論文の要旨

題 目

A Study on Intelligent Area Selection Query

（知的領域選択問合せに関する研究）

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Problems of selecting good location is very important in the services and business field, either for customers or for land owners. User/customer uses location selection query to find good location to buy, to rent, or to visit. From user/customer's perspective, the location is more valuable if it is close to desirable facilities that can bring profits and benefits for the location, and it is far from undesirable facilities that can reduce profits and bring unfavorable effects for the location. On the other hand, location selection for land owner aims to find other locations which are as good as his/her owned locations. One of the important criteria for comparing his/her location to others is the location's distance to desirable and undesirable facilities.

Skyline query is a well-known method for selecting small number of data objects, and it also has been applied in the location selection problem. In some situation, there are some candidate points, which are for example vacant rent rooms, in a map. In such cases, we can utilize skyline query to select a preferable point. However, in some real world situations, we cannot assume there are candidate points for the selection problem on a map. For example, assume a businessman wants to build a new supermarket if there is a good vacant area. The businessman may also want to take over a building that locates in a good area at any cost. In such situation, the candidate points are not given and the businessman has to find a good location in an area on the map. Two-dimensional area is much more complicated than a point; therefore, the area selection problem for two-dimensional area is challenging and important. However, previous skyline algorithms for location selection problem only consider zero dimensional objects and based on the assumption that there will always be some candidate points to be selected. In this dissertation, we introduced two new variants of skyline query, Area Skyline Query: Skyline query for selecting spatial area objects from customers' perspectives and Reverse Area Skyline Query: Skyline query for selecting spatial area objects from land owners' perspectives.

To answer area skyline queries, first we developed Unfixed-shape Area Skyline (UASky) algorithm in our feasibility study. To find area skyline, we divide the query area by

overlaying all Voronoi diagrams of all facility types to generate the unfixed-shape disjoint areas, and calculate the minimum (min) and maximum (max) distance from an area to the closest facility of each types. In order to calculate these distances efficiently, we first compute distance from each of vertexes that enclose an area. Note that we can efficiently compute the closest facility from the vertexes by using Voronoi diagram. Also, note that one vertex is included by more than one area. Then, after computing min distance from vertexes, we calculate min-max distance for each area and record them in a table called Minmax table. Given two unfixed-shape areas, a and a', we say area a dominates area a' if and only if max distance of a is smaller or equal to min distance of a' for all facility types. Skyline query for areas selects all non-dominated areas from the set of the disjoint areas. Based on the extensive experiments, UASky is affected by the number of facility types, as well as the number of objects for each facility. The drawback of UASky is that it selects relatively many areas as skylines, since a large area is likely to be selected as a skyline because they have large max distance.

One countermeasure for UASky's drawback is to divide a large area into smaller areas. We used grid data structure to divide query area and proposed an efficient and practical solution to the area skyline query called Grid based Area Skyline (GASky) algorithm. GASky first divide query area into s number of grids. Then, it finds non-dominant grids as the result. Comprehensive experiments show that the processing time of GASky increases with the increase of the number of grids, facility types, and number of objects. The experiment also shows that we can decrease the ratio of skyline area by increasing the number of grids. Thus, higher number of grid means smaller size of each disjoint area, which in turn will decrease the number of skyline.

By applying grid data structure, the GASky can control the number of area skyline by changing the number of grids. In actual usage scenario, if a user prefers selective areas, she/he had better increase the number of grid, which tends to reduce the ratio of skyline areas.

The author has considered another area skyline queries called "reverse area skyline queries", which are based on land owners' perspective. Here, we combine GASky method to compute min-max distance for each grids and a state of the art reverse area skyline algorithm using global skyline concept for two-dimensional area. We extend conventional global skyline concept so it can be applied to two-dimensional area. This query is very important for location selection in business' or land owners' perspective. One of the important applications of reverse area skyline query is selecting promising buyers of the area, since reverse area skyline query may give clues to the owner of the area in finding who will be interested in the area. Furthermore, it also may help to predict what type of business that would be suitable for the area considering the type of business that had already exist in the reverse area skylines. To answer reverse area skyline problem, we proposed Reverse Area Skyline (RASky) algorithm. Comprehensive experiments are conducted to show the effectiveness and efficiency of the proposed algorithms.

To summarize, this dissertation addresses two new skyline queries in the location selection problem for two dimensional areas: skyline queries for selecting spatial area objects from customers' perspectives and owners' perspective. The outline of this thesis is organized like in the following passage. Chapter 1 present the introduction of this dissertation. Chapter 2 reviews about related works, skyline query and its variants, and also some issues in skyline for location selection. We reported our feasibility study of area skyline query problem in Chapter 3. In this chapter, we presents our starter algorithm, UASky. In Chapter 4, we proposed our efficient algorithm, GASky and compare both algorithms, UASky and GASky based on some related parameters. We find that GASky outperform UASky according to complexity computation and experiment results. In Chapter 5, we introduced another new skyline query problem, reverse area skyline query problem, which is area selection problem based on owner's perspective. In this chapter, we presented a new definition of dynamic area skyline and proposed RASky algorithm to answer reverse area skyline query problem. Our extensive experimental study confirms that GASky and RASky algorithms are able to find reasonable number of desirable skyline areas and can help users to find good locations. Finally in Chapter 6, we concludes our study and presented some future directions.