# The State Excursion Planner

A Synopsis Submitted

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Under

**Dr. Virender Kadyan**

By

# 500077419 R172219018 Bhoomika Singh

# 500077188 R172219035 Mohd. Ahzam Ausaf

# 500077450 R172219039 Prabhjot Singh

# 500077183 R172219053 Shruti Sharma



DEPARTMENT OF INFORMATICS

SCHOOL OF COMPUTER SCIENCE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES, BIDHOLI, DEHRADUN, UTTRAKHAND, INDIA

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Synopsis

1. **Introduction**

The State Excursion Planner is a course streamlining agent that targets reducing the travel time of the client by demonstrating the briefest course and thus, enhancing their experience. Every day hundreds and thousands of travellers in the world set out on their journey to explore its beauty and complete their long-awaited bucket list. The first thought that comes to a person's mind while setting on such a journey is the route they must follow to ensure a safe, smooth and memorable travel time whilst not forgetting the expenditure goals they have set. This project realizes and delivers the solution to a traveller's problems while creating an efficient plan for their journey.

Uttarakhand, often referred to as the Land of Gods and a paradise in itself for its unparalleled and bewitching beauty, welcomes an enormous number of tourists every year. A world full of serenity and spiritualism is one of the specialities that define this hill station. Uttarakhand is most famous for its tourist destinations like Dehradun, Rishikesh, Haridwar, Kedarnath, etc. Being an educational hub makes this state more popular among academicians.

The main idea behind this project is to cater to the needs and desires of everyone that arrives at either of the following places,

Dehradun Railway Station, Dehradun ISBT or Dehradun Airport,

to explore the sublime natural beauty and be a part of the experiences ranging from water sports, bird watching, skiing, yoga, camping, and wildlife tours that this Indian state offers. Along with the efficient and optimized routes, the project has been designed to provide a clear picture of the cost of travel as well as the various amenities at these tourist destinations that a person cannot afford to miss out on. 

We aim to implement the Nearest-Neighbor algorithm within the user's selected destinations and improve the results using Dynamic Programming. The input will be fed by the user in the form of starting point, the number of destinations to be visited and the choice of these destinations. The algorithm will explore all possible routes from the source to the destinations, compute the shortest among them, and give this result as output to the user.

The Nearest-Neighbor algorithm has many variants. In this project, The Bellman-Held-Karp algorithm will be used as a dynamic programming variant to find the most optimized route.



**Figure: A confused traveller**

1. **Motivation (1/4 pg)**

Being students of the prestigious University of Petroleum and Energy Studies, Dehradun, Uttarakhand, we have always seen a common issue arising for a person new to this state. It is difficult for a person to explore this beautiful state unless there's a guide to help the person out. We were motivated and confident to do something for the students and the other travellers visiting Uttarakhand from various other states. Our motivation is to help out all the travellers by providing them with useful information and saving their time by giving them the optimal destination path. In our project, we are using Dynamic Programming techniques instead of Greedy Method Algorithm. Using dynamic programming, we get the exponential time complexity which is less than that of the factorial time complexity of the greedy method algorithm. Lesser time complexity makes our code more stable, thus making our project’s results better.

1. **Related work**

The prominently used Travelling Salesman Problem (TSP) is a classic example of the study of Route Optimization Algorithms. It describes a scenario where a salesman is required to travel between a certain number of places, where the order in which they are visited is not essential. The main challenge is to find the shortest yet most efficient route for him that visits each location exactly once and finishes at the starting point. It is being applied in several fields nowadays and helps solve problems arising in computer wiring, job sequencing and scheduling, vehicle routing, crystallography, overhauling gas turbines, etc. In recent years several solutions for the problem have been put forward. Some of the following are:

1. **Brute Force Method:** This method works as a general brute force technique to generate all the possible routes and selecting the shortest route as the optimal route.
2. **Branch and Bound Method:** The key to this method is to divide the problem into a series of subproblems. First, choose a starting node and then set the bound to a very high value (infinity). Then, select the cheapest arc between the current and unvisited node and add this distance to the current distance. This continues while the current distance is less than the bound. On being added, the distance becomes equal to the bound. The process is repeated until all the arcs are covered.
3. **Greedy Algorithm**: The algorithm creates a list and sorts all the nodes in the network based on the cost. Then, a departure node with the minimum cost is selected, followed by the next one in the network, provided that a cycle is not generated. This continues till every node is visited once and only once and then returns to the first node. When the algorithm is terminated, the sequence is returned as the optimized route.
4. **The Nearest Neighbor Method:** This method is similar to the greedy approach and is the most straightforward method to solve the TSP. A starting point is selected arbitrarily, followed by the nearest unvisited destination such that it does not create a cycle. Once all the destinations are visited, the traveller returns to the starting point and the sequence of the visited places the outcome of the algorithm.
5. **Proposed Method**

As expressed before, our circumstance is like that of TSP, where, given a bunch of cities and distance between each pair of the areas, the issue is to track down the shortest conceivable course that visits every city precisely once. Here, in the event of cities we have different vacationer area that a traveler wishes to visit during his stay in Uttarakhand.

In order to overcome and solve the situation we use the Bellman-Held-Karp Algorithm. It helps in solving the TSP and gives the most optimum route. We will also be approaching the situation with dynamic programming.

**Dynamic programming** is basically a technique for solving a complex problem by first breaking it into a collection of relatively simpler sub-problems and then solving them one by one and then storing their solutions to avoid repetitive computations.

**Bellman-Held-Karp Algorithm:** This algorithm uses dynamic programming. In this algorithm the user chooses the beginning position, the next spot is chosen in accordance with the fact that it is nearest to the initial point. This procedure continues till all the nodes are covered and then ends at the very point we began from.

The time complexity is O(2n x n2).

The data structure we would be using is Adjacency Matrix involving the data set including distance between the major tourist spots in Uttarakhand and also from Dehradun Railway Station, Dehradun Airport and Dehradun ISBT.

1. **Methodology**

The project's problem statement pertains to the commonly used Travelling Salesman Problem and uses various algorithms in order to find the most effective and the shortest path to reach the desired destination.

The algorithm begins with the user choosing the start point of the journey and is followed by the next point that is closest to the start point. This repetitive cycle continues till all the nodes are covered and terminates when it reaches the start point again.

**Tools, Technologies and Techniques Used:** C, Bellman – Held – Karp, Dynamic Programming Approach

**Data Set Used:** Travel Distance between the starting point (Dehradun Railway Station, Dehradun ISBT, and Dehradun Airport) and various other tourist attractions.

**Data Structure Used:** Adjacency Matrix to help us keep track of the distances between the nodes in our dataset

**Time Complexity:** O(2n  x n2)

**Space Complexity:** O(n x 2n)

1. **Plan of work**
2. **Literature Review and Research**

* The study of various TSP-solving algorithms.
* Discussion of recommended technique and selection of the most suitable algorithm for our use case.
* Identifying the most popular tourist attractions in Uttarakhand and selecting the top fourteen to be included in our list of recommendations.

**References**: [*https://www.holidify.com/state/uttarakhand/top-destinations-places-to-visit.html*](https://www.holidify.com/state/uttarakhand/top-destinations-places-to-visit.html)

1. **Data Collection**

* Finding the distances between each pair of places and constructing three adjacency matrices for the three starting points i.e. Dehradun Railway Station, Dehradun ISBT, Dehradun Airport respectively.

**References:** *Google Maps*

1. **Implementation**

* Implementation of the Bellman-Held-Karp algorithm to determine the shortest path between all of the user's desired destinations. The crucial aspect is that the journey's starting and ending sites are the same.

1. **Examining the algorithm**

* To verify the findings, test the code with multiple inputs and manually inspect the path for the quickest route. Also, look for areas where we may improve.

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