Experiment No.7

Optimal Binary Search Trees using Dynamic Programming

Reg.No.24141028

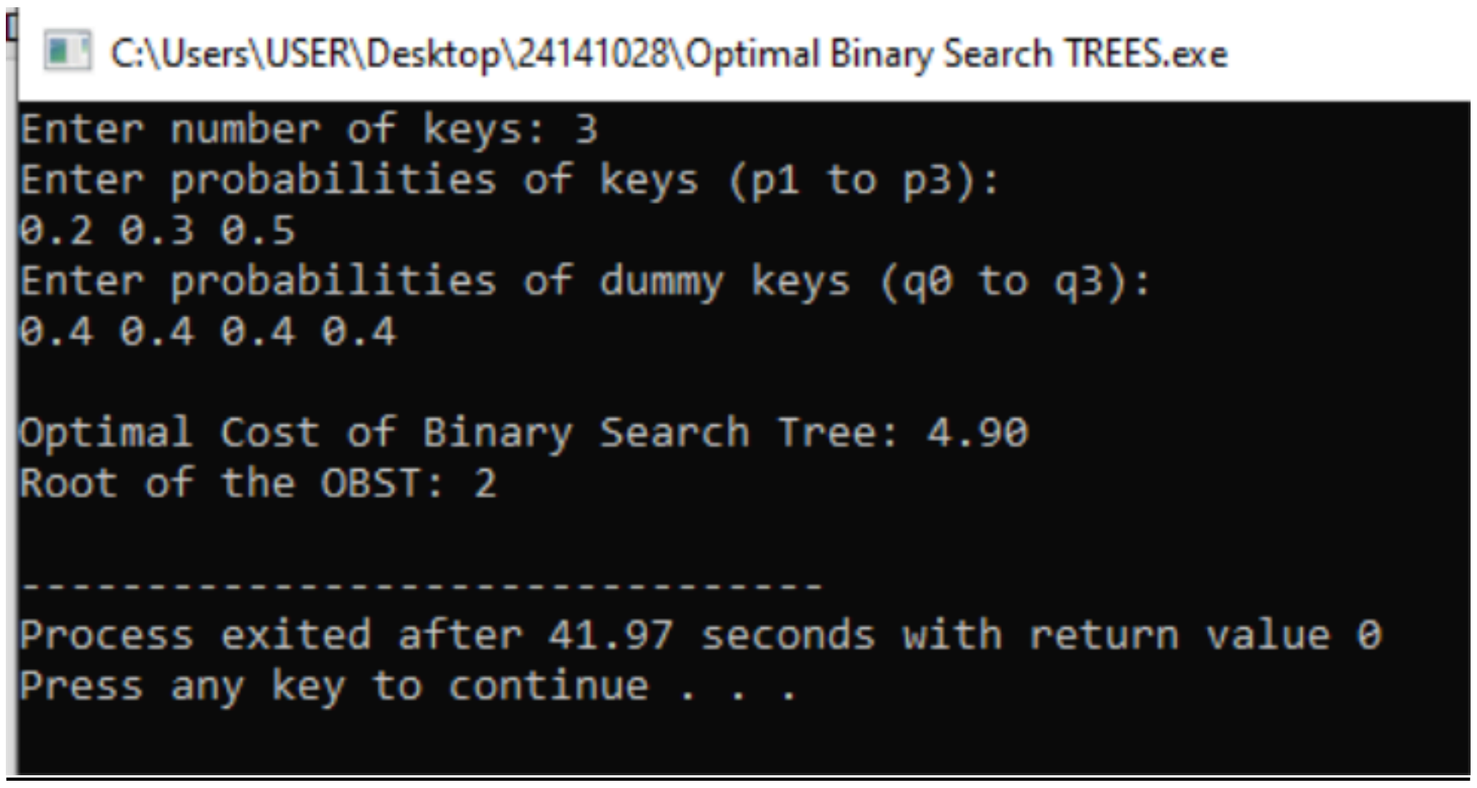
Program :

```
#include <stdio.h>

#define MAX 10

#define INF 9999

int main() {

    int n, i, j, k;

    float p[MAX], q[MAX], w[MAX][MAX], c[MAX][MAX];

    int r[MAX][MAX];

    printf("Enter number of keys: ");

    scanf("%d", &n);

    printf("Enter probabilities of keys (p1 to p%d):\n", n);

    for (i = 1; i <= n; i++)

        scanf("%f", &p[i]);

printf("Enter probabilities of dummy keys (q0 to q%d):\n", n);

for (i = 0; i <= n; i++)

    scanf("%f", &q[i]);

// Initialization

for (i = 0; i <= n; i++) {
```

```
        w[i][i] = q[i];
        c[i][i] = 0;
        r[i][i] = 0;
}
  // OBST Calculation
  for (int m = 1; m <= n; m++) {                    // m = chain length
        for (i = 0; i <= n - m; i++) {
j = i + m;
w[i][j] = w[i][j - 1] + p[j] + q[j];
float min = INF;
int min_k = 0;
for (k = i + 1; k <= j; k++) {
        float cost = c[i][k - 1] + c[k][j];
        if (cost < min) {
                min = cost;
                min_k = k;
                }
        }
        c[i][j] = w[i][j] + min;
        r[i][j] = min_k;
    }
}
```

```
        printf("\nOptimal Cost of Binary Search Tree: %.2f\n", c[0][n]);
        printf("Root of the OBST: %d\n", r[0][n]);
        return 0;
}
```

Output :



Time Complexity :

The outer loop (m) runs n times.

The middle loop (i) also runs roughly n times (depending on m).

The innermost loop (k) runs up to n times (for each range).

So total operations ≈ $O(n \times n \times n) = O(n^3)$

Space Complexity :

Because we use 2D matrices w[][], c[][], and r[][] of size n x n : $O(n^2)$

Real-Time Applications :

Compiler Design:

Used in symbol table organization to minimize average search time.

Database Indexing:

For faster access to records with different search probabilities.

Search Optimization:

Used when different items have different frequencies of search.

Speech and Pattern Recognition:

Helps in optimizing search structures in probabilistic models.

Decision Trees in AI:

OBST concept is used for probabilistic decision making.