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Sub: Algorithm Analysis and Design

Practical 5

You are working at the cash counter at a fun-fair, and you have three types of coins available to you in infinite quantities (coins are Rs. 1, Rs. 4 and Rs. 6). You are required to calculate the minimum numbers of coins required for changing the value of Rs. 9.

Design the algorithm for the same and implement using the programming language of your choice. Make comparative analysis for various use cases & input size.

Code:-

```python
from flask import Flask, render_template_string, request
import time
from collections import Counter

app = Flask(__name__)

def min_coins(coins, amount):
    dp = [float('inf')] * (amount + 1)
    coin_used = [-1] * (amount + 1)
    dp[0] = 0

    for i in range(1, amount + 1):
        for coin in coins:
            if coin <= i:
                if dp[i - coin] + 1 < dp[i]:
                    dp[i] = dp[i - coin] + 1
                    coin_used[i] = coin

    if dp[amount] == float('inf'):
```

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```python
            return -1, {}

    result_coins = []
    while amount > 0:
        result_coins.append(coin_used[amount])
        amount -= coin_used[amount]

    coin_count = dict(Counter(result_coins))

    return dp[amount + sum(result_coins)], coin_count

@app.route('/', methods=['GET', 'POST'])
def coin_change():
    result = None
    coins_used = {}
    execution_time = None

    if request.method == 'POST':
        coins = [int(x) for x in request.form.get('coins').split(',')]
        amount = int(request.form.get('amount'))

        start_time = time.time()
        result, coins_used = min_coins(coins, amount)
        execution_time = time.time() - start_time

    html_content = '''
    <html>
    <head>
        <title>Coin Change Problem</title>
    </head>
    <body>
        <h1>Coin Change Problem</h1>
        <form method="POST">
                <label for="coins">Enter the coin denominations (comma
separated):</label><br>
            <input type="text" id="coins" name="coins" required><br><br>
            <label for="amount">Enter the amount:</label><br>
```

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```
                            <input  type="number"  id="amount"  name="amount"
required><br><br>
            <button type="submit">Calculate Minimum Coins</button>
        </form>

        {% if result is not none %}
            <h2>Results:</h2>
            {% if result == -1 %}
                <p>It's  impossible  to  make  the  amount  with  the  given
coins.</p>
            {% else %}
                <p>Minimum number of coins required: {{ result }}</p>
                <h3>Coins Used:</h3>
                <ul>
                {% for coin, count in coins_used.items() %}
                    <li>Coin: {{ coin }}, Count: {{ count }}</li>
                {% endfor %}
                </ul>
                <p>Execution time: {{ execution_time }} seconds</p>
            {% endif %}
        {% endif %}
    </body>
    </html>
    '''

            return   render_template_string(html_content,   result=result,
coins_used=coins_used, execution_time=execution_time)

app.run(debug=True)
```

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Coin Change Problem

Enter the coin denominations (comma separated):

[   ]

Enter the amount:

[   ]

[Calculate Minimum Coins]

Results:

Minimum number of coins required: 3

Coins Used:

- Coin: 1, Count: 1
- Coin: 4, Count: 2

Execution time: 0.0 seconds