# Assignment 8

Problem Statement:
Given sequence k = k1 < …<kn of n sorted keys, with a search probability pi for each key ki . Build the Binary search tree that has the least search cost given the access probability for each key?

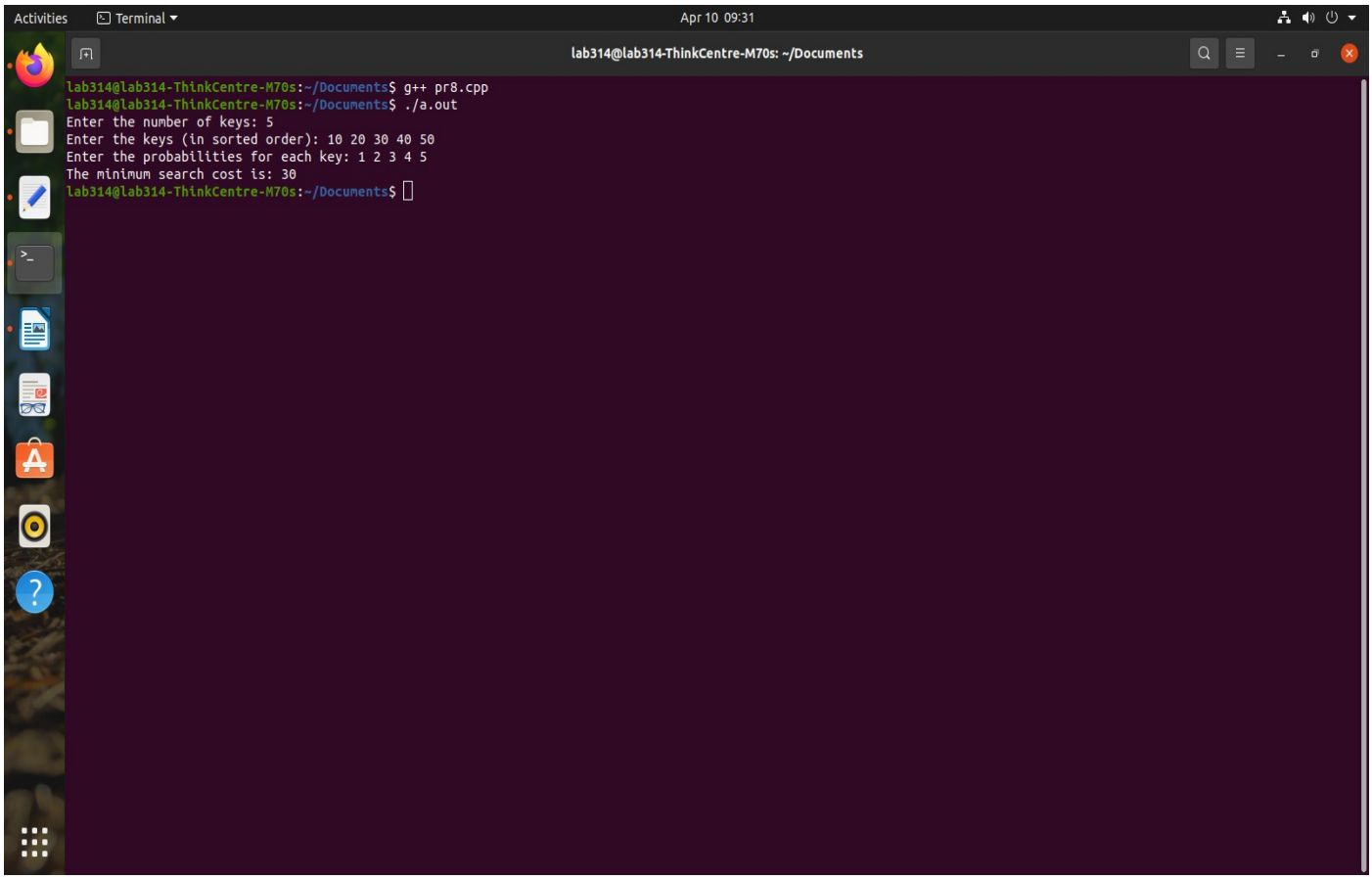
Source Code:

```
#include <iostream>
#include <vector>
#include <climits>

using namespace std;

// Function to compute the sum of probabilities for a subarray from i to j
int sum(const vector<int>& prob, int i, int j) {
    int s = 0;
    for (int k = i; k <= j; k++) {
        s += prob[k];
    }
    return s;
}

// Function to find the minimum search cost and build the optimal BST
int optimalBST(const vector<int>& keys, const vector<int>& prob, int n) {
    // dp[i][j] will store the minimum cost for the subtree from i to j
    vector<vector<int>> dp(n, vector<int>(n, 0));

    // w[i][j] will store the sum of probabilities from i to j
    vector<vector<int>> w(n, vector<int>(n, 0));

    // Calculate the sum of probabilities for each subarray
```

```
    for (int i = 0; i < n; i++) {
        w[i][i] = prob[i];
        for (int j = i + 1; j < n; j++) {
            w[i][j] = w[i][j - 1] + prob[j];
        }
    }

    // Fill the dp table using bottom-up dynamic programming
    for (int len = 1; len <= n; len++) {
        for (int i = 0; i <= n - len; i++) {
            int j = i + len - 1;
            if (len == 1) {
                dp[i][j] = prob[i];
            } else {
                dp[i][j] = INT_MAX;
                for (int r = i; r <= j; r++) {
                    int cost = (r > i ? dp[i][r - 1] : 0) + (r < j ? dp[r + 1][j] : 0) + w[i][j];
                    dp[i][j] = min(dp[i][j], cost);
                }
            }
        }
    }

    return dp[0][n - 1];
}

int main() {
    int n;

    // Take input for number of keys
    cout << "Enter the number of keys: ";
    cin >> n;

    vector<int> keys(n), prob(n);
```

```
    // Take input for the keys
    cout << "Enter the keys (in sorted order): ";
    for (int i = 0; i < n; i++) {
        cin >> keys[i];
    }

    // Take input for the probabilities
    cout << "Enter the probabilities for each key: ";
    for (int i = 0; i < n; i++) {
        cin >> prob[i];
    }

    // Call the optimalBST function to get the minimum cost
    int minCost = optimalBST(keys, prob, n);

    cout << "The minimum search cost is: " << minCost << endl;

    return 0;
}
```

Output


Activities
Terminal
Apr 10 09:31
lab314@lab314-ThinkCentre-M70s: ~/Documents
lab314@lab314-ThinkCentre-M70s:~/Documents$ g++ pr8.cpp
lab314@lab314-ThinkCentre-M70s:~/Documents$ ./a.out
Enter the number of keys: 5
Enter the keys (in sorted order): 10 20 30 40 50
Enter the probabilities for each key: 1 2 3 4 5
The minimum search cost is: 30
lab314@lab314-ThinkCentre-M70s:~/Documents$