NORTHERN UNIVERSITY
BANGLADESH

Assignment on

1. 0/1 Knapsack: Input : Knapsack Capacity: 10 ; Item Weights: [2, 3, 4, 5] ; Item Values: [3, 4, 5, 6]

Output : Maximum Value: 13.

2. Longest Common Subsequence (LCS): Input : String 1: "ABCDGH" ; String 2 : "AEDFHR"

Output : Length of LCS: 3.

3. Edit Distance: Input : String 1: "kitten" ; String 2: "sitting" **Output :** Minimum Edit Distance: 3.

4. Huffman Coding: Input : Character Frequencies: {'a': 5, 'b': 9, 'c': 12, 'd': 13, 'e': 16, 'f': 45}

Output: Huffman Codes: {'a': '1100', 'b': '1101', 'c': '100', 'd': '101', 'e': '11', 'f': '0'}

Course Title: Algorithms Design & Analysis

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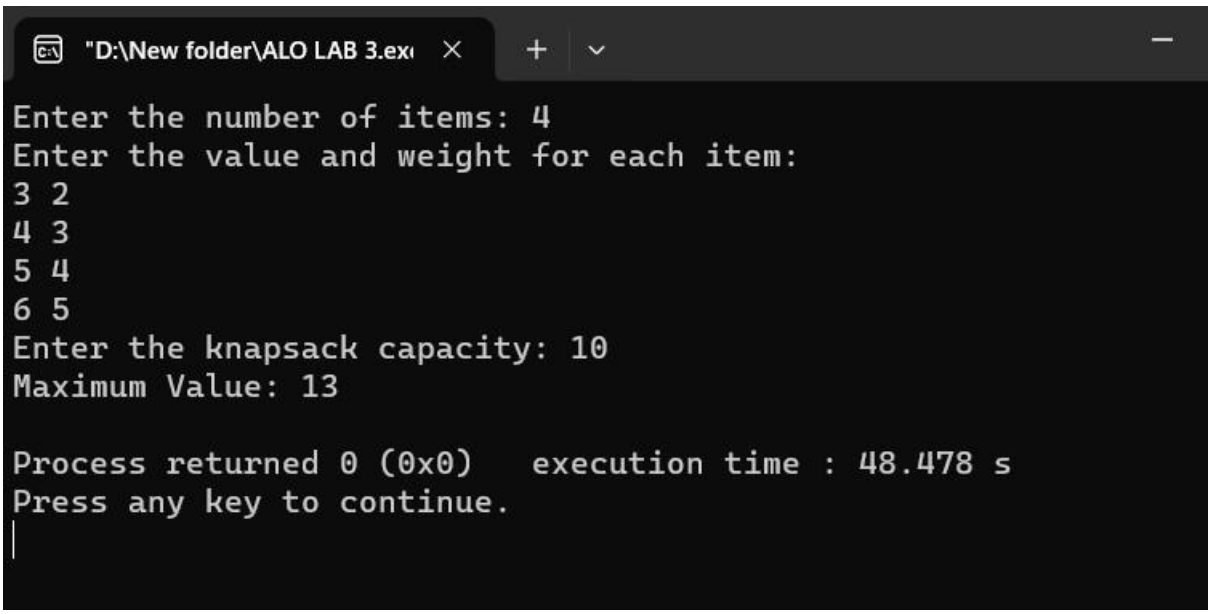
1. 0/1 Knapsack:

```
#include<iostream> using

namespace std;


int main() {     int item;     cout << "Enter

the number of items: ";     cin >> item;


   int value[item];

int weight[item];


   cout << "Enter the value and weight for each item:" << endl;

for(int i = 0; i < item; i++) {         cin >> value[i] >> weight[i];

   }


   int capacity;     cout << "Enter the

knapsack capacity: ";     cin >> capacity;


   int dp[item + 1][capacity + 1];


   for(int i = 0; i <= item; i++) {

for(int j = 0; j <= capacity; j++) {

if (i == 0 || j == 0) {                dp[i][j]

= 0;

          }           else if (weight[i

- 1] > j) {               dp[i][j] =

dp[i - 1][j];
```

```
            }            else {                dp[i][j] = max(value[i - 1] + dp[i - 1][j -
weight[i - 1]], dp[i - 1][j]);
            }
        }
    }

    cout << "Maximum Value: " << dp[item][capacity] << endl;

    return 0;
}
```

Output:

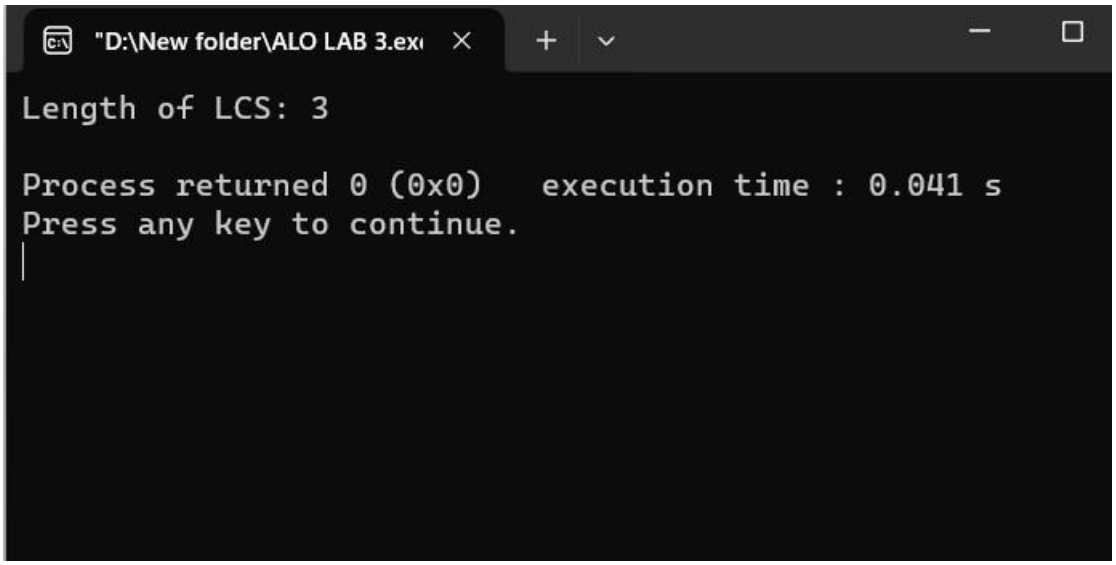


2. Longest Common Subsequence (LCS):

```
#include<iostream> using
namespace std; const int
MAX = 500;


int maxDistance(const string & word1, const string & word2)
{    int m =
word1.length();    int n =
word2.length();    int
dp[MAX][MAX];


   for (int i = 0; i <= m; ++i) {
for (int j = 0; j <= n; ++j) {
if (i == 0 || j == 0) {
dp[i][j] = 0;
          } else if (word1[i - 1] == word2[j - 1]) {
dp[i][j] = dp[i - 1][j - 1] + 1;
          } else {               dp[i][j] = max (dp[i -
1][j], dp[i][j - 1]);
          }
       }
   }
   return dp[m][n];
}


int main() {    string word1 =
"ABCDGH";    string word2 =
"AEDFHR";
```

```
    int distance = maxDistance(word1, word2);
    cout << "Length of LCS: " << distance << endl;


    return 0;
}
```

Output:

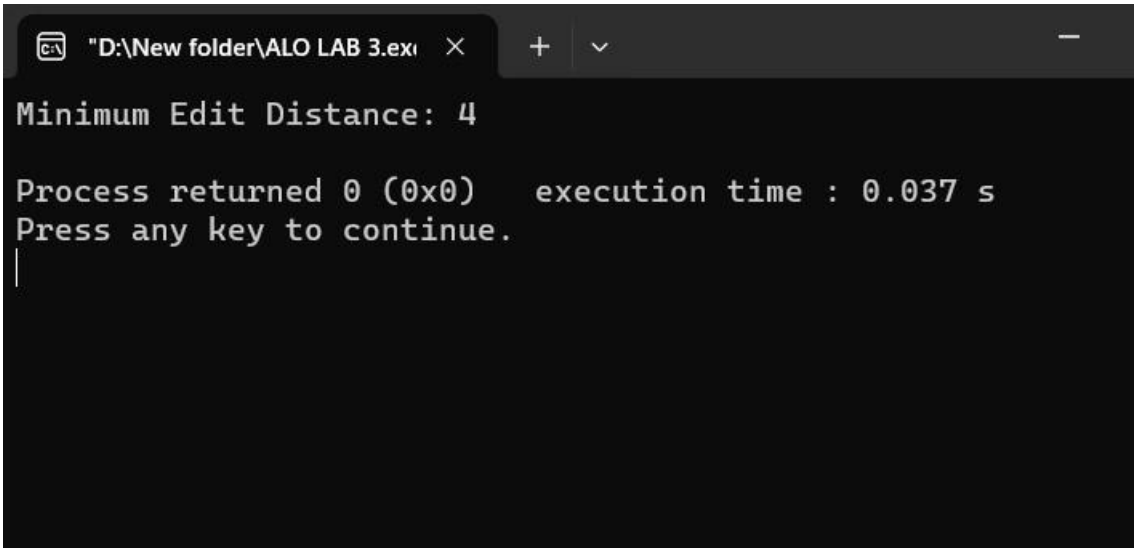


3. Edit Distance:

```
#include<iostream> using
namespace std; const int
MAX = 500;


int minDistance(const string & word1, const string & word2)
{    int m =
word1.length();    int n =
word2.length();    int
dp[MAX][MAX];


   for (int i = 0; i <= m; ++i) {
for (int j = 0; j <= n; ++j) {
if (i == 0 || j == 0) {
dp[i][j] = 0;
          } else if (word1[i - 1] == word2[j - 1]) {
dp[i][j] = dp[i - 1][j - 1] + 0;
          } else {              dp[i][j] = min(min(dp[i - 1][j] + 1, dp[i][j - 1] + 1), dp[i
- 1][j - 1] + 2);
          }
       }
   }
   return dp[m][n];
}
```

```
int main() {     string word1
= "kitten";     string word2
= "sitting";


    int distance = minDistance(word1, word2);
    cout << "Minimum Edit Distance: " << distance << endl;


    return 0;
}
```

Output:



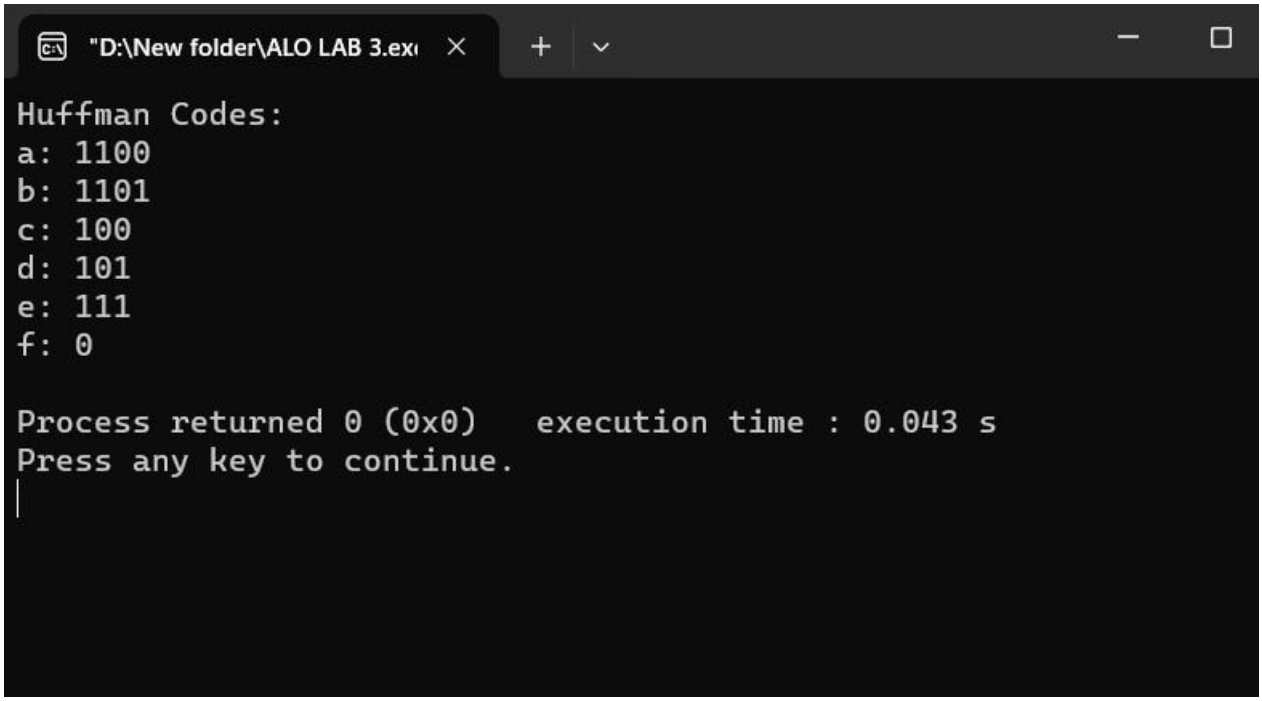
4. Huffman Coding:

```
#include <iostream>

#include <queue>

#include <map>

#include <vector>


using namespace std;


struct HuffmanNode {

   char data;

int freq;

   HuffmanNode *left, *right;


   HuffmanNode(char data, int freq) : data(data), freq(freq), left(nullptr),
right(nullptr) {}

};


struct CompareNodes {     bool operator()(HuffmanNode*

lhs, HuffmanNode* rhs) {        return lhs->freq > rhs->freq;

   }

};


void generateHuffmanCodes(map<char, string>& huffmanCodes,
HuffmanNode* root, string code) {

if (root == nullptr)        return;
```

```
    if (root->data != '\0') {        huffmanCodes[root-
>data] = code;
    }
    generateHuffmanCodes(huffmanCodes, root->left, code + "0");
generateHuffmanCodes(huffmanCodes, root->right, code + "1");
}

map<char, string> buildHuffmanTree(map<char, int>& charFrequencies) {
    priority_queue<HuffmanNode*, vector<HuffmanNode*>, CompareNodes>
minHeap;

    for (auto& entry : charFrequencies) {        minHeap.push(new
HuffmanNode(entry.first, entry.second));
    }

    while (minHeap.size() > 1) {
        HuffmanNode* left = minHeap.top();
minHeap.pop();

        HuffmanNode* right = minHeap.top();
minHeap.pop();

        HuffmanNode* newNode = new HuffmanNode('\0', left->freq + right->freq);
newNode->left = left;        newNode->right = right;

        minHeap.push(newNode);
    }
    HuffmanNode* root = minHeap.top();
```

```
    map<char, string> huffmanCodes;
generateHuffmanCodes(huffmanCodes, root, "");     return huffmanCodes;
}

int main() {

    map<char, int> charFrequencies = {{'a', 5}, {'b', 9}, {'c', 12}, {'d', 13}, {'e', 16}, {'f', 45}};

    map<char, string> huffmanCodes = buildHuffmanTree(charFrequencies);

    cout << "Huffman Codes:" << endl;     for (auto&
entry : huffmanCodes) {         cout << entry.first << ": "
<< entry.second << endl;
    }

    return 0;
}
```

Output:


"D:\New folder\ALO LAB 3.ex
Huffman Codes:
a: 1100
b: 1101
c: 100
d: 101
e: 111
f: 0
Process returned 0 (0x0)   execution time : 0.043 s
Press any key to continue.