BINARY SOLUTIONS

MAT 275
Generation of Powers of 2 Sequence in C++

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Introduction

This program generates a sequence of numbers that are powers of 2, starting from 1 and continuing until the largest power of 2 that is less than 1000. It demonstrates the usage of bitwise left shift operator (<<) for efficient computation.

Problem Statement

The task is to generate a sequence of powers of 2 up to the largest power of 2 that is less than 1000 and store them in a vector for further processing.

Solution Steps

- Initialize an empty vector ‘v’ to store the generated sequence.
- Set ‘k’ and ‘value’ to 1, representing the exponent and the corresponding power of 2 respectively.
- Use a while loop to generate powers of 2 until the value exceeds 1000.
- Within the loop, push the current value to the vector ‘v’, update the exponent ‘k’, and compute the next power of 2 using bitwise left shift operation ‘(1 << k)’.
- Output the generated sequence stored in the vector v.

Pseudo Code

1. Include necessary header files (iostream, vector).
2. Begin main function.
    2.1 Declare an empty vector 'v' to store powers of 2.
    2.2 Initialize variables 'k' and 'value' to 1.
    2.3 While 'value' is less than 1000:
        2.3.1 Add 'value' to the vector 'v'.
        2.3.2 Increment 'k' to calculate the next power of 2.
        2.3.3 Calculate the next power of 2 using left bit shift and assign it to 'value'.
    2.4 Output the label "v: ".
    2.5 Iterate over each element in 'v':
        2.5.1 Output the current element followed by a space.
    2.6 Output a newline.
    2.7 End main function.

C++ Code

```
#include <iostream>
#include <vector>
using namespace std;
int main() {
    vector<int> v;
    int k = 1;
    int value = 1;
    while (value < 1000) {
        v.push_back(value);
        k++; // Update k
        value = 1 << k;
    }
    cout << "v: ";
    for (int i = 0; i < v.size(); ++i) {
        cout << v[i] << " ";
    }
    cout << endl
    return 0;
}
```

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Code Explanation

- **#include <iostream>#include <vector>using namespace std;**

These lines include necessary header files.

- **int main() {**

This line marks the beginning of the main function, which serves as the entry point of the program.

- **vector<int> v;**

This line declares a vector named ‘v’ that will store integer values. It's initially empty.

- **int k = 1; int value = 1;**

These lines declare and initialize two integer variables ‘k’ and ‘value’.

- **while (value < 1000) {**

This line begins a while loop that continues as long as the value of ‘value’ is less than 1000.

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Code Explanation

- **v.push_back(value);**

This line adds the current value of ‘value’ (which represents a power of 2) to the end of the vector ‘v’.

- **k++;**

This line increments the exponent ‘k’ to calculate the next power of 2.

- **value = 1 << k;**

This line calculates the next power of 2 using left bit shift (<<).

- **} cout << "v: ";**

This line outputs the label "v: " to indicate the start of the vector's elements.

- **for (int i = 0; i < v.size(); ++i) {**

This line begins a for loop that iterates over each element of the vector ‘v’, starting from index ‘0’ up to ‘v.size() – 1’.

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Code Explanation

- **cout << v[i] << " ";**

This line outputs the value of the current element of the vector ‘v’, followed by a space.

- **} cout << endl;**

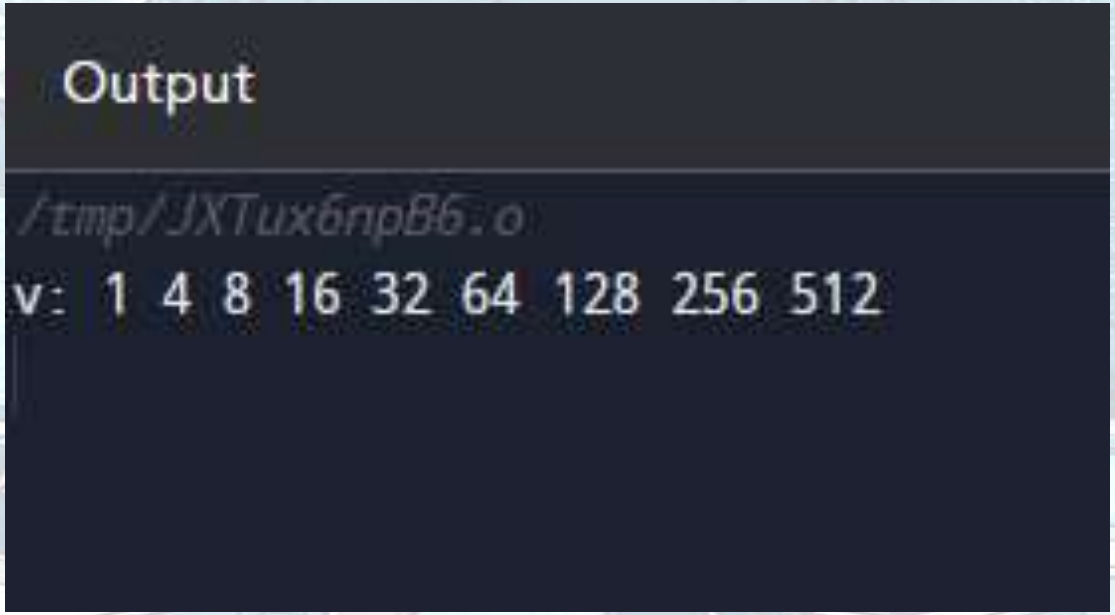
This line outputs a newline character to move to the next line after printing all elements of the vector.

- **return 0;}**

This line indicates the end of the ‘main’ function and returns an integer value of ‘0’ to the operating system, typically indicating successful execution.

Final Answer

The final output is the vector v containing powers of 2 up to the point where the value reaches or exceeds 1000.



Additional Comments/Tips

- Understand the concept of bitwise left shift operator (<<) and its application in generating powers of 2.
- Verify the correctness of the generated sequence to ensure that it meets the specified criteria.

Conclusion

This program demonstrates an efficient approach to generate a sequence of powers of 2 in C++, showcasing the versatility of bitwise operations for mathematical computations.