Thematic Map Modeling$^1$

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Abstract

We study here how to provide the designer of geographic databases with a database query language extensible and customizable. The model presented here is a first step toward a high level spatial query language adapted to the manipulation of thematic maps.

For this, we take as an example a toy application on thematic maps, and show by using a complex objects algebra that application dependent geometric operations can be expressed through an extension of the replace operator of [AB88].

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1 Introduction

The representation and manipulation of geometric information require the use of two technologies: database systems and computational geometry. Several recent proposals have been made for the modeling and design of Geographic Information Systems (GIS) (see for example [LM84], [OM86], [SW86], [MOD87], [Dav88], [RFS88]). For a comprehensive study on the requirements for the design and implementation of large-scale GIS, see [Fra84], [SMSE87]. Several spatial query languages have recently been proposed in [CF80], [CK81], [BB81], [Fra82], [SMO87], [CJ88], [Gut88]. A survey on data structures for spatial databases can be found in [Sam84].

One characteristic of GIS is that they cover an extremely wide range of applications for which, neither a common definition of objects, nor a common set of functions on these objects exist. Designing a close general information system for geographic applications therefore becomes an ambitious and somewhat hazardous task.

It is our belief that there might exist a set of application dependent basic objects and operations on these objects, and that the database system should permit an easy extension of this set or an easy change to another set more adapted to a particular application. Examples of applications we consider are cartography and urban planning which both manipulate thematic maps.

In order to validate the concepts presented in the paper, we consider a restricted application with limited functionalities since it manipulates only regions, i.e. subsets of \( \mathbb{R}^2 \) (and neither lines nor points).

This application is described in Section 2. Basically, one would like to answer queries such as:

- "Display the districts of the province of Toulouse",
- "From the map of the districts of France, zoom to the map of provinces",
- "Overlay the map of crops with the map of the province of Rennes",
- "Create the map of districts from the map of provinces belonging to the North of France" (district boundaries as well as data associated to districts must be entered),
- "Display districts with more than 20% of the people voting for the communist party in the district of Lille".

For designing such an application, the following are required:

- some high level query and manipulation language with the confidence that, when the application changes (and therefore the query language changes), there are only minimal incremental changes to bring to the system in order to provide new functionalities,