Chapter XIII

Spatial Online Analytical Processing (SOLAP): Concepts, Architectures, and Solutions from a Geomatics Engineering Perspective

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Abstract

It is recognized that 80% of data have a spatial component (e.g., street address, place name, geographic coordinates, map coordinates). Having the possibilities to display data on maps, to compare maps of different phenomena or epochs, and to combine maps with tables and statistical charts allows one to get more insights into spatial datasets. Furthermore, performing fast spatio-temporal analysis, interactively...
exploring the data by drilling on maps similarly to drilling on tables and charts, and easily synchronizing such operations among these views is nowadays required by more and more users. This can be done by combining geographical information systems (GIS) with online analytical processing (OLAP), paving the way to “SOLAP” (spatial OLAP). The present chapter focuses on the spatial characteristics of SOLAP from a geomatics engineering point of view: concepts, architectures, tools and remaining challenges.

Introduction

It is recognized that up to 80% of corporate data have spatial components such as street addresses, place names, geographic coordinates, or map coordinates. This fact, estimated by Franklin (1992), is still recognized today and it only starts to show its potential for the masses with recent commercial advances such as Google Maps and Google Earth. However, the true power of maps typically remains underused for geographic knowledge discovery unless one combines a geographic information system (GIS) to OLAP technology.

The Power of Maps

Map data are the raw material to produce the geographic information that leads to knowledge about the position, extent, and distribution of phenomena over our territories. Such phenomena are counted by thousands and include insect territorial expansions, environment-health correlations, land-use evolution, 911 vehicle tracking and watershed analysis, to name a few. Visualizing geographic phenomena on maps facilitates the extraction of insights that help to understand these phenomena. Such insights include spatial characteristics (position, shape, size, orientation, etc.), spatial relationships (adjacency, connectivity, inclusion, proximity, exclusion, overlap, etc.), and spatial distribution (concentrated, scattered, grouped, regular, etc.). When we visualize a map displaying different regions, we can compare. When we visualize different maps for a same region, we can discover correlations between phenomena. When we visualize the map of a region for different epochs, we can see the evolution of the phenomena. When we use maps, we often get a better understanding of the structures and relationships contained within spatial datasets than using simple tables and charts. When we combine maps with tables and statistical charts, we can relate these to make new discoveries. Maps are natural aids to the knowledge discovery process. In the context of spatial data exploration, maps do more than just make the data visible, they are active instruments to support the end user thinking process. Using maps for geographic knowledge discovery requires less
Using Dempster-Shafer Theory in Data Mining
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