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Practical 10

Huffman coding assigns variable length code words to fixed length input characters based on their frequencies. More frequent characters are assigned shorter code words and less frequent characters are assigned longer code words. All edges along the path to a character contain a code digit. If they are on the left side of the tree, they will be a 0 (zero). If on the right, they'll be a 1 (one). Only the leaves will contain a letter and its frequency count. All other nodes will contain anull instead of a character, and the count of the frequency of all of it and its descendantcharacters.

Construct the Huffman tree for the following data and obtain its Huffman code.

Characters	**A**	**B**	**C**	**D**	**E**	**-**
Frequency/ Probability	**0.5**	**0.35**	**0.5**	**0.1**	**0.4**	**0.2**

(i) Encode text CAD-BE using the above code.

Input: CAD-BE

Output: 10011100110111100

(ii) Decode the text 1100110110 using the above information.

Input: 0011011100011100

Output: E-DAD

****app.py****

```
from flask import Flask, render_template, request
import heapq


app = Flask(__name__)


class Node:
    def __init__(self, freq, char=None, left=None, right=None):
        self.freq = freq
        self.char = char
        self.left = left
        self.right = right

    def __lt__(self, other):
        return self.freq < other.freq



def build_huffman_tree(char_freq):
    heap = [Node(freq, char) for char, freq in char_freq.items()]
```

```
    heapq.heapify(heap)

    while len(heap) > 1:
        left = heapq.heappop(heap)
        right = heapq.heappop(heap)
        merged = Node(left.freq + right.freq, None, left, right)
        heapq.heappush(heap, merged)

    return heap[0]


def generate_huffman_codes(node, prefix='', codebook={}):
    if node.char:
        codebook[node.char] = prefix
    else:
        generate_huffman_codes(node.left, prefix + '0', codebook)
        generate_huffman_codes(node.right, prefix + '1',
codebook)
    return codebook


def encode(text, codebook):
    return ''.join([codebook[char] for char in text])
```

```
def decode(encoded_text, huffman_tree):
    decoded_text = []
    node = huffman_tree

    for bit in encoded_text:
        if bit == '0':
            node = node.left
        else:
            node = node.right

        if node.char:
            decoded_text.append(node.char)
            node = huffman_tree

    return ''.join(decoded_text)

@app.route('/', methods=['GET', 'POST'])
def huffman():
    if request.method == 'POST':
        characters = request.form.getlist('characters')
        frequencies = list(map(float,
request.form.getlist('frequencies')))
```

```
        char_freq = {characters[i]: frequencies[i] for i in
range(len(characters))}



        huffman_tree = build_huffman_tree(char_freq)

        codebook = generate_huffman_codes(huffman_tree)




        text_to_encode = request.form['text_to_encode']

        encoded_text = encode(text_to_encode, codebook)



        text_to_decode = request.form['text_to_decode']

        decoded_text = decode(text_to_decode, huffman_tree)



        return render_template('result.html',
encoded_text=encoded_text, decoded_text=decoded_text,
codebook=codebook)



    return render_template('index.html')



if__name__== '__main__':

    app.run(debug=True)
```

index.html

```
<!DOCTYPE html>

<html lang="en">

<head>

    <meta charset="UTF-8">

    <meta name="viewport" content="width=device-width,
initial-scale=1.0">

    <title>Huffman Encoding and Decoding</title>

    <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/6.0.0-b
eta3/css/all.min.css">

    <style>

        body {

            font-family: Arial, sans-serif;

            background-color: #f4f4f4;

            margin: 0;

            padding: 20px;

        }

        h1, h3 {

            color: #333;

        }

        form {

            background: #fff;

            padding: 20px;
```

```
        border-radius: 5px;
        box-shadow: 0 0 10px rgba(0, 0, 0, 0.1);
    }
    label {
        display: block;
        margin: 10px 0 5px;
    }
    input[type="text"], input[type="number"] {
        width: calc(100% - 20px);
        padding: 10px;
        border: 1px solid #ccc;
        border-radius: 5px;
        margin-bottom: 10px;
    }
    button {
        background: #28a745;
        color: #fff;
        border: none;
        padding: 10px 15px;
        border-radius: 5px;
        cursor: pointer;
        font-size: 16px;
    }
```

```
        button:hover {
            background: #218838;
        }
        .codebook {
            margin-top: 20px;
            padding: 15px;
            border-radius: 5px;
            background: #e9ecef;
        }
        .codebook ul {
            list-style-type: none;
            padding: 0;
        }
        .codebook li {
            padding: 5px 0;
        }
    </style>
</head>
<body>
    <h1>Huffman Encoding and Decoding</h1>
    <form method="POST">
        <h3>Enter Characters and Frequencies:</h3>
        <div id="character-freq-inputs">
```

```
            <div>
                <label>Character:</label>
                <input type="text" name="characters" required>
                <label>Frequency:</label>
                <input type="number" step="0.01"
name="frequencies" required>
            </div>
        </div>
        <button type="button" onclick="addCharacterInput()">Add
More Characters</button>
        <br><br>

        <label for="text_to_encode">Text to Encode (e.g.,
CAD-BE):</label>
        <input type="text" id="text_to_encode"
name="text_to_encode" required>
        <br><br>

        <label for="text_to_decode">Encoded Text to Decode (e.g.,
10011100110111100):</label>
        <input type="text" id="text_to_decode"
name="text_to_decode" required>
        <br><br>

        <input type="submit" value="Submit">
    </form>
```

```
    <script>
        function addCharacterInput() {
            const div = document.createElement('div');
            div.innerHTML = `
                <label>Character:</label>
                <input type="text" name="characters" required>
                <label>Frequency:</label>
                <input type="number" step="0.01"
name="frequencies" required>
            `;

document.getElementById('character-freq-inputs').appendChild(div)
;
        }
    </script>
</body>
</html>
```

****result.html****

```
<!DOCTYPE html>
<html lang="en">
<head>
```

```
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width,
initial-scale=1.0">
    <title>Huffman Result</title>
    <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/6.0.0-b
eta3/css/all.min.css">
    <style>
        body {
            font-family: Arial, sans-serif;
            background-color: #f4f4f4;
            margin: 0;
            padding: 20px;
        }
        h1, h3 {
            color: #333;
        }
        .result-container {
            background: #fff;
            padding: 20px;
            border-radius: 5px;
            box-shadow: 0 0 10px rgba(0, 0, 0, 0.1);
        }
        .codebook {
```

```
            margin-top: 20px;
            padding: 15px;
            border-radius: 5px;
            background: #e9ecef;
        }
        .codebook ul {
            list-style-type: none;
            padding: 0;
        }
        .codebook li {
            padding: 5px 0;
        }
        .btn-back {
            margin-top: 20px;
            padding: 10px 15px;
            background: #007bff;
            color: #fff;
            border: none;
            border-radius: 5px;
            cursor: pointer;
            font-size: 16px;
        }
        .btn-back:hover {
```

```
            background: #0056b3;

        }

    </style>

</head>

<body>

    <h1>Huffman Encoding and Decoding Result</h1>

    <div class="result-container">

        <h3>Huffman Codebook:</h3>

        <div class="codebook">

            <ul>

                {% for char, code in codebook.items() %}

                    <li><strong>{{ char }}:</strong> {{ code
}}</li>

                {% endfor %}

            </ul>

        </div>



        <h3>Encoded Text:</h3>

        <p>{{ encoded_text }}</p>



        <h3>Decoded Text:</h3>

        <p>{{ decoded_text }}</p>
```

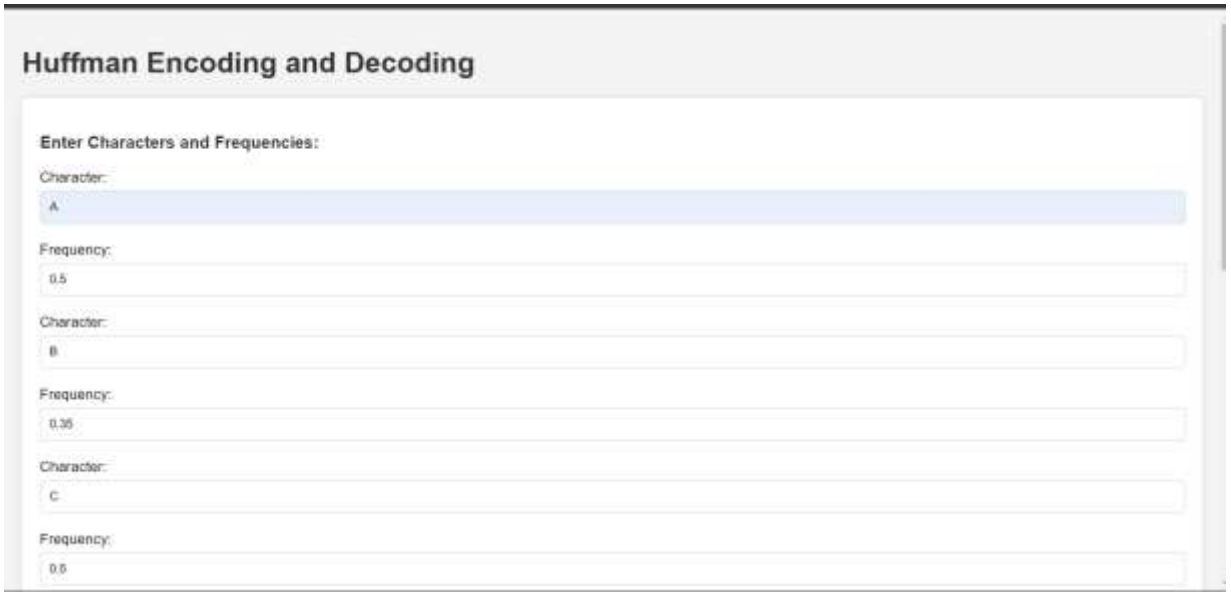
```
        <button class="btn-back"
onclick="window.location.href='/'">Go back</button>

    </div>

</body>

</html>
```

****OUTPUT****




Character:
D
Frequency:
0.1
Character:
E
Frequency:
0.4
Character:
-
Frequency:
0.2
Add More Characters
Text to Encode (e.g., CAD-BE):


Huffman Encoding and Decoding Result
Huffman Codebook:
E: 00
C: 01
A: 10
D: 1100
-: 1101
B: 111
Encoded Text:
011011001101111100
Decoded Text:
ACD-BE
Go back