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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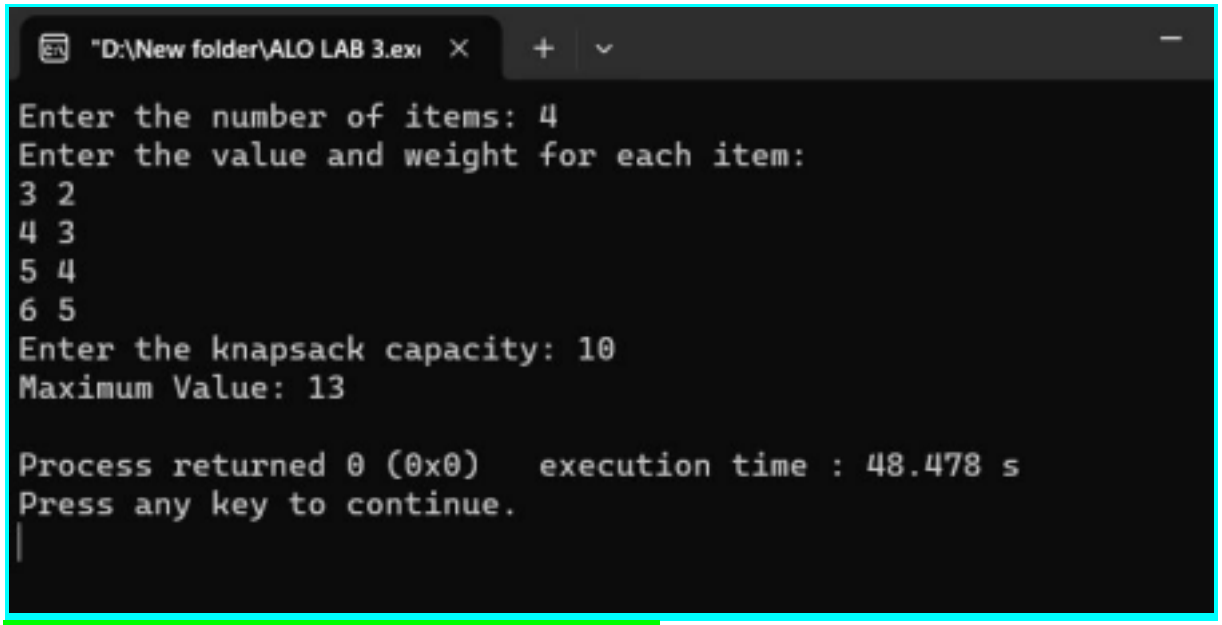
1. 0/1 Knapsack:

```
#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:

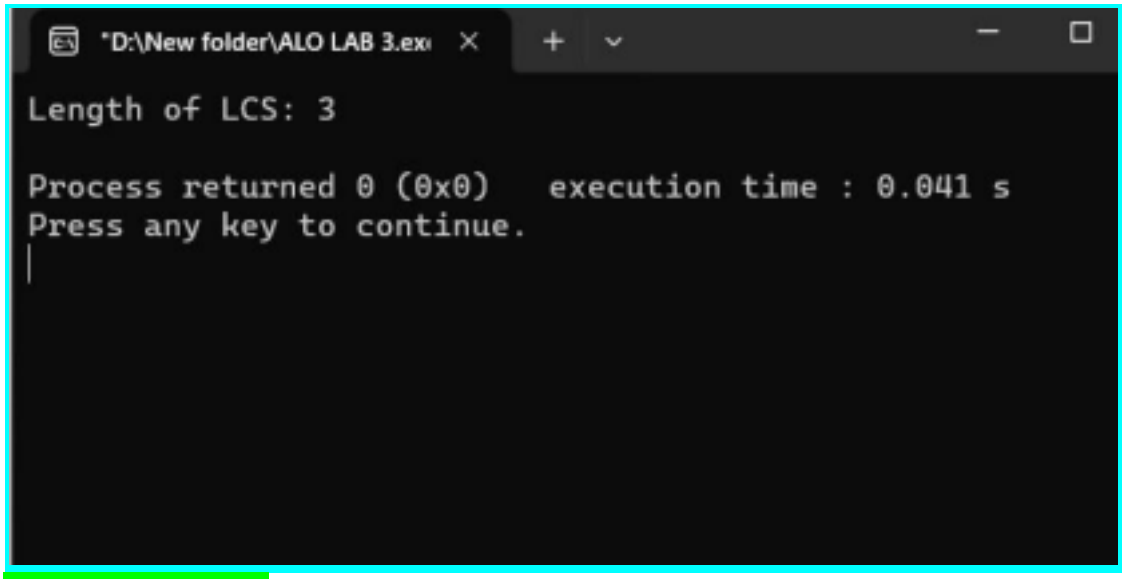


2. Longest Common Subsequence (LCS):

```
#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:

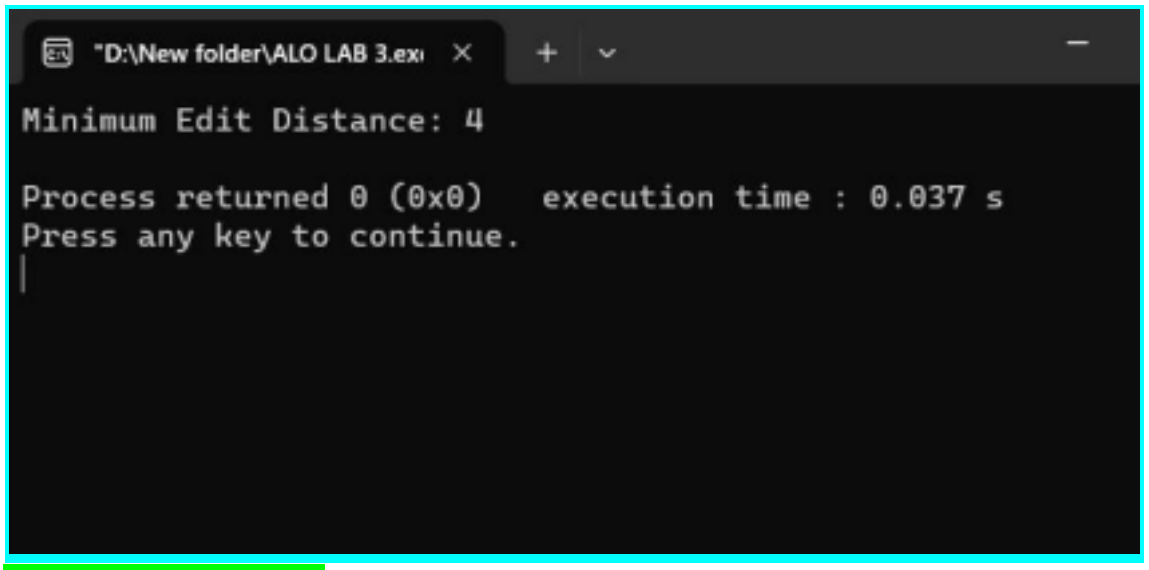


3. Edit Distance:

```
#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: