Tour Group Recommendation

Project for Algorithm and Complexity

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Abstract. This project introduces the concept of tour recommendation. It includes the brief introduction of needs, features, constraints and objectives regarding personalized tour planning and tour group recommendation. Finally, it lists all the requirements and rules for each group. Please read this document carefully and complete the corresponding tasks.
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1 Tour Recommendation Problem

Tourists that visit a destination for one or several days, are facing the problem to decide which points of interest (POIs) would be more interesting to visit and to determine a route for each trip day, i.e., which POIs to visit as well as the visiting order among them. This is a challenging question that involves a number of constraints such as the visiting time required for each POI, the POI's visiting days/hours, the traveling distance among POIs, the time available for sightseeing on a daily basis and the "degree of satisfaction" (termed "profit") associated with the visit to each POI (based on personal profile and preferences). Essentially, these problems can be regarded as extensions of Travelling Salesman Problem.

Moreover, people tend to travel together, namely to go with their lovers, children or friends. However, most existing tour recommenders mainly focus on recommending a POI sequence to a single tourist but cannot be applied to the tour group, which is a common way to travel. Therefore, the problem is complicated when designing itineraries intended for a group of tourists.

The problem of tour group recommendation is to recommend a sequence of POIs potentially attractive to a group of tourists. For ease of exposition, let $U = \{u_1, u_2, \ldots, u_m\}$ be the members of group G and $p = \{p_1, p_2, \ldots, p_n\}$, be the set of POIs, where m and n denote the number of members in group G and the number of POIs, respectively. Each member has observable properties e_{u_t} (e.g., member's reviews, travel photos and GPS trajectories). Also, each POI keeps observable properties e_{p_t} (e.g., POI's related textual description and spatial coordinates in terms of longitude and latitude). The goal is to recommend a POI sequence to satisfy the overall preference of group G under maximum travel time limit.

2 Tasks

In this project, you are required to deal with the following tasks. The relevant data is shown in the attached file. You are required to design algorithms to recommend the route for tour groups with time limitations (6 hours) in a specific city. At first, you should design an algorithm to get the preference of the tour group. Then you are supposed to leverage the algorithm to recommend a route for the group.

2.1 Preference Based Tour Group Recommendation

First, you are supposed to define a formula to measure the similarity between the POI and user's preference with the help of the provided data and other factors you can think of.

It is evident that tourists are with different or even contradictory tastes in a group. Consequently, every POI may have different potential interest to distinct group members, thereby this discord among members must be taken into account when planning a tour.

2.2 Tour Group Recommendation with Influence Variation

This problem arises from the changeable influence of members at different stages of the tour and in different POIs. Influence variation refers to the varying of a member's influence in a group along with the stage of a trip. Taking a honeymoon trip to Los Angles as an example, the bridegroom has a passion for basketball while the bride loves movies. If they are at the northwest of the city currently, where Hollywood is located, the system should incline to the bride's preference and partially ignore the other. If they are in the downtown area, where Staples Center lies, the bridegroom's taste ought to be considered.

3 Requirements

In this project, you are required to solve all the problems mentioned in section 2. For each problem, please finish the following tasks.

3.1 Problem Formulation

Please formulate the problem formally as a mathematical programming. You need to define variables carefully and model the description of every requirement and constraint mathematically. Moreover, can you convert your programming as an LP (Linear Programming) or ILP (Integer LP)?

3.2 Problem Analysis and Algorithm Design

Firstly, please judge the difficulty of your defined problem. Whether it is in P, NP, NP-Complete, or NP-Hard? Prove or clarify your conclusion.

Next, please design an efficient algorithm to solve the detection problem in polynomial time with respect to the input size. You need to describe your design first, introduce the necessary concepts, symbols, definitions, etc., and write the pseudo code of your design.

3.3 Theoretical Analysis and Performance Evaluation

For each variation of detection problem, you need to complete the following tasks:

Theoretical Analysis: For this part you are aiming to distinguish the theoretical properties of your problem and algorithm designs, including the following items:

1. Analyze the time complexity of your designed algorithm.
2. If the problem you are dealing with is in P, then prove the correctness of your design. Otherwise discuss the feasibility or the approximation property of your algorithm.

Performance Evaluation: it includes the following requirements:

1. Based on the provided data, evaluate the effectiveness and efficiency of your design by simulations. In this dataset, since the lack of information about relationships, members in a group should be randomly selected from the pool of tourists. However, we encourage that you independently search the appropriate dataset or crawl data from tourism websites to get extra credits.
2. There are three evaluation criterions. Fist, the running time of the algorithm. Second, the profit sum of all the POIs in the recommended route. Finally, the degree of satisfaction of the group for the recommended route.

3.4 Report Requirements

You need to submit a report for this project, with the following requirements:

1. Your report should have the title, the author names, IDs, email addresses, the page header, the page numbers, figure for your simulations, tables for discussions and comparisons, with the corresponding figure titles and table titles.
2. Your report is English only, with a clear structure, divided by sections, and may contain organizational architecture like itemizations, definitions, or theorems and proofs.
3. Please include reference section and acknowledgement section. You may also include your feelings, suggestion, and comments in the acknowledgement section.
4. Please define your variables clearly. If needed, a symbol table is strongly recommended to help readers catch your design.
5. Please also include your latex source and simulation codes upon submission.