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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 file:

```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
    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

    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 file:

```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: 'Segoe UI', Tahoma, Geneva, Verdana, sans-serif;
        background-color: #eef2f3;
        margin: 0;
        padding: 20px;
    }

    h1 {
        color: #333;
        text-align: center;
    }

    form {
        background: #fff;
        padding: 20px;
        border-radius: 10px;
        box-shadow: 0 4px 20px rgba(0, 0, 0, 0.1);
        margin-bottom: 20px;
        max-width: 500px;
        margin-left: auto;
        margin-right: auto;
    }

    label {
        display: block;
        margin-bottom: 5px;
        font-weight: bold;
    }

    input[type="text"] {
        width: 100%;
        padding: 10px;
        margin-bottom: 15px;
        border: 1px solid #ccc;
        border-radius: 5px;
    }
```

```css
input[type="submit"] {
    background-color: #007bff;
    color: white;
    padding: 12px;
    border: none;
    border-radius: 5px;
    cursor: pointer;
    width: 100%;
}

input[type="submit"]:hover {
    background-color: #0056b3;
}

.table-container {
    margin-top: 20px;
}

table {
    width: 100%;
    border-collapse: collapse;
    margin-top: 10px;
    background: #fff;
    border-radius: 5px;
    overflow: hidden;
    box-shadow: 0 4px 10px rgba(0, 0, 0, 0.1);
}

table, th, td {
    border: 1px solid #ddd;
}

th, td {
    padding: 12px;
    text-align: center;
}

th {
    background-color: #007bff;
    color: white;
}

.result {
    background: #fff;
    padding: 20px;
```

```html
            border-radius: 10px;
            box-shadow: 0 4px 20px rgba(0, 0, 0, 0.1);
            margin-top: 20px;
        }

    </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">
            <h2>Results:</h2>
            <div class="table-container">
                <h3>Maximum Profit:</h3>
                <table>
                    <tr>
                        <th>Profit</th>
                    </tr>
                    <tr>
                        <td>{{ max_profit }}</td>
                    </tr>
                </table>
            </div>

            <div class="table-container">
                <h3>DP Table:</h3>
                <table>
                    <tr>
                        {% for w in range(dp_table[0]|length) %}
```

```html
                    <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>
    </div>

    <div class="table-container">
        <h3>Items Selected:</h3>
        <table>
            <tr>
                <th>Item Index</th>
            </tr>
            {% for item in items_selected %}
                <tr>
                    <td>{{ item }}</td>
                </tr>
            {% endfor %}
        </table>
    </div>
    </div>
    {% endif %}
</body>
</html>
```

OUTPUT:

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

Results:

Maximum Profit:

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:

Item Index
1

Items Selected:

Item Index
1
0