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Efficient Mobile Sequential Recommendation Using Backward Path Growth

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Abstract

The goal of mobile sequential suggestion is to give a taxi driver a route that connects a number of pick-up locations so that they are more likely to pick up clients while spending less money on gas. In essence, a significant barrier is this problem's tremendous difficulty of the computation.. In this research, we offer a unique dynamic programming-based strategy with two distinct stages—offline pre-processing as well as online search—to tackle the mobile sequential recommendation issue. From a list of pick-up spots, various candidate sequences are pre-calculated in the offline step. Based on the cost function's noted iterative feature, a backward incremental sequence creation technique is suggested. In order to efficiently minimize the search space for candidate sequences, an incremental pruning approach is simultaneously applied during the sequence generating process. The produced possible sequences are also subjected to a batch trimming technique to exclude some subpar sequences of a specified length. At the online stage, our technique can effectively select the best driving route for an empty taxi from the left candidate sequences because the pruning efficacy increases as the sequence length increases. Moreover, our approach can deal with the issue of finding the best route when there is a destination limitation or a maximum cruise distance. Experimental findings on actual and artificial data sets demonstrate that our strategy outperforms state-of-the-art approaches in regards of both pruning ability and efficiency. Hence, in practical applications, our strategies may be used to successfully handle the issue of mobile sequential recommendation with several pick-up places.

1. INTRODUCTION

Access to position trace information for a large number of moving items is made possible by the use of wireless sensors and information infrastructures like GPS, Wi-Fi, Blue Tooth, and RFID. By utilising this information, businesses may operate more efficiently and consume less energy. In order to increase the likelihood that a driver would pick up passengers while incurring the least amount of trip expenses, Ge et al. have suggested a unique difficulty of mobile sequential recommendation (MSR), objective is to recommend a route connecting several pick-up locations for an empty cab. They suggested a function of prospective trip distance (PTD) for calculating the cost of a driving route to address the MSR problem. Two efficient potential sequence pruning methods, LCP and Sky Route, have been suggested to lower the computational cost.

Yet, each of these two techniques' temporal and spatial difficulties increase rapidly. In this research, an innovative and effective offline-online two-stage solution to the MSR problem is proposed. At the offline step, the search space is pruned and a limited number of candidate sequences are produced. The goal of the online stage is to determine the best driving path given the location of an empty cab. The approach makes use of the PTD function's iterative nature to gradually develop possible sequences and eliminate fruitful search space, which dramatically improves efficiency and lowers memory use.

This essay explores a technique for quickly finding the best driving route online. The algorithm's ability to produce all conceivable candidate sequences of any length, the proposal of the recursive PTD function, the development of a backward incremental sequence generation algorithm with reduced time complexity, the presentation of an effective technique for assessing the PTD costs of many possible driving routes as well as sequences, and the adoption of a sequence pruning method that combines incremental pruning with batch pruning are the main contributions. According to experimental findings, the strategy is substantially more successful than state-of-the-art techniques in both offline pruning and online search.

A comparable issue to MSR is the shortest-path searches in spatial databases. With the use of contraction hierarchies, Funke and Storandt investigated the shortest routes. Ge et al. used historical trajectory data to study a unique challenge of mobile sequential recommendation. The authors found the iterative behaviour of the PTD function and suggested the pruning concept, which may successfully minimise the search space for MSR, in order to overcome the computing difficulties of the MSR issue.

The MSR problem with the destination constraint is discussed in this article along with some solutions. To lower the computation cost of the PTD values of the routes, a recursive calculation algorithm and an incremental backward path growth approach are used. In contrast to the technique previously described, candidate sequence generation involves cost comparison and trimming among possible sequences that have the same source point and destination point. When a driver enters the destination cd online, we just need to look for the best route among the remaining potential sequences using the destination cd.

2. LITERATURE SURVEY

Large spatio-temporal datasets are being compiled as a result of the expanding use of location-acquisition technologies (like GPS, GSM networks, etc.), providing researchers with the chance to learn practical information about human mobility. The sequential pattern mining paradigm is extended in this study to analyse the motions of moving objects. It presents trajectory patterns as succinct, time- and space-based explanations of recurrent behaviours. To comprehend mobility-related phenomena, spatial-temporal patterns that simply depict the cumulative behaviour of a population of moving objects are helpful abstractions. These patterns would be especially helpful in the fields of sustainable mobility and traffic management in urban settings. This work provides a sequential pattern mining paradigm extension that examines the motions of moving objects. In regards of both space and time, it introduces trajectory patterns as succinct explanations of typical behaviours. A group of independent trajectories that visit the same sequence of locations while taking a comparable amount of time to get there are called a trajectory pattern. An efficient mining technique to extract trajectory patterns from the source trajectory data is required in order to extract a potentially useful pattern from the data. Three strategies are suggested: movement attractors, pre-conceived zones of interest, and pattern mining. The third technique employs arbitrary background information to designate a collection of locations of interest. The first two methods are based on the idea that identifying the regions of interest is difficult since it's an issue of discretizing the spatial dimension [1].

This article presents a pilot investigation on the viability of extracting green knowledge (energy-efficient driving patterns) from taxi drivers' location traces. It concentrates on a series of mobile suggestions that can suggest a series of taxi pick-up locations or a series of suitable parking spaces. Each potential sequence is assessed using the Potential Travel Distance (PTD) function, and two algorithms—LCP and SkyRoute—are created to determine the best course of action. The PTD function may be used to efficiently trim the search space, according to experimental results. The suggested system may offer efficient mobile sequential recommendations, and the information gleaned from location histories can be applied to driver coaching and energy-saving measures. If we attempt to give several ideal driving routes determined by various company demands, it will reduce the overall processing time for online transactions. The fact that it results in a costly network traversal operation is a drawback, though [2].

This essay offers a straightforward but useful technique for cutting cruise kilometres by advising taxi drivers to go to lucrative spots. It aids taxi drivers in finding customers by utilizing historical data also a calculated Spatio-Temporal Profitability (STP) map. The efficiency of the suggested approach is demonstrated by experiments utilising a sizable sample of GPS data from Shanghai taxis. The suggested framework makes use of past GPS data to simulate the potential profitability of places based on a taxi driver's current position and time. It avoids the issue of giving the same information to every driver by providing tailored suggestions based on time and location to a taxi driver. There are two types of taxi service: dispatching and cruising. This essay explores alternative remedies for an inefficient system where taxi drivers often cover hotspots and wait a long time for

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fares, creating an imbalance between supply and demand. Using the road network, present traffic conditions, and recognised impediments to calculate profitability is one such method. The system must be real-time and include unobtrusive, simple-to-understand visualisations. In order to calculate a more accurate profitability score and provide better prospective profitability path ideas leading to a successful site, it might also take into account the present traffic flow [3].

The information about customers' mobility patterns and taxi drivers' pick-up behaviours collected from the GPS trajectories of taxicabs is used by this system to offer a recommender for taxi drivers as well as those intending to take a taxi. The objective is to increase the use of these taxis while lowering energy usage. Using the trajectories produced by 12,000 cabs over the course of 110 days, the system is verified. The time-dependent taxi behaviours (pick-up/drop-off/cruising/parking) are formulated using a probabilistic model, and the city-wide statistical information is learned using a partition-and-group approach. The evaluation's findings support the method's ability to advise taxi drivers on where they may make more money and cut down on travel time. This advice decreases the amount of time a cab spends cruising (waiting for a fare), reduces energy use, reduces exhaust pollution, and increases driver profit [4].

By selecting a subset of useful data points from a potentially enormous amount of data points, the Skyline operation is a technique that has been proposed to expand database systems. This operation may be expanded to include Skyline queries, alternate Skyline implementation techniques, and a demonstration of how to integrate this operation with other database actions. The points that are undominated by any other point are referred to as the maximum vector issue. The Skyline of a set M has the good characteristic that if p M maximises any monotone scoring function M R, then p is in the Skyline. This paper introduces and assesses various Manhattan skyline computation techniques. It is at least as excellent in certain aspects and equal to or better in all of them. The main flaw, however, is that it is irrelevant in what sequence the measurements are stated [5].

3. PROPOSED SYSTEM

With the help of developments in sensor, wireless communication, and information infrastructure like GPS, WiFi, and mobile phone technology, we are now able to gather and process enormous amounts of location-based data with global road coverage, giving us unparalleled opportunities to comprehend mobile user behaviours and produce useful knowledge. This knowledge then provides intelligence for real-time decision making in a variety of fields, including mobile recommendations. For instance, the growth of the mobile Internet has led to a revolution in recent years in mobile phone technology. As of June 2006, there were 34.6 million mobile online users in the US, according to the Telephia Mobile Internet Report. Even though this represents just 17% of all cellular phone subscribers, the penetration rate has been rising.

Mobile ubiquitous recommendation will be in high demand as the mobile Internet develops, and as a result, mobile consumers' knowledge of mobile applications is continuing to rise. It is claimed that mobile users would have access to customised suggestions whenever and wherever they are. Understanding the distinctive characteristics that set mobile recommendation systems apart from traditional recommender systems is urgently required in order to maintain this promise. In fact, the goal of this dissertation is to create mobile recommender systems by utilising the hidden data in location traces gathered from various application domains.

Recommender systems have drawn more attention in recent years (Hofmann, 1999; Resnick, Iacovou, Suchak, Bergstrom, & Riedl, 1994), particularly after Amazon and Netflix made these technologies popular and after the launch of the $1,000,000 Netflix Prize Competition, which attracted over 45,000 participants from 180 nations. During the past ten years, much work has been put out in both the business and academia to create novel methods to recommender systems.

The recommendation challenge may be reduced to the issue of predicting ratings for goods that have not yet been reviewed by users in its most basic form. This evaluation is often based on the ratings that this user has given to other products, the ratings that other users have given to the same item, and other information (features) about the goods. Once we are able to predict ratings for the unknowable ratings, we can simply suggest to the user the product or products with the highest rating (s).

With the advancement of mobile technology, including GPS and WiFi, and the rising demand from users for mobile apps, such travel planning and location-based purchasing, recommender systems in mobile contexts have become a promising field. Earlier this decade, there has been a lot of effort done on building new systems

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and applications in both the industry and academia. Mobile recommender systems often help or advise users while they make decisions "on the fly," or, to put it another way, as they move into an unfamiliar area. Mobile recommendation is distinct from conventional recommendation methods in that it can be location-aware. The geographic location of the user, a crucial but mostly untapped piece of information, is added by mobile computing to the recommendation problem.

However because of the complexity of spatial data and underlying spatiotemporal linkages, the uncertain roles of context-aware information, the dearth of user rating information, and the variety of location-sensitive recommendation tasks, establishing personalised recommender systems in mobile and pervasive contexts is far more difficult than constructing recommender systems from traditional domains. In actuality, research on recommender systems in mobile contexts has already been done. For instance, the effort focuses on the creation of portable tour guides.

Moreover, Heijden et al. have talked about a few technology possibilities connected to mobile recommendation systems. Moreover, Averjanova et al. have created a mobile recommender system based on maps that may offer consumers some tailored recommendations. Nevertheless, because the majority of this earlier research was exploratory in character and focused mostly on user ratings, the issue of utilising distinctive traits to set mobile recommender systems apart is still largely unresolved. 1 Designing and executing a successful mobile recommend system in ubiquitous contexts presents a variety of technological and domain problems. Secondly, the data is more complicated than standard commercial item data, like the Movie data, due to the varied and noisy nature of mobile surroundings. Spatial and temporal data are what location traces are. Benefits of the suggested strategy include the following:

- The TRAST model may be utilised as a useful evaluation tool for the automated construction of travel groups.
- Next, together with the initial training data, these additional training examples are utilised to develop the CF models once more.
- The TRAST model may be utilised as a useful evaluation tool for the automated construction of travel groups. These positive results, we hope, will inspire a lot of new work in the future.

4. RESULTS

The sequential mobile recommendation problem is addressed in this work using a dynamic programming-based approach. This work offers a unique dynamic programming-based solution with two distinct stages—an offline pre-processing stage and an online search stage—to tackle the mobile sequential recommendation issue. With the use of a backward incremental sequence generation method and an incremental pruning policy, the offline stage effectively reduces the search space of the possible candidate sequences by pre-calculating prospective candidate sequences from a collection of pick-up sites. The approach effectively finds the best driving path for an empty cab from the remaining candidate sequences, and the pruning efficacy increases as the sequence length increases. Experimental findings on actual and artificial data sets demonstrate that the strategy outperforms cutting edge approaches in terms of both pruning ability and efficiency. In practical applications, the issue of mobile sequential recommendation may be successfully solved by using our methodologies.

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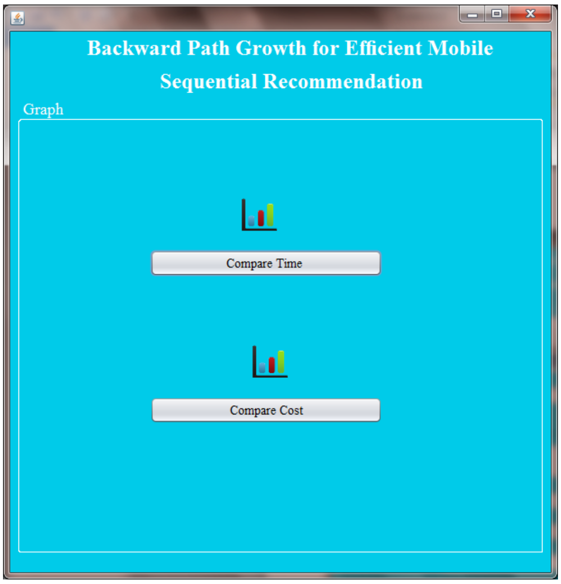
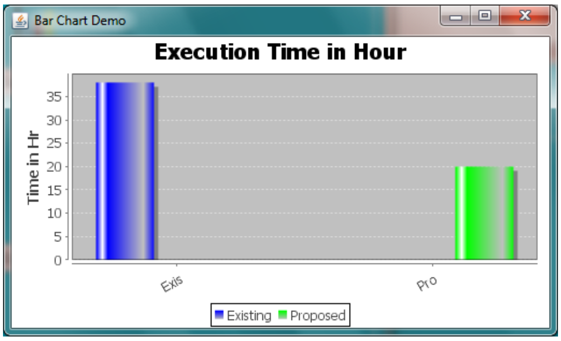
Total Amount Calculation



Time And Cost Comparison Graph



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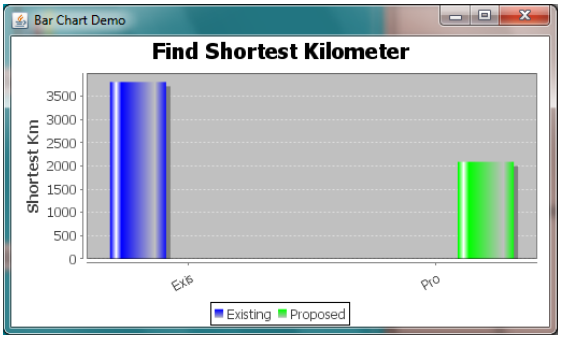

Performance Analysis

5. CONCLUSION

In this research, a dynamic programming-based approach to the sequential mobile recommendation issue has been suggested. The pruning impact is significantly enhanced by the suggested method's use of numerous pruning rules and the cost function's iterative character. Without a length restriction, the mobile sequential recommendation problem's overall time complexity has decreased from ON! to ON22 N. According to experimental findings, the pruning impact and the online search time are superior to those of other approaches now in use. The utilisation of parallel approaches for sequence creation and recommendation will be intriguing in the future.

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