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SUB :- AAD

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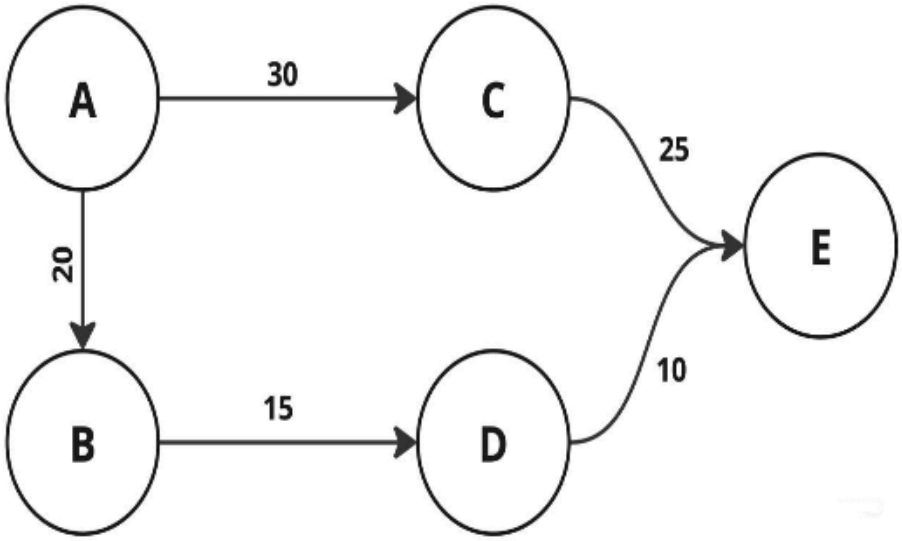
Institute of Computer Technology
B. Tech Computer Science and Engineering

Sub: Algorithm Analysis and Design

Practical 11

AIM:
A government official needs to visit several cities within a state. To minimize travel costs, they want to find the shortest path between their starting city and each destination city.
Task:
Given a graph representing the cities and their connecting roads, determine the minimum cost path from a given starting city to all other cities.



Input:
Enter total number of nodes: 5
Enter the node from where you want to calculate the distance: A
Enter Data (Weight):

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	A	*B*	*C*	*D*	*E*
A	0	20	30	∞	∞
B	∞	0	∞	15	∞
C	∞	∞	0	∞	25
D	∞	∞	∞	0	10
E	∞	∞	∞	∞	0

Output:

	A	*B*	*C*	*D*	*E*
A	0	20	30	35	45
B	∞	0	∞	15	25
C	∞	∞	0	∞	25
D	∞	∞	∞	0	10
E	∞	∞	∞	∞	0

OR

Source	**Destination**	**Cost**
A	A	0
	B	20
	C	30
	D	35
	E	45

Python Code:-

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

app = Flask(__name__)

# Dijkstra's algorithm to find shortest paths
def dijkstra(graph, start):
    distances = {node: float('inf') for node in graph}
```

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```
    distances[start] = 0
    priority_queue = [(0, start)]

    while priority_queue:
        current_distance, current_node =
heapq.heappop(priority_queue)

        if current_distance > distances[current_node]:
            continue

        for neighbor, weight in graph[current_node].items():
            if weight == float('inf'):
                continue  # Skip unconnected nodes
            distance = current_distance + weight

            if distance < distances[neighbor]:
                distances[neighbor] = distance
                heapq.heappush(priority_queue, (distance,
neighbor))

    return distances

@app.route("/", methods=["GET", "POST"])
def index():
    result = None
    nodes = 0
    start_city = None
    graph = {}

    if request.method == "POST":
        nodes = int(request.form.get("nodes"))
        start_city = request.form.get("start_city").upper()
```

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```
        # Gather city names
        cities = [request.form.get(f"city_{i}").upper() for i in
range(nodes)]
        graph = {city: {} for city in cities}

        # Build graph with weights
        for i in range(nodes):
            for j in range(nodes):
                neighbor = cities[j]
                weight = request.form.get(f"weight_{i}_{j}")
                weight_value = float('inf') if weight == '∞'
else int(weight)
                graph[cities[i]][neighbor] = weight_value

        # Run Dijkstra's algorithm
        result = dijkstra(graph, start_city)

        # Replace 'inf' with '∞' in results for clarity
        for city in result:
            result[city] = '∞' if result[city] == float('inf')
else str(result[city])

    # Renderable graph for HTML visualization
    renderable_graph = {
        city: {neighbor: ('∞' if weight == float('inf') else
str(weight)) for neighbor, weight in neighbors.items()}
        for city, neighbors in graph.items()
    }

    return render_template("index.html", result=result,
nodes=nodes, start_city=start_city, graph=renderable_graph)

if __name__ == "__main__":
```

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```
    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>Shortest Path Finder</title>
    <link rel="stylesheet" href="{{ url_for('static',
filename='style.css') }}">
</head>

<body>
    <div class="main-container">
        <h1 class="title">Shortest Path Finder</h1>

        <div class="container">
            <!-- Input Form -->
            <div class="form-container">
                <form method="POST">
                    <label for="nodes">Enter Total Number of
Cities:</label>
                    <input type="number" id="nodes" name="nodes"
required>

                    <label for="start_city">Enter Starting
City:</label>
                    <input type="text" id="start_city"
name="start_city" required>
```

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```
                    <h3>Enter City Names</h3>
                    <div id="city_names"
class="city-names"></div>

                    <h3>Enter Distances (Use '∞' for no
connection)</h3>
                    <div id="graph_inputs"
class="distance-inputs"></div>

                    <button type="submit"
class="btn">Submit</button>
                </form>
            </div>

            <!-- Results -->
            <div class="result-container">
                {% if result %}
                <h3>Input Distance Table</h3>
                <table>
                    <thead>
                        <tr>
                            <th></th>
                            {% for city in graph.keys() %}
                            <th>{{ city }}</th>
                            {% endfor %}
                        </tr>
                    </thead>
                    <tbody>
                        {% for city in graph.keys() %}
                        <tr>
                            <th>{{ city }}</th>
                            {% for neighbor in
graph[city].keys() %}
```

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```
                            <td>{{ graph[city][neighbor] }}</td>
                            {% endfor %}
                        </tr>
                        {% endfor %}
                    </tbody>
                </table>

                <h3>Shortest Path Results from {{ start_city
}}</h3>
                <table>
                    <thead>
                        <tr>
                            <th>Source</th>
                            <th>Destination</th>
                            <th>Cost</th>
                        </tr>
                    </thead>
                    <tbody>
                        {% for city, cost in result.items() %}
                        <tr>
                            <td>{{ start_city }}</td>
                            <td>{{ city }}</td>
                            <td>{{ cost }}</td>
                        </tr>
                        {% endfor %}
                    </tbody>
                </table>
                {% endif %}
            </div>
        </div>
    </div>

    <script>
```

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```
        // Dynamically generate input fields for city names and
distances

document.getElementById('nodes').addEventListener('change',
function () {
            const nodes = parseInt(this.value);
            const cityContainer =
document.getElementById('city_names');
            const graphContainer =
document.getElementById('graph_inputs');
            cityContainer.innerHTML = '';
            graphContainer.innerHTML = '';

            for (let i = 0; i < nodes; i++) {
                cityContainer.innerHTML += `<input type="text"
name="city_${i}" placeholder="City ${i + 1}" required>`;
            }

            for (let i = 0; i < nodes; i++) {
                graphContainer.innerHTML += `<h4>Distances from
City ${i + 1}</h4>`;
                for (let j = 0; j < nodes; j++) {
                    graphContainer.innerHTML += `<label>To City
${j + 1}:</label>
                        <input type="text"
name="weight_${i}_${j}" value="${i === j ? '' : '∞'}"
required>`;
                }
            }
        });
    </script>
</body>
```

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```
</html>
```

Style.css:-

```
body {
    font-family: 'Arial', sans-serif;
    background-color: #f0f8ff;
    margin: 0;
    padding: 20px;
}

h1 {
    text-align: center;
    color: #2c3e50;
    animation: fadeInDown 1s;
}

.container {
    display: flex;
    justify-content: space-between;
    gap: 20px;
}

.form-container,
.result-container {
    background: #ffffff;
    padding: 20px;
    border-radius: 8px;
    box-shadow: 0 2px 10px rgba(0, 0, 0, 0.1);
    transition: transform 0.3s, box-shadow 0.3s;
}

.form-container:hover,
.result-container:hover {
```

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```
    transform: translateY(-5px);
    box-shadow: 0 4px 15px rgba(0, 0, 0, 0.2);
}

input[type="text"],
input[type="number"] {
    width: calc(100% - 20px);
    padding: 10px;
    margin-bottom: 15px;
    border: 1px solid #ccc;
    border-radius: 5px;
    transition: border-color 0.3s;
}

input:focus {
    border-color: #3498db;
    outline: none;
}

button {
    width: 100%;
    padding: 10px;
    background: linear-gradient(90deg, #3498db, #2ecc71);
    color: white;
    border: none;
    border-radius: 5px;
    cursor: pointer;
    font-size: 16px;
    transition: background 0.3s, transform 0.2s;
}

button:hover {
    background: linear-gradient(90deg, #2ecc71, #3498db);
```

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```
    transform: scale(1.05);
}

table {
    width: 100%;
    border-collapse: collapse;
    margin-top: 20px;
}

th, td {
    border: 1px solid #ddd;
    padding: 10px;
    text-align: center;
}

th {
    background-color: #3498db;
    color: white;
}

tr:nth-child(even) {
    background-color: #f9f9f9;
}

tr:hover {
    background-color: #f1c40f;
    color: white;
}

@keyframes fadeInDown {
    from {
        opacity: 0;
        transform: translateY(-20px);
```

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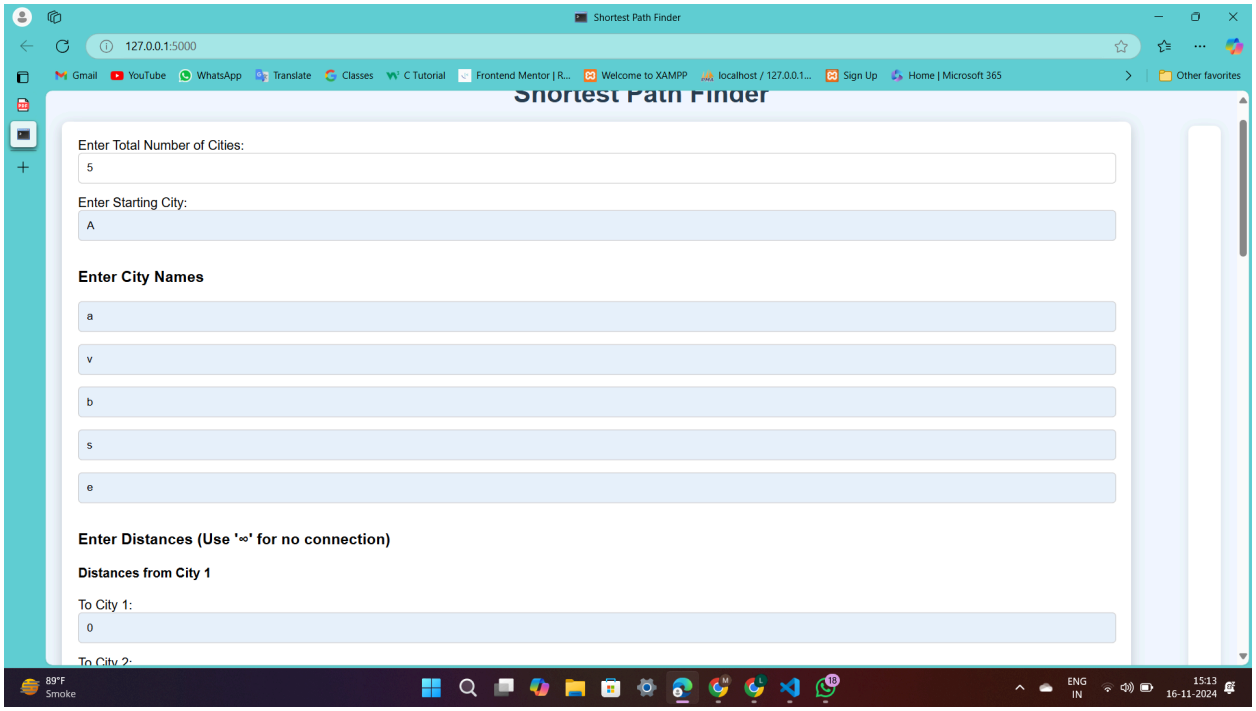
```
    }
    to {
        opacity: 1;
        transform: translateY(0);
    }
}
```

Output:-



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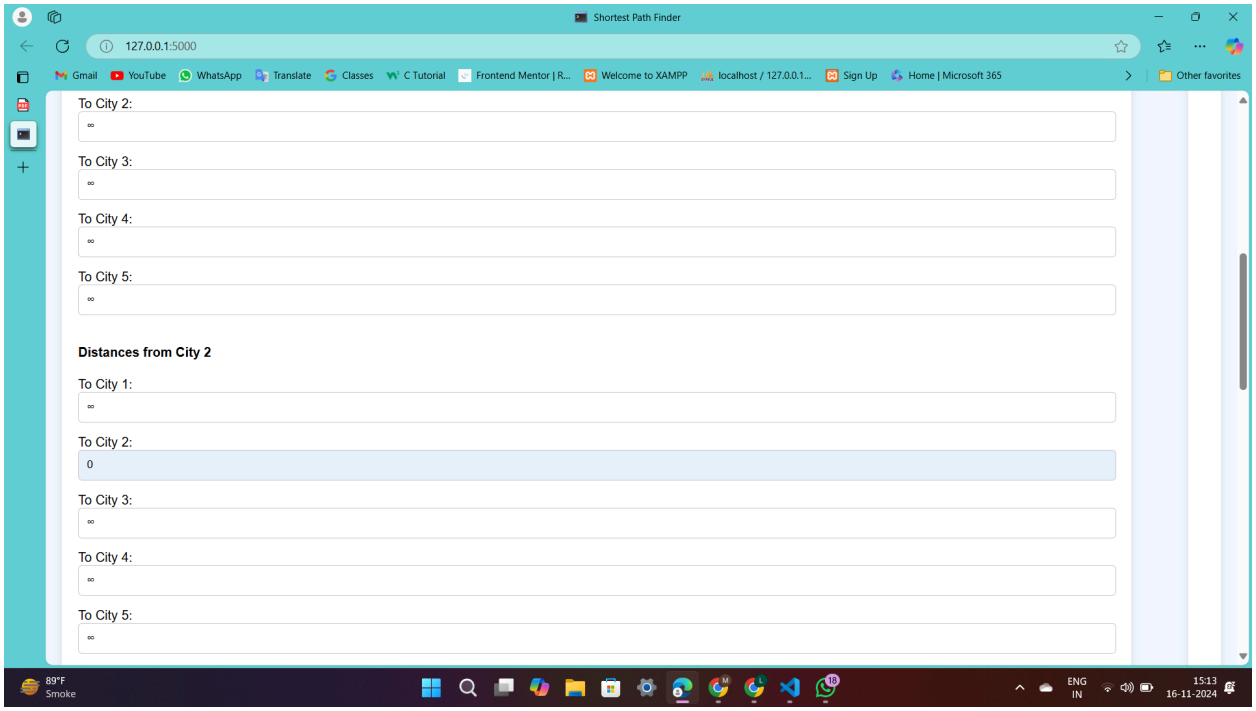

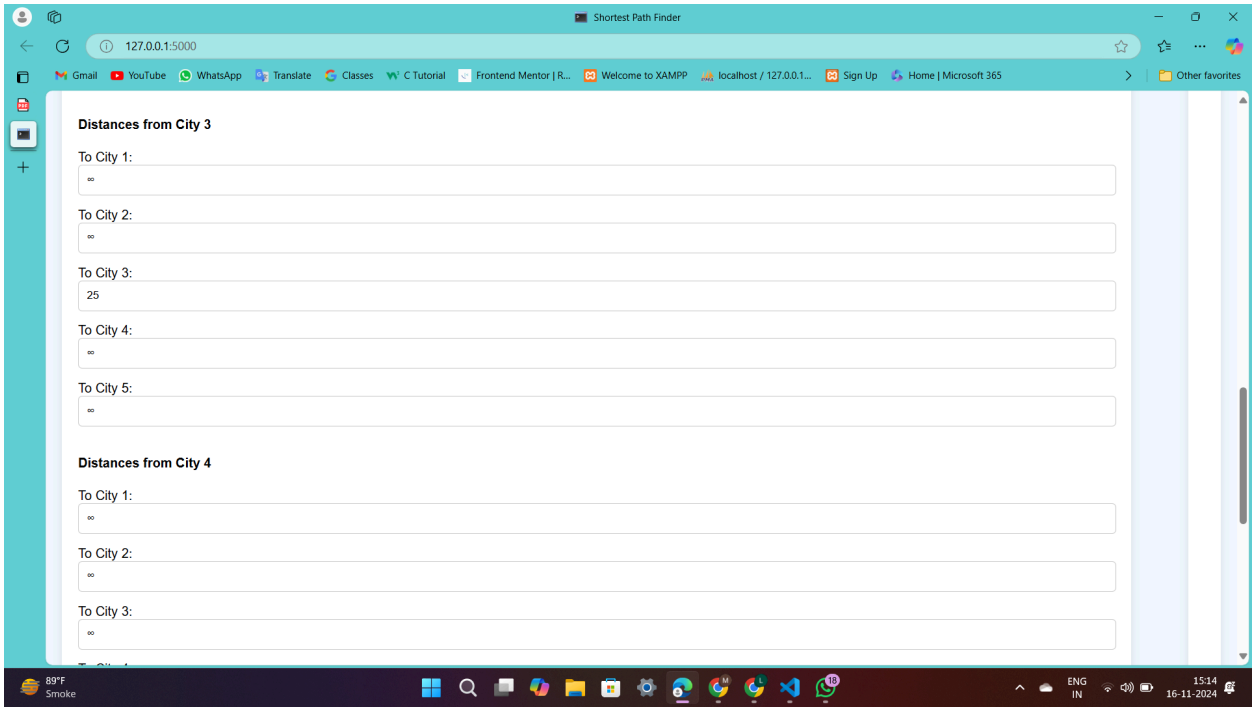

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