DAA LAB ASSIGNMENT 4

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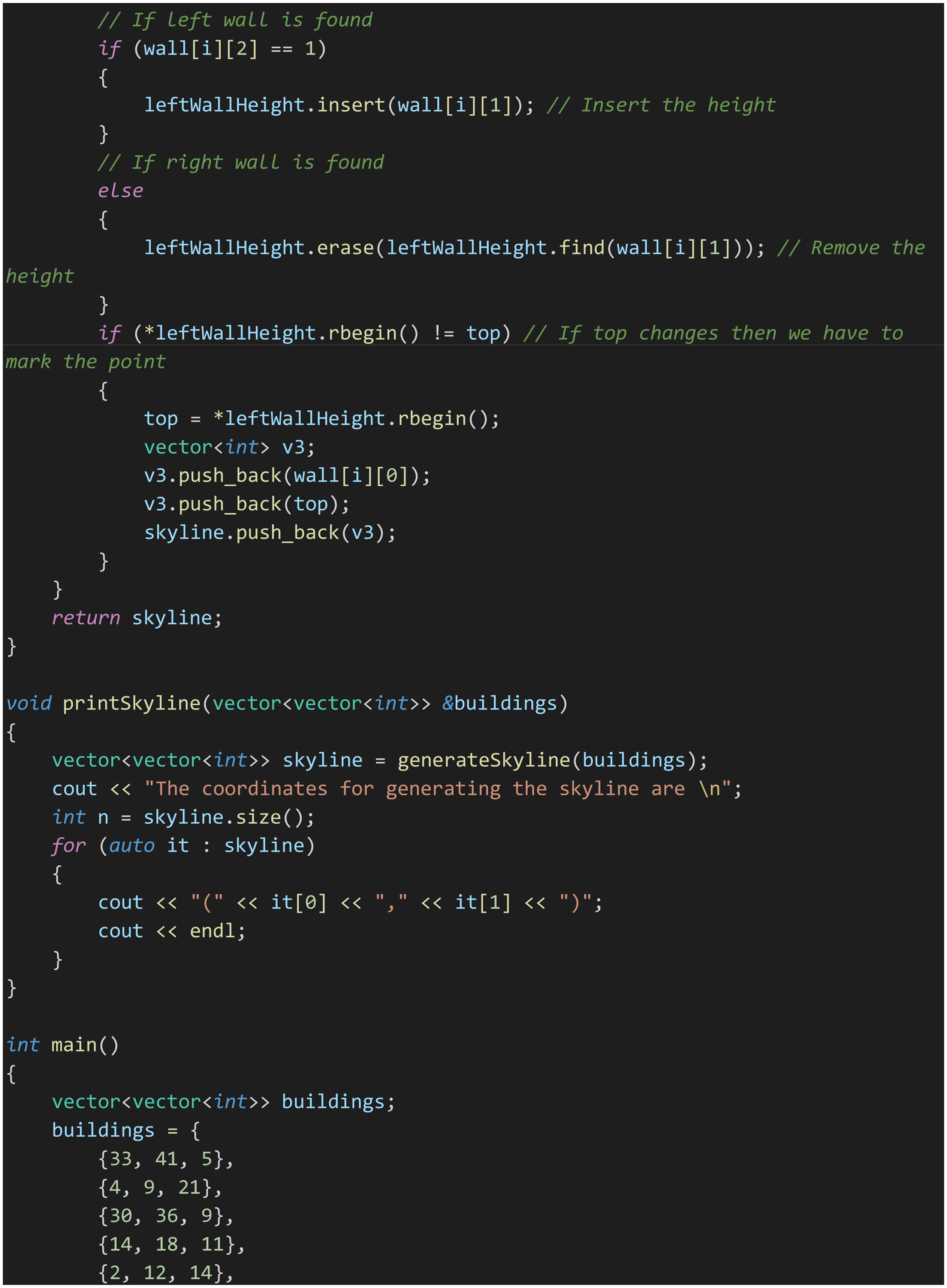
1.1

CODE

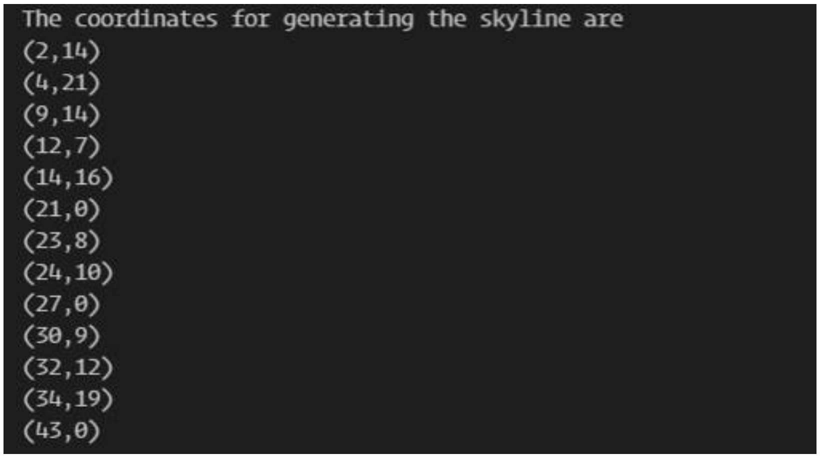
```
#include <bits/stdc++.h>
using namespace std;

bool comp(const vector<int> &v1, const vector<int> &v2)
{
    return v1[0] < v2[0];
}

vector<vector<int>> generateSkyline(vector<vector<int>> &buildings)
{
    int N = buildings.size();
    vector<vector<int>> wall;
    int left, right, height;
    for (int i = 0; i < N; i++)
    {
        left = buildings[i][0];
        right = buildings[i][1];
        height = buildings[i][2];

        vector<int> v1, v2;
        v1.push_back(left);
        v1.push_back(height);
        v1.push_back(1); // 1 for left wall

        v2.push_back(right);
        v2.push_back(height);
        v2.push_back(0); // 0 for right wall

        wall.push_back(v1); // Storing the left and height
        wall.push_back(v2); // Storing the right and height
    }
    sort(wall.begin(), wall.end(), comp); // Comparator to avoid duplicate /
redundant points with same x coordinate
    vector<vector<int>> skyline;
    multiset<int> leftWallHeight = {0};    // Initializing multiset
    int top = 0;                           // Current max height among walls
    for (int i = 0; i < wall.size(); i++) // Traverse through the sorted walls
    {
```



```
        // If left wall is found
        if (wall[i][2] == 1)
        {
            leftWallHeight.insert(wall[i][1]); // Insert the height
        }
        // If right wall is found
        else
        {
            leftWallHeight.erase(leftWallHeight.find(wall[i][1])); // Remove the
height
        }
        if (*leftWallHeight.rbegin() != top) // If top changes then we have to
mark the point
        {
            top = *leftWallHeight.rbegin();
            vector<int> v3;
            v3.push_back(wall[i][0]);
            v3.push_back(top);
            skyline.push_back(v3);
        }
    }
    return skyline;
}

void printSkyline(vector<vector<int>> &buildings)
{
    vector<vector<int>> skyline = generateSkyline(buildings);
    cout << "The coordinates for generating the skyline are \n";
    int n = skyline.size();
    for (auto it : skyline)
    {
        cout << "(" << it[0] << "," << it[1] << ")";
        cout << endl;
    }
}

int main()
{
    vector<vector<int>> buildings;
    buildings = {
        {33, 41, 5},
        {4, 9, 21},
        {30, 36, 9},
        {14, 18, 11},
        {2, 12, 14},
        {34, 43, 19},
        {23, 25, 8},
        {14, 21, 16},
        {32, 37, 12},
        {7, 16, 7},
        {24, 27, 10}};
    printSkyline(buildings);
}
```

OUTPUT

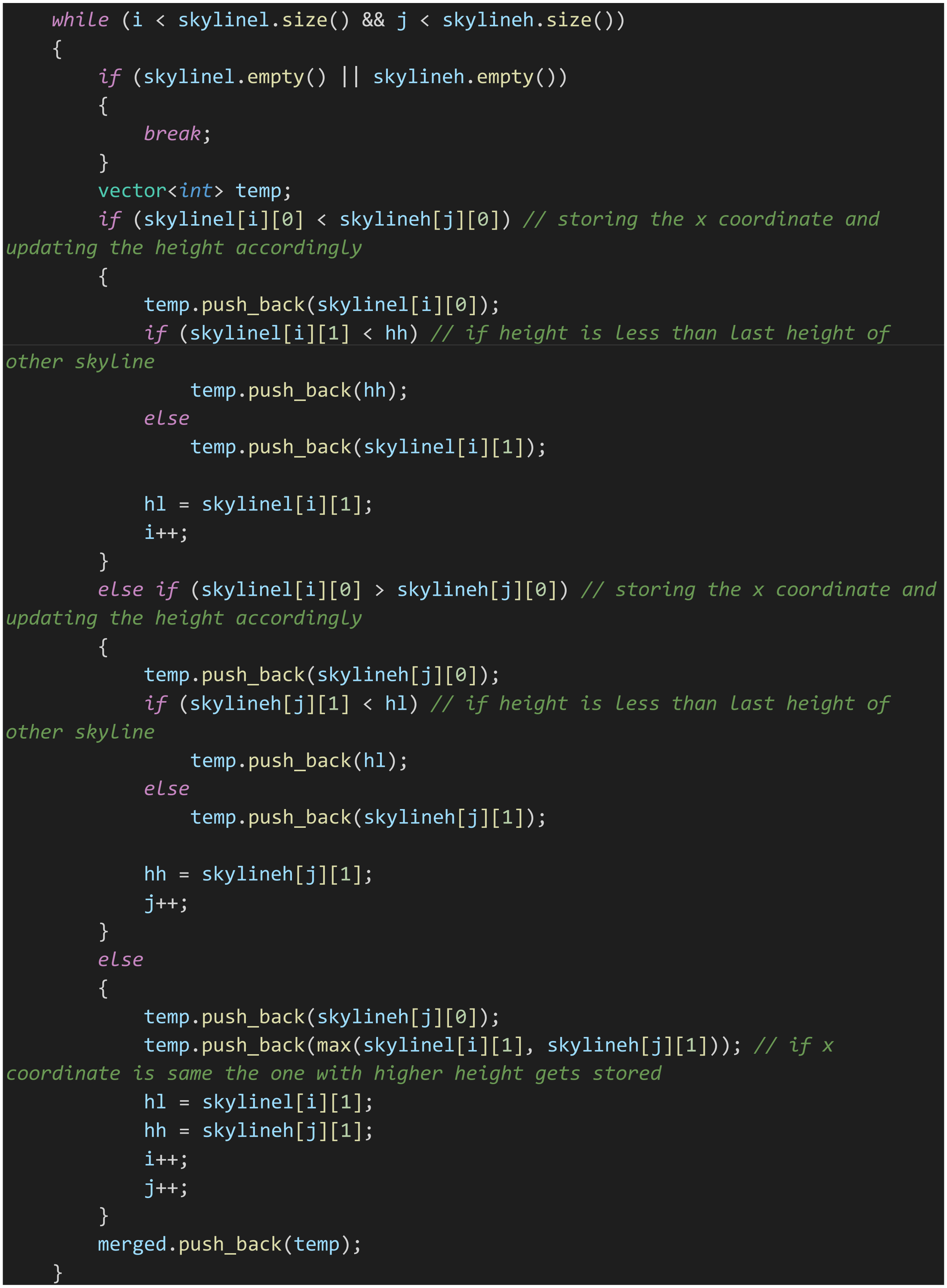
1.2



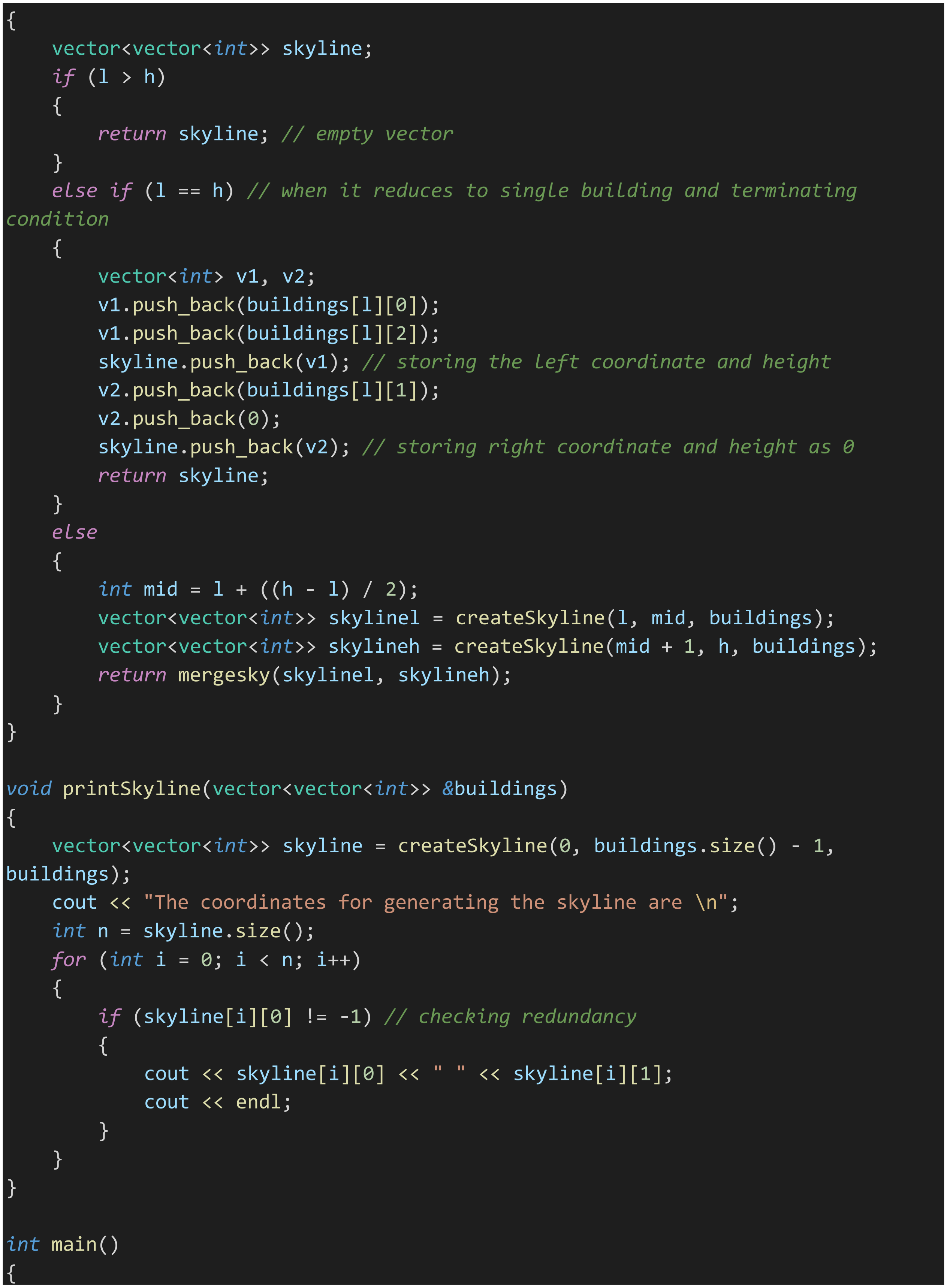
```
The coordinates for generating the skyline are
(2,14)
(4,21)
(9,14)
(12,7)
(14,16)
(21,0)
(23,8)
(24,10)
(27,0)
(30,9)
(32,12)
(34,19)
(43,0)
```

CODE

```
#include <bits/stdc++.h>
using namespace std;

struct point
{
    int x;
    int y;
};

vector<vector<int>> mergesky(vector<vector<int>> &skylinel, vector<vector<int>> 
&skylineh)
{
    int hl = 0, hh = 0; // to strore the previous heights of skylines
    int i = 0, j = 0;
    vector<vector<int>> merged; // to store the final output
```

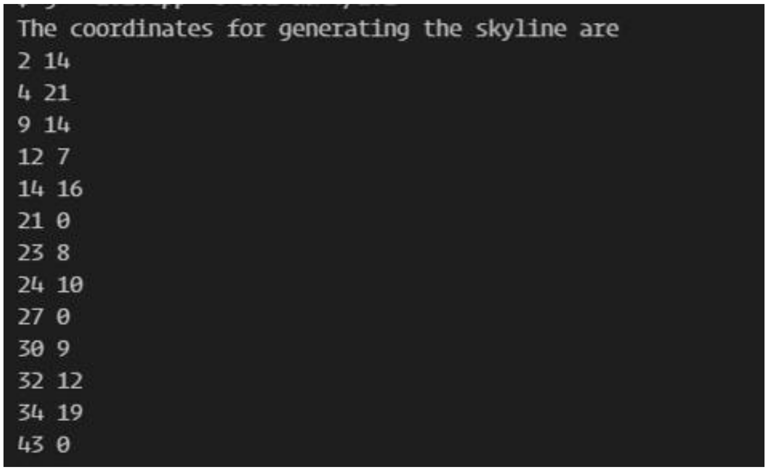


```
    while (i < skylinel.size() && j < skylineh.size())
    {
        if (skylinel.empty() || skylineh.empty())
        {
            break;
        }
        vector<int> temp;
        if (skylinel[i][0] < skylineh[j][0]) // storing the x coordinate and
updating the height accordingly
        {
            temp.push_back(skylinel[i][0]);
            if (skylinel[i][1] < hh) // if height is less than last height of
other skyline
                temp.push_back(hh);
            else
                temp.push_back(skylinel[i][1]);

            hl = skylinel[i][1];
            i++;
        }
        else if (skylinel[i][0] > skylineh[j][0]) // storing the x coordinate and
updating the height accordingly
        {
            temp.push_back(skylineh[j][0]);
            if (skylineh[j][1] < hl) // if height is less than last height of
other skyline
                temp.push_back(hl);
            else
                temp.push_back(skylineh[j][1]);

            hh = skylineh[j][1];
            j++;
        }
        else
        {
            temp.push_back(skylineh[j][0]);
            temp.push_back(max(skylinel[i][1], skylineh[j][1])); // if x
coordinate is same the one with higher height gets stored
            hl = skylinel[i][1];
            hh = skylineh[j][1];
            i++;
            j++;
        }
        merged.push_back(temp);
    }
    if (i >= skylinel.size()) // to store the left out points
    {
        while (j < skylineh.size())
        {
            vector<int> temp;
            temp.push_back(skylineh[j][0]);
            temp.push_back(skylineh[j][1]);
            merged.push_back(temp);
            j++;
        }
    }
    if (j >= skylineh.size()) // to store the left out points
    {
        while (i < skylinel.size())
        {
            vector<int> temp;
            temp.push_back(skylinel[i][0]);
            temp.push_back(skylinel[i][1]);
            merged.push_back(temp);
            i++;
        }
    }
    int ind = 1;
    vector<int> redun;
    redun.push_back(0);
    while (ind < merged.size())
    {
        if (merged[ind][1] == merged[ind - 1][1]) // to remove the redundant
points
            redun.push_back(1);
        else
            redun.push_back(0);
        ind++;
    }
    for (i = 0; i < redun.size(); i++)
    {
        if (redun[i] == 1)
            merged[i][0] = -1;
    }

    return merged;
}

vector<vector<int>> createSkyline(int l, int h, vector<vector<int>> &buildings)
```



```cpp
{
    vector<vector<int>> skyline;
    if (l > h)
    {
        return skyline; // empty vector
    }
    else if (l == h) // when it reduces to single building and terminating
condition
    {
        vector<int> v1, v2;
        v1.push_back(buildings[l][0]);
        v1.push_back(buildings[l][2]);
        skyline.push_back(v1); // storing the left coordinate and height
        v2.push_back(buildings[l][1]);
        v2.push_back(0);
        skyline.push_back(v2); // storing right coordinate and height as 0
        return skyline;
    }
    else
    {
        int mid = l + ((h - l) / 2);
        vector<vector<int>> skylinel = createSkyline(l, mid, buildings);
        vector<vector<int>> skylineh = createSkyline(mid + 1, h, buildings);
        return mergesky(skylinel, skylineh);
    }
}

void printSkyline(vector<vector<int>> &buildings)
{
    vector<vector<int>> skyline = createSkyline(0, buildings.size() - 1,
buildings);
    cout << "The coordinates for generating the skyline are \n";
    int n = skyline.size();
    for (int i = 0; i < n; i++)
    {
        if (skyline[i][0] != -1) // checking redundancy
        {
            cout << skyline[i][0] << " " << skyline[i][1];
            cout << endl;
        }
    }
}

int main()
{
    vector<vector<int>> buildings;
    buildings = {
        {33, 41, 5},
        {4, 9, 21},
        {30, 36, 9},
        {14, 18, 11},
        {2, 12, 14},
        {34, 43, 19},
        {23, 25, 8},
        {14, 21, 16},
        {32, 37, 12},
        {7, 16, 7},
        {24, 27, 10}};
    printSkyline(buildings);
}
```

OUTPUT

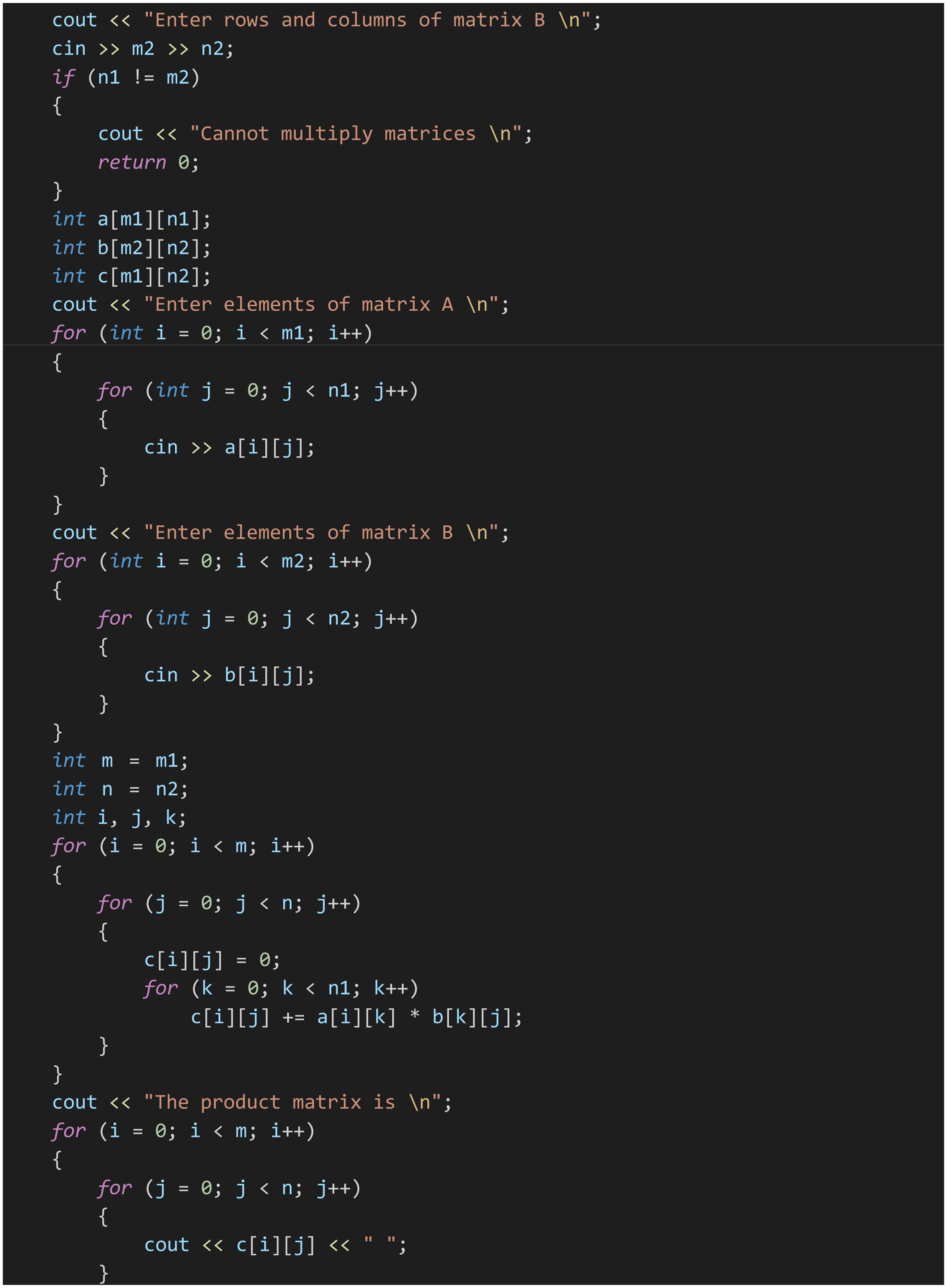


```
The coordinates for generating the skyline are
2 14
4 21
9 14
12 7
14 16
21 0
23 8
24 10
27 0
30 9
32 12
34 19
43 0
```

2.1

CODE

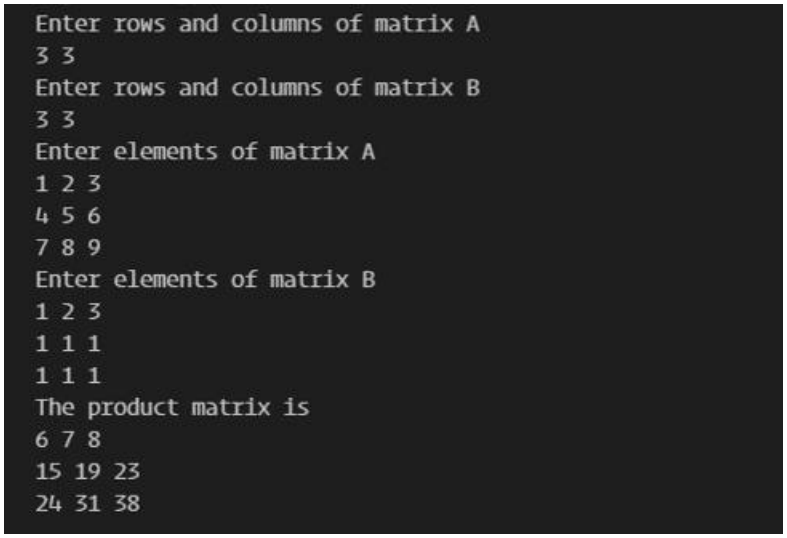
```
#include <bits/stdc++.h>
using namespace std;

int main()
{
    int m1, n1, m2, n2;
    cout << "Enter rows and columns of matrix A \n";
    cin >> m1 >> n1;
```



```
    cout << "Enter rows and columns of matrix B \n";
    cin >> m2 >> n2;
    if (n1 != m2)
    {
        cout << "Cannot multiply matrices \n";
        return 0;
    }
    int a[m1][n1];
    int b[m2][n2];
    int c[m1][n2];
    cout << "Enter elements of matrix A \n";
    for (int i = 0; i < m1; i++)
    {
        for (int j = 0; j < n1; j++)
        {
            cin >> a[i][j];
        }
    }
    cout << "Enter elements of matrix B \n";
    for (int i = 0; i < m2; i++)
    {
        for (int j = 0; j < n2; j++)
        {
            cin >> b[i][j];
        }
    }
    int m = m1;
    int n = n2;
    int i, j, k;
    for (i = 0; i < m; i++)
    {
        for (j = 0; j < n; j++)
        {
            c[i][j] = 0;
            for (k = 0; k < n1; k++)
                c[i][j] += a[i][k] * b[k][j];
        }
    }
    cout << "The product matrix is \n";
    for (i = 0; i < m; i++)
    {
        for (j = 0; j < n; j++)
        {
            cout << c[i][j] << " ";
        }
        cout << endl;
    }
}
```

OUTPUT

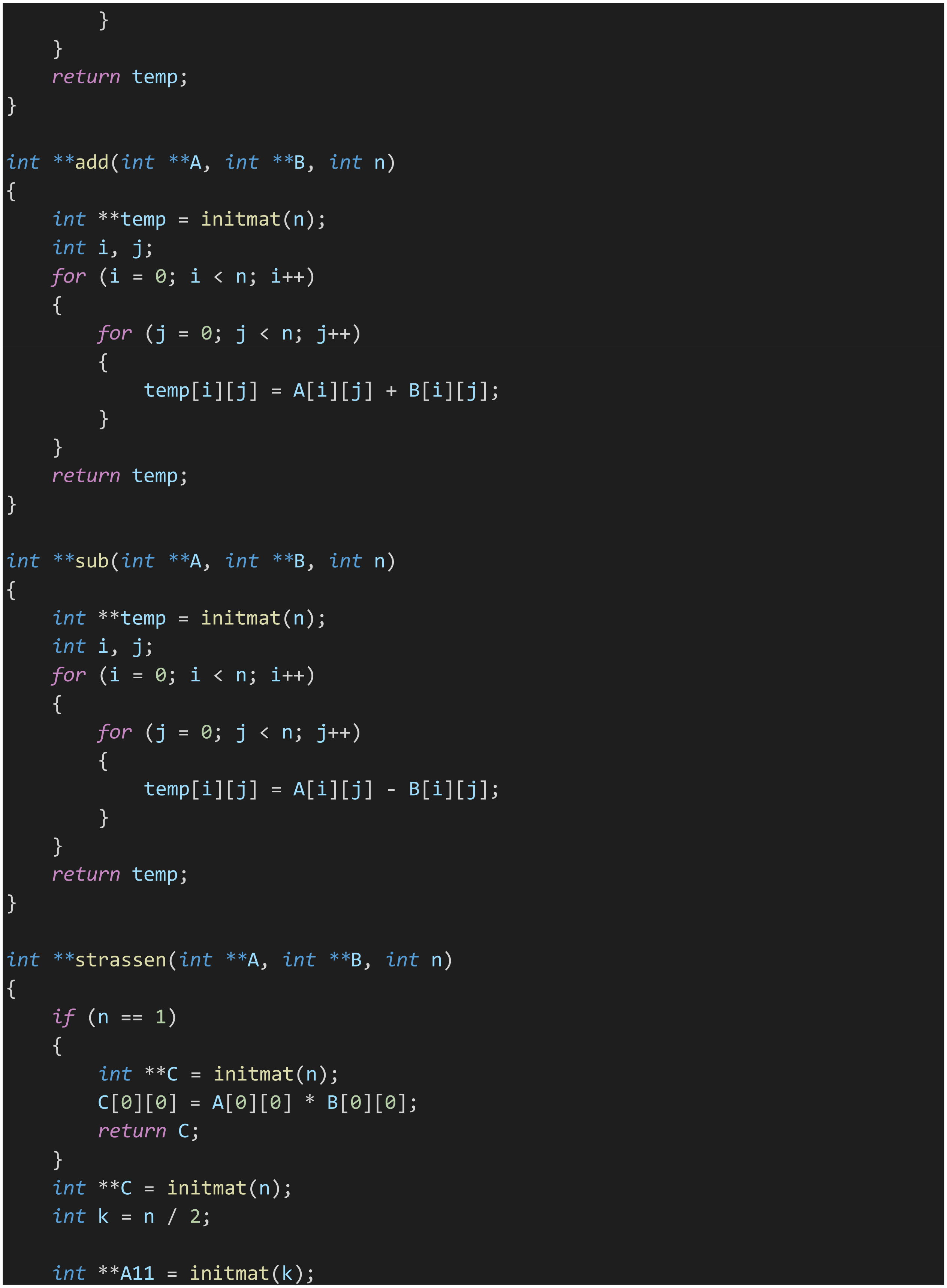
2.2



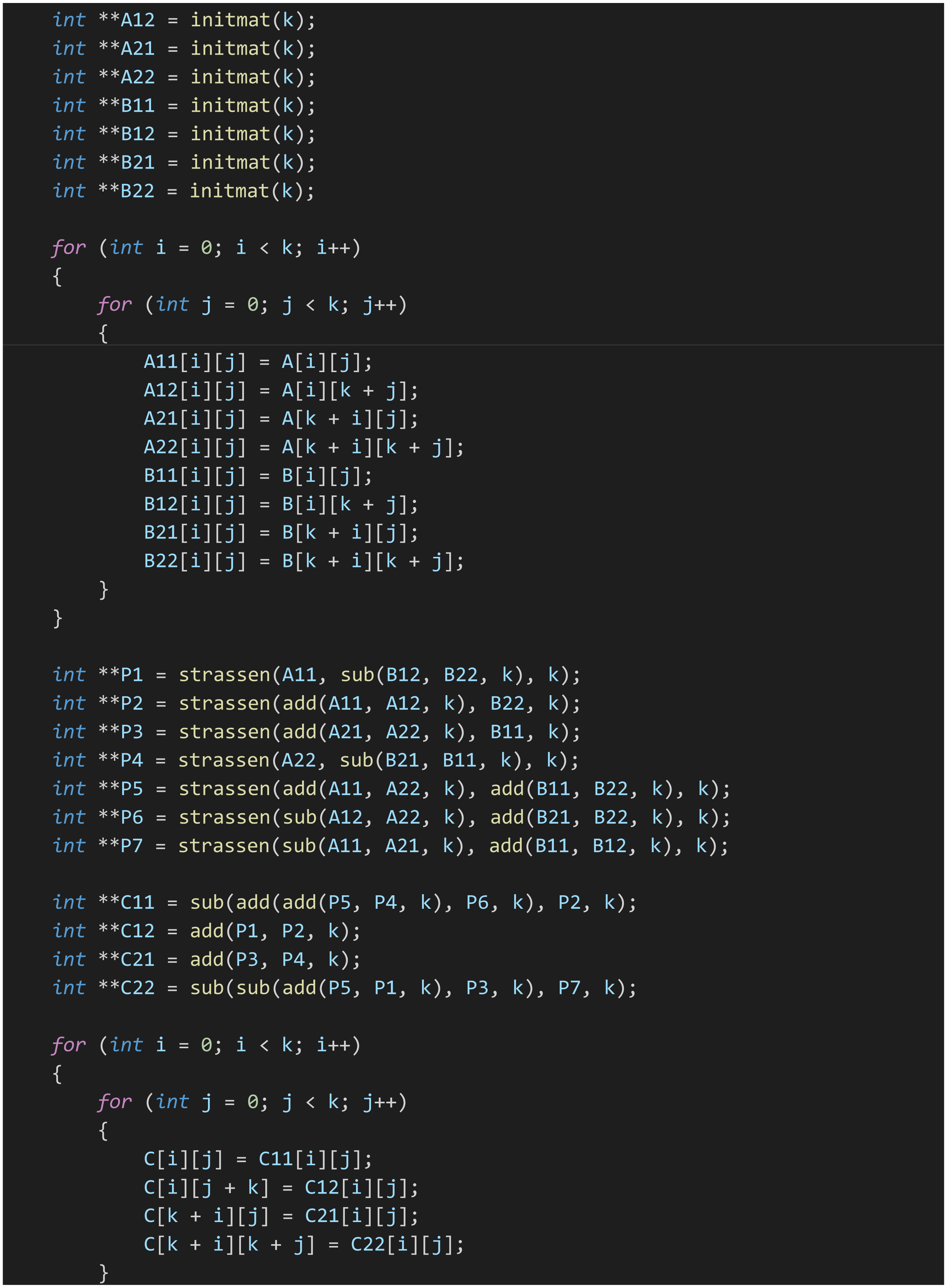
```
Enter rows and columns of matrix A
3 3
Enter rows and columns of matrix B
3 3
Enter elements of matrix A
1 2 3
4 5 6
7 8 9
Enter elements of matrix B
1 2 3
1 1 1
1 1 1
The product matrix is
6 7 8
15 19 23
24 31 38
```

CODE

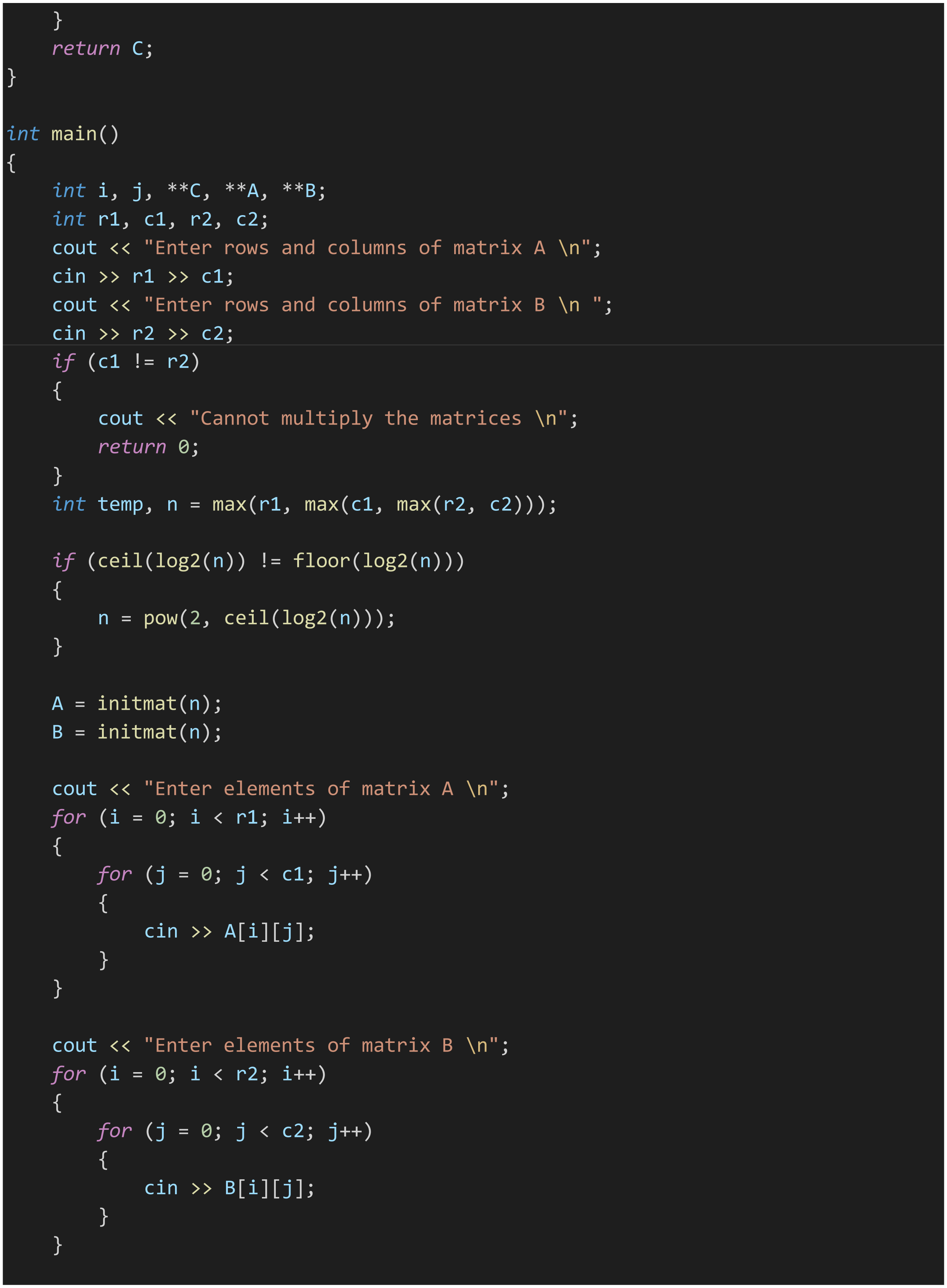
```
#include <bits/stdc++.h>
using namespace std;
typedef long long ll;

int **initmat(int n)
{
    int **temp = new int *[n];
    int i, j;
    for (i = 0; i < n; i++)
    {
        temp[i] = new int[n];
    }
    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n; j++)
        {
            temp[i][j] = 0;
```



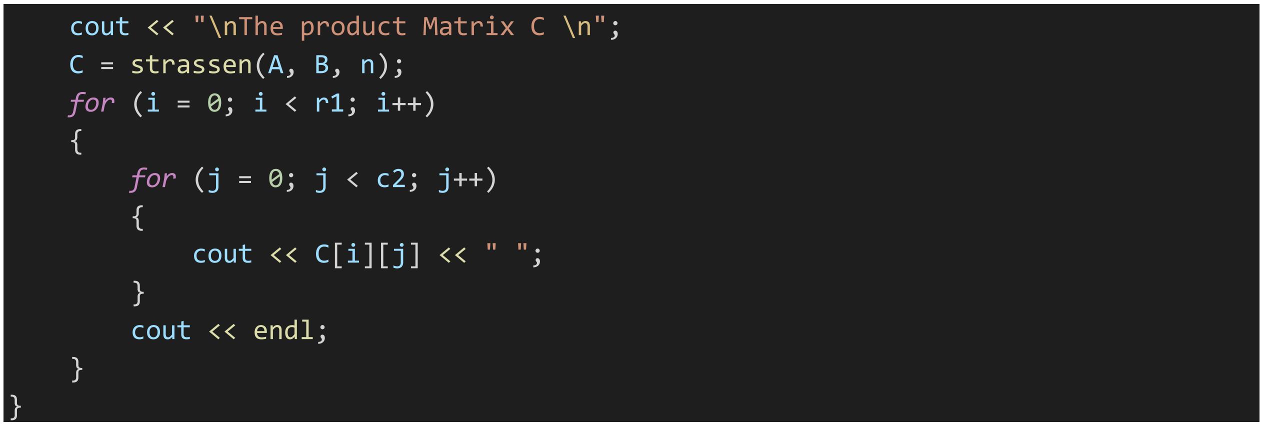
```
        }
    }
    return temp;
}

int **add(int **A, int **B, int n)
{
    int **temp = initmat(n);
    int i, j;
    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n; j++)
        {
            temp[i][j] = A[i][j] + B[i][j];
        }
    }
    return temp;
}

int **sub(int **A, int **B, int n)
{
    int **temp = initmat(n);
    int i, j;
    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n; j++)
        {
            temp[i][j] = A[i][j] - B[i][j];
        }
    }
    return temp;
}

int **strassen(int **A, int **B, int n)
{
    if (n == 1)
    {
        int **C = initmat(n);
        C[0][0] = A[0][0] * B[0][0];
        return C;
    }
    int **C = initmat(n);
    int k = n / 2;

    int **A11 = initmat(k);
```



```
    int **A12 = initmat(k);
    int **A21 = initmat(k);
    int **A22 = initmat(k);
    int **B11 = initmat(k);
    int **B12 = initmat(k);
    int **B21 = initmat(k);
    int **B22 = initmat(k);

    for (int i = 0; i < k; i++)
    {
        for (int j = 0; j < k; j++)
        {
            A11[i][j] = A[i][j];
            A12[i][j] = A[i][k + j];
            A21[i][j] = A[k + i][j];
            A22[i][j] = A[k + i][k + j];
            B11[i][j] = B[i][j];
            B12[i][j] = B[i][k + j];
            B21[i][j] = B[k + i][j];
            B22[i][j] = B[k + i][k + j];
        }
    }

    int **P1 = strassen(A11, sub(B12, B22, k), k);
    int **P2 = strassen(add(A11, A12, k), B22, k);
    int **P3 = strassen(add(A21, A22, k), B11, k);
    int **P4 = strassen(A22, sub(B21, B11, k), k);
    int **P5 = strassen(add(A11, A22, k), add(B11, B22, k), k);
    int **P6 = strassen(sub(A12, A22, k), add(B21, B22, k), k);
    int **P7 = strassen(sub(A11, A21, k), add(B11, B12, k), k);

    int **C11 = sub(add(add(P5, P4, k), P6, k), P2, k);
    int **C12 = add(P1, P2, k);
    int **C21 = add(P3, P4, k);
    int **C22 = sub(sub(add(P5, P1, k), P3, k), P7, k);

    for (int i = 0; i < k; i++)
    {
        for (int j = 0; j < k; j++)
        {
            C[i][j] = C11[i][j];
            C[i][j + k] = C12[i][j];
            C[k + i][j] = C21[i][j];
            C[k + i][k + j] = C22[i][j];
        }
```

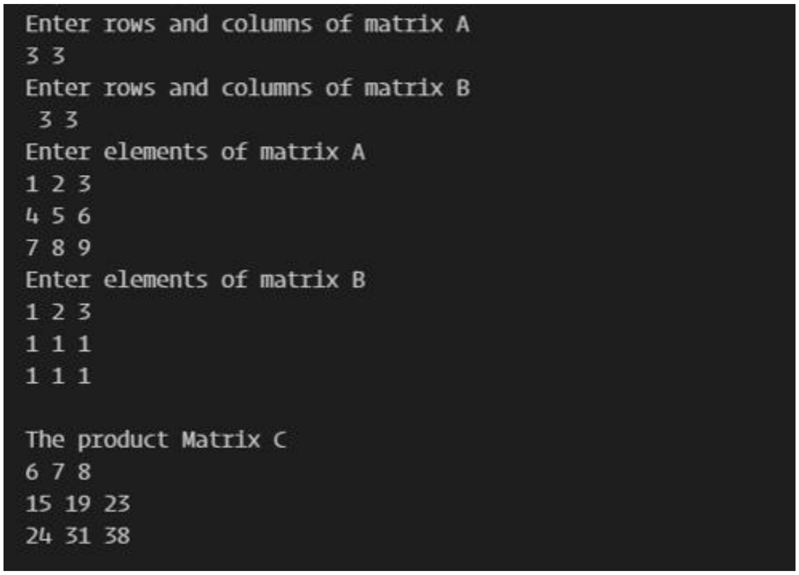


```
    }
    return C;
}

int main()
{
    int i, j, **C, **A, **B;
    int r1, c1, r2, c2;
    cout << "Enter rows and columns of matrix A \n";
    cin >> r1 >> c1;
    cout << "Enter rows and columns of matrix B \n ";
    cin >> r2 >> c2;
    if (c1 != r2)
    {
        cout << "Cannot multiply the matrices \n";
        return 0;
    }
    int temp, n = max(r1, max(c1, max(r2, c2)));

    if (ceil(log2(n)) != floor(log2(n)))
    {
        n = pow(2, ceil(log2(n)));
    }

    A = initmat(n);
    B = initmat(n);

    cout << "Enter elements of matrix A \n";
    for (i = 0; i < r1; i++)
    {
        for (j = 0; j < c1; j++)
        {
            cin >> A[i][j];
        }
    }

    cout << "Enter elements of matrix B \n";
    for (i = 0; i < r2; i++)
    {
        for (j = 0; j < c2; j++)
        {
            cin >> B[i][j];
        }
    }
```



```
    cout << "\nThe product Matrix C \n";
    C = strassen(A, B, n);
    for (i = 0; i < r1; i++)
    {
        for (j = 0; j < c2; j++)
        {
            cout << C[i][j] << " ";
        }
        cout << endl;
    }
}
```

OUTPUT



```
Enter rows and columns of matrix A
3 3
Enter rows and columns of matrix B
 3 3
Enter elements of matrix A
1 2 3
4 5 6
7 8 9
Enter elements of matrix B
1 2 3
1 1 1
1 1 1

The product Matrix C
6 7 8
15 19 23
24 31 38
```