DAA PRACTICAL 6

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Aim: Construction of OBST

Problem Statement: Smart Library Search Optimization

Task 1:

Scenario:

A university digital library system stores frequently accessed books using a binary search

mechanism. The library admin wants to minimize the average search time for book lookups by

arranging the book IDs optimally in a binary search tree.

Each book ID has a probability of being searched successfully and an associated probability for

unsuccessful searches (when a book ID does not exist between two keys).

Your task is to determine the minimum expected cost of searching using an Optimal Binary

Search Tree (OBST).

Input Format

First line: integer n — number of book IDs.

Second line: n integers representing the sorted book IDs (keys).

Third line: n real numbers — probabilities of successful searches (p[i]).

Fourth line: n+1 real numbers — probabilities of unsuccessful searches (q[i]).

Keys: 10 20 30 40

P[i]: 0.1 0.2 0.4 0.3

Q[i]: 0.05 0.1 0.05 0.05 0.1

Output Format

Print the minimum expected cost of the Optimal Binary Search Tree, rounded to 4 decimal places.

Code:

```
#include <stdio.h>
#include <float.h>

#define MAX 100

int main() {
    int n = 4;
    int i, j, k, d;
    double p[] = {0.1, 0.2, 0.4, 0.3};
    double q[] = {0.05, 0.1, 0.05, 0.05, 0.1};
    double E[MAX][MAX], W[MAX][MAX];
    int R[MAX][MAX];

    for (i = 0; i <= n; i++) {
        E[i][i] = q[i];
        W[i][i] = q[i];
        R[i][i] = 0;
    }

    for (d = 1; d <= n; d++) {
```

```
        for (i = 0; i <= n - d; i++) {
            j = i + d;
            E[i][j] = DBL_MAX;
            W[i][j] = W[i][j - 1] + p[j - 1] + q[j];
            for (k = i + 1; k <= j; k++) {
                double cost = E[i][k - 1] + E[k][j] + W[i][j];
                if (cost < E[i][j]) {
                    E[i][j] = cost;
                    R[i][j] = k;
                }
            }
        }
    }

    printf("minimum expected cost : %.4lf\n", E[0][n]);


    return 0;
}
```

Output:

```
Output                                   Clear
minimum expected cost : 2.9000


=== Code Execution Successful ===
```

Task 2:

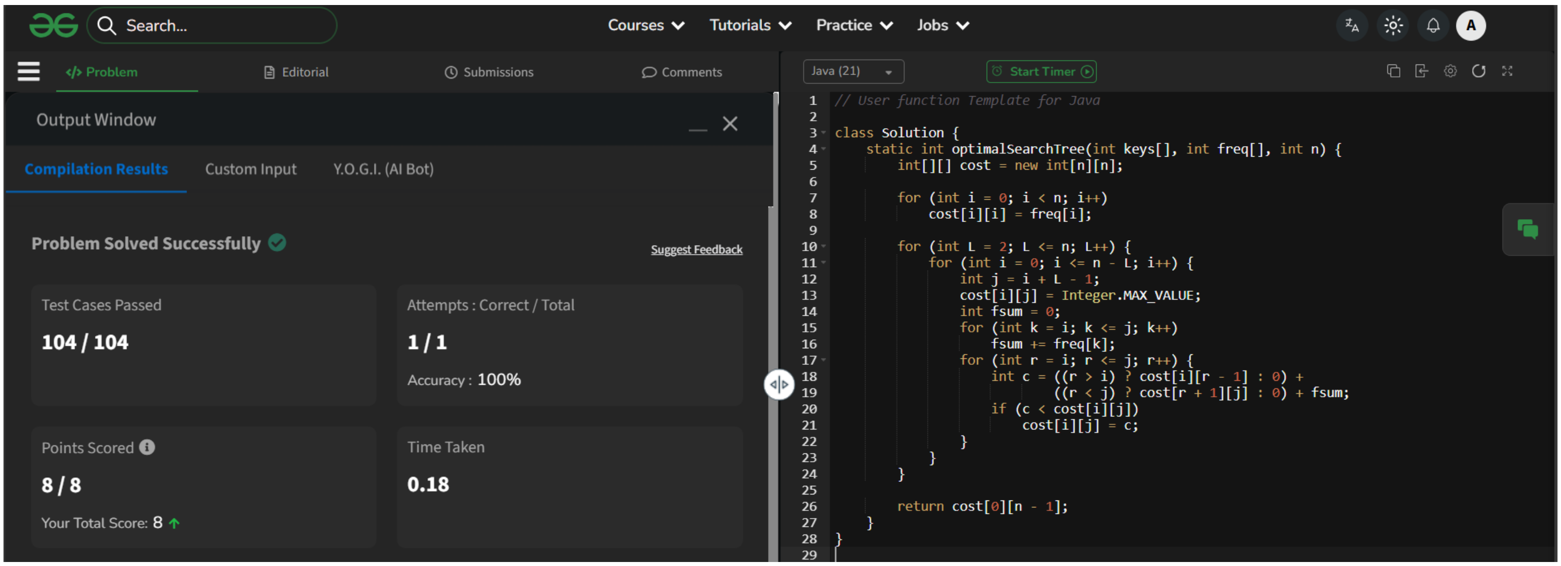
https://www.geeksforgeeks.org/problems/optimal-binary-search-tree2214/1

Code:

```
class Solution {
    static int optimalSearchTree(int keys[], int freq[], int n) {
        int[][] cost = new int[n][n];

        for (int i = 0; i < n; i++)
            cost[i][i] = freq[i];

        for (int L = 2; L <= n; L++) {
            for (int i = 0; i <= n - L; i++) {
                int j = i + L - 1;
                cost[i][j] = Integer.MAX_VALUE;
                int fsum = 0;
                for (int k = i; k <= j; k++)
                    fsum += freq[k];
                for (int r = i; r <= j; r++) {
                    int c = ((r > i) ? cost[i][r - 1] : 0) +
                            ((r < j) ? cost[r + 1][j] : 0) + fsum;
                    if (c < cost[i][j])
                        cost[i][j] = c;
                }
            }
        }

        return cost[0][n - 1];
```

```
    }
}
```

Output:



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104 / 104
Attempts : Correct / Total
1 / 1
Accuracy : 100%
Points Scored
8 / 8
Your Total Score: 8
Time Taken
0.18
// User function Template for Java
class Solution {
static int optimalSearchTree(int keys[], int freq[], int n) {
int[][] cost = new int[n][n];
for (int i = 0; i < n; i++)
cost[i][i] = freq[i];
for (int L = 2; L <= n; L++) {
for (int i = 0; i <= n - L; i++) {
int j = i + L - 1;
cost[i][j] = Integer.MAX_VALUE;
int fsum = 0;
for (int k = i; k <= j; k++)
fsum += freq[k];
for (int r = i; r <= j; r++) {
int c = ((r > i) ? cost[i][r - 1] : 0) +
((r < j) ? cost[r + 1][j] : 0) + fsum;
if (c < cost[i][j])
cost[i][j] = c;
}
}
}
return cost[0][n - 1];
}
}