Name: Devanshi Jain
Er-No: 22162101006
Batch: 51
Branch: CBA

Institute of Computer Technology
B. Tech Computer Science and Engineering

Sub: Algorithm Analysis and Design

Practical 7

A thief carrying a single knapsack with limited (W = 5) capacity. The museum you stole had (n=4) artefacts that you could steal. Unfortunately, you might not be able to steal the entire artefact because of your limited knapsack capacity.

Help the thief to cherry pick the artefact in order to maximise the total value (<=W) of the artefacts you stole.

First solve the given below example:
Let n = 4, W=5

(P1, P2, P3, P4) = (3,4,5,6)
(w1, w2, w3, w4) = (2,3,4,5)

CODE:

.py:

```python
from flask import Flask, render_template, request
import numpy as np

app = Flask(__name__)

def knapsack(capacity, weights, profits):
    n = len(weights)
    dp = np.zeros((n + 1, capacity + 1))
```

```python
    # Build the DP table
    for i in range(1, n + 1):
        for w in range(capacity + 1):
            if weights[i - 1] <= w:
                dp[i][w] = max(dp[i - 1][w], profits[i - 1] + dp[i - 1][w -
weights[i - 1]])
            else:
                dp[i][w] = dp[i - 1][w]

    max_profit = dp[n][capacity]
    items_selected = []
    w = capacity

    # Find which items were selected
    for i in range(n, 0, -1):
        if max_profit != dp[i - 1][w]:
            items_selected.append(i - 1)
            max_profit -= profits[i - 1]
            w -= weights[i - 1]

    return dp, items_selected, dp[n][capacity]

@app.route('/', methods=['GET', 'POST'])
def index():
    if request.method == 'POST':
        W = int(request.form['capacity'])
        n = int(request.form['num_items'])
        profits = list(map(int, request.form['profits'].split(',')))
        weights = list(map(int, request.form['weights'].split(',')))

        dp_table, items_selected, max_profit = knapsack(W, weights, profits)

        # Convert dp_table to a list for easier handling in the template
        dp_table_list = dp_table.tolist()

        return render_template('p7.html', dp_table=dp_table_list,
                               items_selected=items_selected,
                               max_profit=max_profit,
                               num_items=len(items_selected))

    return render_template('p7.html', dp_table=None)

if __name__ == '__main__':
    app.run(debug=True)
```

.html:

```html
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Knapsack Problem Solver</title>
    <style>
        body {
            font-family: Arial, sans-serif;
            background-color: #f4f4f4;
            margin: 0;
            padding: 20px;
        }
        h1 {
            color: #333;
        }
        form {
            background: #fff;
            padding: 20px;
            border-radius: 5px;
            box-shadow: 0 2px 10px rgba(0,0,0,0.1);
            margin-bottom: 20px;
        }
        label {
            display: block;
            margin-bottom: 5px;
        }
        input[type="text"] {
            width: 100%;
            padding: 8px;
            margin-bottom: 10px;
            border: 1px solid #ccc;
            border-radius: 4px;
        }
        input[type="submit"] {
            background-color: #28a745;
            color: white;
            padding: 10px;
            border: none;
            border-radius: 5px;
            cursor: pointer;
        }
        input[type="submit"]:hover {
```

```
                background-color: #218838;
            }
            table {
                width: 100%;
                border-collapse: collapse;
                margin-top: 20px;
            }
            table, th, td {
                border: 1px solid #ddd;
            }
            th, td {
                padding: 8px;
                text-align: center;
            }
            th {
                background-color: #f2f2f2;
            }
            .result {
                background: #fff;
                padding: 15px;
                border-radius: 5px;
                box-shadow: 0 2px 10px rgba(0,0,0,0.1);
            }
        </style>
</head>
<body>
    <h1>Knapsack Problem Solver</h1>
    <form method="post">
        <label for="capacity">Knapsack Capacity:</label>
        <input type="text" id="capacity" name="capacity" required>

        <label for="num_items">Number of Items:</label>
        <input type="text" id="num_items" name="num_items" required>

        <label for="profits">Profits (comma separated):</label>
        <input type="text" id="profits" name="profits" required>

        <label for="weights">Weights (comma separated):</label>
        <input type="text" id="weights" name="weights" required>

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

    {% if dp_table %}
        <div class="result">
```

```html
            <h2>Results:</h2>
            <p><strong>Number of Items Selected:</strong> {{ num_items }}</p>
            <p><strong>Maximum Profit:</strong> {{ max_profit }}</p>

            <h3>DP Table:</h3>
            <table>
                <tr>
                    {% for w in range(dp_table[0]|length) %}
                        <th>{{ w }}</th>
                    {% endfor %}
                </tr>
                {% for i in range(dp_table|length) %}
                    <tr>
                        {% for j in range(dp_table[i]|length) %}
                            <td>{{ dp_table[i][j] }}</td>
                        {% endfor %}
                    </tr>
                {% endfor %}
            </table>

            <p><strong>Items Selected:</strong> {{ items_selected }}</p>
        </div>
    {% endif %}
</body>
</html>
```

OUTPUT:

```
PROBLEMS    OUTPUT    DEBUG CONSOLE    TERMINAL    PORTS    SEARCH ERROR    SQL CONSOLE    COMMENTS         python  + ∨  ⬚  ⬚  ⋯  ∧  ×

(venv) PS C:\ICT\SEM-5\AAD\venv> python p7.py
 * Serving Flask app 'p7'
 * Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
 * Running on http://127.0.0.1:5000
Press CTRL+C to quit
 * Restarting with stat
 * Debugger is active!
 * Debugger PIN: 496-905-480
127.0.0.1 - - [16/Oct/2024 19:31:26] "GET / HTTP/1.1" 200 -
127.0.0.1 - - [16/Oct/2024 19:31:27] "GET /favicon.ico HTTP/1.1" 404 -
127.0.0.1 - - [16/Oct/2024 19:31:42] "POST / HTTP/1.1" 200 -
```

Knapsack Problem Solver

Knapsack Capacity:

5

Number of Items:

4

Profits (comma separated):

3,4,5,6

Weights (comma separated):

2,3,4,5

Submit

Profits (comma separated):

3,4,5,6

Weights (comma separated):

2,3,4,5

Submit

Results:

Number of Items Selected: 2

Maximum Profit: 7.0

DP Table:

0	1	2	3	4	5
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	3.0	3.0	3.0	3.0
0.0	0.0	3.0	4.0	4.0	7.0
0.0	0.0	3.0	4.0	5.0	7.0
0.0	0.0	3.0	4.0	5.0	7.0

Items Selected: [1, 0]