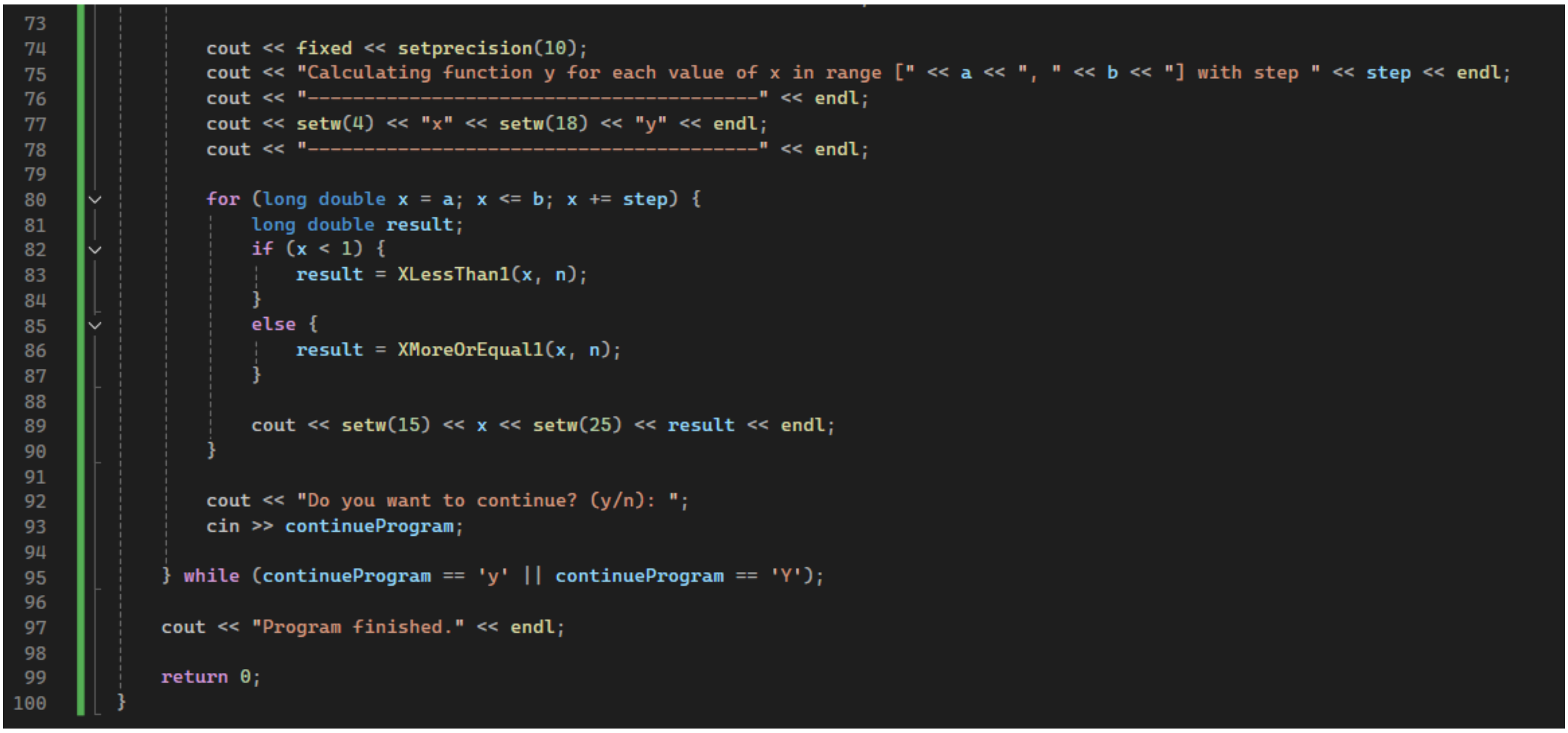
1. **The code:**



```cpp
#include <iostream>
#include <cmath>
#include <iomanip>
#include <limits>

using namespace std;

long double XLessThan1(long double x, int n) {
    long double mlt = 1;
    for (int i = 2; i <= n - 3; i++) {
        long double term = (pow(x, 2) + 2 * x) / i;
        mlt *= term;
    }
    return mlt;
}

long double XMoreOrEqual1(long double x, int n) {
    long double sum = 0;
    for (int j = 2; j <= n - 4; j++) {
        long double mlt = 1;
        for (int i = 0; i <= n; i++) {
            long double term = x - (i * j) / double(i + j) - 7;
            mlt *= term;
        }
        sum += mlt;
    }
    sum += 6 / x;
    return sum;
}

int main() {
    char continueProgram;

    do {
        long double a, b, step;
        int n;
```

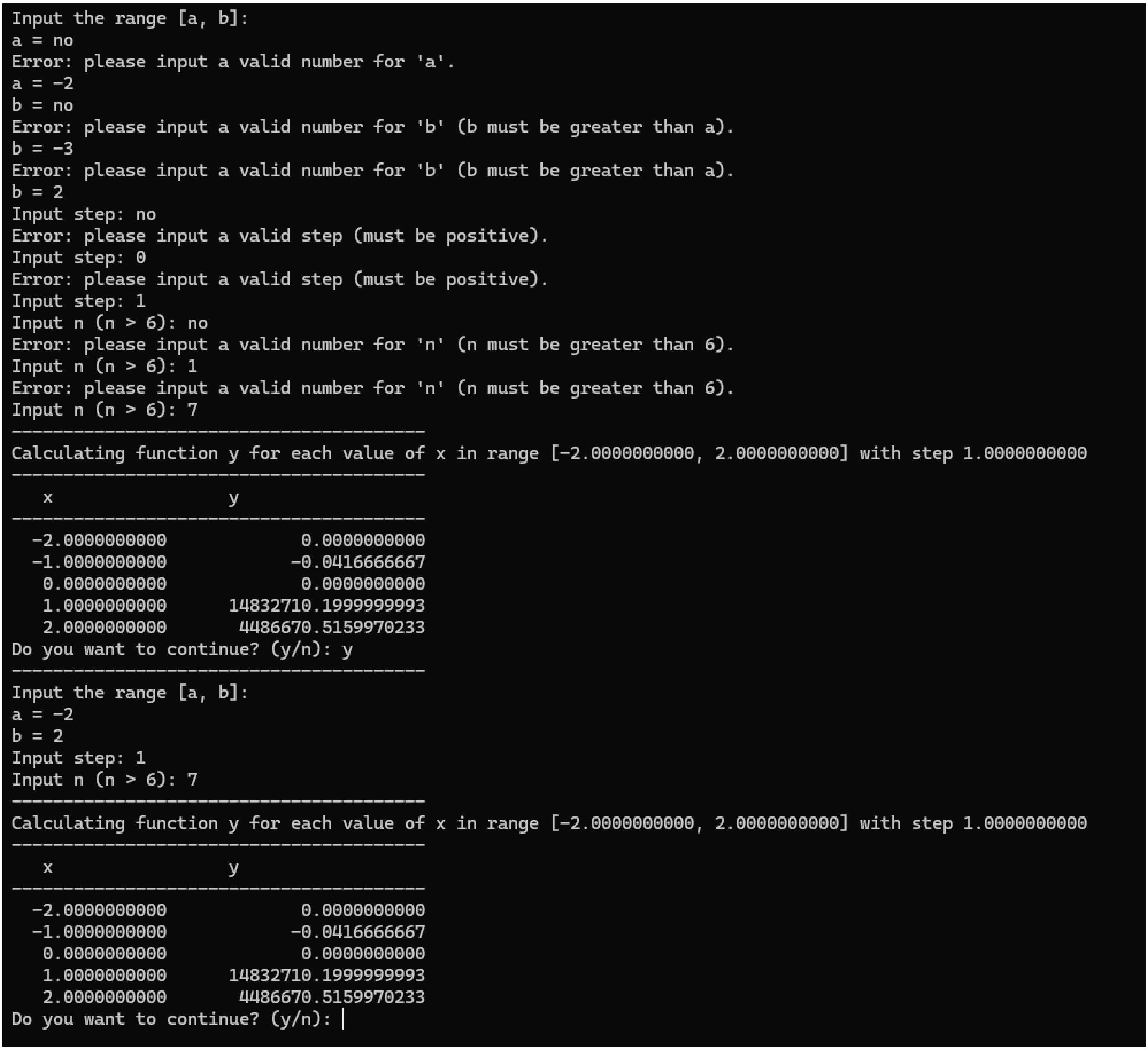


```cpp

        cout << "----------------------------------------" << endl;
        cout << "Input the range [a, b]:" << endl;

        cout << "a = ";
        while (!(cin >> a)) {
            cout << "Error: please input a valid number for 'a'." << endl;
            cin.clear();
            cin.ignore(numeric_limits<streamsize>::max(), '\n');
            cout << "a = ";
        }

        cout << "b = ";
        while (!(cin >> b) || b <= a) {
            cout << "Error: please input a valid number for 'b' (b must be greater than a)." << endl;
            cin.clear();
            cin.ignore(numeric_limits<streamsize>::max(), '\n');
            cout << "b = ";
        }

        cout << "Input step: ";
        while (!(cin >> step) || step <= 0) {
            cout << "Error: please input a valid step (must be positive)." << endl;
            cin.clear();
            cin.ignore(numeric_limits<streamsize>::max(), '\n');
            cout << "Input step: ";
        }

        cout << "Input n (n > 6): ";
        while (!(cin >> n) || n <= 6) {
            cout << "Error: please input a valid number for 'n' (n must be greater than 6)." << endl;
            cin.clear();
            cin.ignore(numeric_limits<streamsize>::max(), '\n');
            cout << "Input n (n > 6): ";
        }
        cout << "----------------------------------------" << endl;
```



```cpp

        cout << fixed << setprecision(10);
        cout << "Calculating function y for each value of x in range [" << a << ", " << b << "] with step " << step << endl;
        cout << "----------------------------------------" << endl;
        cout << setw(4) << "x" << setw(18) << "y" << endl;
        cout << "----------------------------------------" << endl;

        for (long double x = a; x <= b; x += step) {
            long double result;
            if (x < 1) {
                result = XLessThan1(x, n);
            }
            else {
                result = XMoreOrEqual1(x, n);
            }

            cout << setw(15) << x << setw(25) << result << endl;
        }

        cout << "Do you want to continue? (y/n): ";
        cin >> continueProgram;

    } while (continueProgram == 'y' || continueProgram == 'Y');

    cout << "Program finished." << endl;

    return 0;
}
```

## 2. How it works:



```
Input the range [a, b]:
a = no
Error: please input a valid number for 'a'.
a = -2
b = no
Error: please input a valid number for 'b' (b must be greater than a).
b = -3
Error: please input a valid number for 'b' (b must be greater than a).
b = 2
Input step: no
Error: please input a valid step (must be positive).
Input step: 0
Error: please input a valid step (must be positive).
Input step: 1
Input n (n > 6): no
Error: please input a valid number for 'n' (n must be greater than 6).
Input n (n > 6): 1
Error: please input a valid number for 'n' (n must be greater than 6).
Input n (n > 6): 7
----------------------------------------
Calculating function y for each value of x in range [-2.0000000000, 2.0000000000] with step 1.0000000000
----------------------------------------
   x                 y
----------------------------------------
  -2.0000000000             0.0000000000
  -1.0000000000            -0.0416666667
   0.0000000000             0.0000000000
   1.0000000000      14832710.1999999993
   2.0000000000       4486670.5159970233
Do you want to continue? (y/n): y
----------------------------------------
Input the range [a, b]:
a = -2
b = 2
Input step: 1
Input n (n > 6): 7
----------------------------------------
Calculating function y for each value of x in range [-2.0000000000, 2.0000000000] with step 1.0000000000
----------------------------------------
   x                 y
----------------------------------------
  -2.0000000000             0.0000000000
  -1.0000000000            -0.0416666667
   0.0000000000             0.0000000000
   1.0000000000      14832710.1999999993
   2.0000000000       4486670.5159970233
Do you want to continue? (y/n): 
```

The program calculates a function y for different values of x within a range [a, b] using a specified step size. It starts by asking the user for input values (a, b, step, and n), validating that the inputs are correct (e.g., b > a, step > 0, and n > 6).

For each x in the range:

- If x < 1, it calls XLessThan1(x, n) to compute a product of terms.
- If x >= 1, it calls XMoreOrEqual1(x, n) to compute a sum of products.

The results are output in a formatted table with precision and aligned columns. The program continues to run until the user decides to exit.

**Conclusions**: during execution of this laboratory training I got skills and knowledge about C++ language and learned how to develop code.