Searching Trajectories by Regions of Interest

ABSTRACT:

With the increasing availability of moving-object tracking data, trajectory search is increasingly important. We propose and investigate a novel query type named trajectory search by regions of interest (TSR query). Given an argument set of trajectories, a TSR query takes a set of regions of interest as a parameter and returns the trajectory in the argument set with the highest spatial-density correlation to the query regions. This type of query is useful in many popular applications such as trip planning and recommendation, and location based services in general. TSR query processing faces three challenges: how to model the spatial-density correlation between query regions and data trajectories, how to effectively prune the search space, and how to effectively schedule multiple so-called query sources. To tackle these challenges, a series of new metrics are defined to model spatial-density correlations. An efficient trajectory search algorithm is developed that exploits upper and lower bounds to prune the search space and that adopts a query-source selection strategy, as well as integrates a heuristic search strategy based on priority ranking to schedule multiple query sources. The performance of TSR query processing is studied in extensive experiments based on real and synthetic spatial data.

INTRODUCTION:

The availability of GPS-equipped devices(e.g., vehicle navigation systems and smart phones) and online map-based services (e.g., Google Maps1 , Bing Maps2 , and MapQuest3) enable people to capture their current location and to share their trajectories by means of services such as Bikely4 , GPS-Way-points5 , Share-My-Routes6 , and Microsoft GeoLife7 . Also, more and more social networking sites, including Twitter8 , Four square9 , and Facebook10, support the sharing of trajectories. The availability of massive trajectory data enables novel mobile applications. Such applications may utilize trajectory search, which finds trajectories that are similar in some specific sense to query parameters (a set or sequence of locations or regions). This type of query can benefit popular services, such as travel planning and recommendation, and location-based services in

general. For example, when planning a trip to multiple places in an unfamiliar city, a tourist may benefit from the experience of previous visitors. In particular, visitors with similar interests may have visited nearby landmarks that the user may not know, but may be interested in. Or others may have avoided a specific road because it is unpleasant, although it may seem like a good choice in terms of distance. Such experiences are captured in trajectories shared by previous visitors. In existing studies, all trajectories are treated the same, regardless of their frequencies of use. For example, some less traveled trajectories may be new or just less popular because the region they are in is less traveled. Such trajectories may still be of interest to users. In most existing studies on trajectory search, the query parameters are a set or sequence of locations. However, in some cases, a place may not be a point location, but may be a region of interest that contains several spatial objects (e.g., a scenic area, a commercial district, or a dining area, where spatial objects can be points of interest (POIs), geotagged photos, or geo-tagged tweets). Moreover, especially when planning a trip in an unfamiliar city, users may fail to specify intended locations exactly and may use intended regions instead. These two common cases motivate our study. Extending conventional trajectory search, we propose and investigate a novel query named trajectory search by regions (TSR). In our setting, a region is circular, and users can specify a region on a map simply by specifying a center and a radius. Given a trajectory set T, a user provides a set of regions of interest as query parameters, and the TSR query retrieves the trajectory from T with the highest spatial-density correlation with the query regions. Intuitively, a trajectory that is spatially close to regions with many spatial objects is more attractive to travelers than a further-away trajectory.