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Abstract:
GearScape is a Free and Open-Source Software (FOSS). It is a Geographic Information System (GIS), that is a software dedicated to storage, retrieval, analysis and mapping of geographic data. More precisely, it is a platform focused on geo-processing that can be used in both interactive and batch modes. Its two main distinguishing features are: on the one hand it can be extended not only through the Application Programming Interface (by an advanced user with clear programming skill) but also through a simple spatial SQL based language called GGL (by a common end user), and one the other hand it relies on a generic layer that intends to uncouple the geo-processes with the specificities of each underlying spatial format. Extensibility and re-usability in a groupware context are the two main reasons that justify its clear appropriateness to the Territorial Intelligence main thematic.

Résumé:
Gearscape est un logiciel libre. C'est un Système d'Information Géographique (SIG), c'est-à-dire un outil logiciel adapté au stockage, à l'extraction, à l'analyse et à la représentation cartographique de données géographiques. Plus précisément, c'est une plate-forme orientée géo-traitements qui peut être utilisée en mode conversationnel comme en traitement par lot. Ses deux principales caractéristiques sont: l'extensibilité d'une part (non seulement par le biais de son interface programmative d'application pour les utilisateurs-développeurs d'application, mais aussi par le biais du langage GGL qui est simple et repose sur une version spatiale du SQL pour tous les autres), la généricité d'autre part (puisqu'il repose sur une couche applicative d'abstraction qui lui permet de s'affranchir du format des données sous-jacentes). Ces deux traits essentiels en font un outil de choix pour tous les traitements liés aux thématiques de l'Intelligence Territoriale.

Resumen:
GearScape es software de fuentes abiertas y libre. Es un Sistema de Información Geográfica (SIG) que permite el almacenamiento, recuperación análisis y visualización de datos geográficamente referenciados. Más concretamente, GearScape es una plataforma para la creación de geoprocesos que puede ser utilizada de manera interactive o por lotes. Sus dos principales características son: por una parte puede ser extendido a través de la Interfaz de Programación de Aplicaciones (por un usuario con conocimientos de programación) y también a través de un lenguaje de geoprocesamiento basado en SQL llamado GGL (por un usuario final); por la otra parte, GearScape está construido sobre una capa de acceso a datos que desacopla los geo-procesos de las características de los distintos formatos. Extensibilidad y reusabilidad en un contexto groupware son las dos mayores razones que justifican su clara adecuación la principal temática de la Inteligencia Territorial.

Keywords: GIS, geomatics, geo-processing, spatial SQL, GearScape, GGL

Mots clés : SIG, géomatique, géo-traitement, SQL spatial, GearScape, GGL

In spanish : SIG, geomática, geoprocesamiento, SQL espacial, GearScape, GGL

I. Introduction

One of the three current main research activities in progress in the European Network of Territorial Intelligence (ENTI) aims to develop the territorial information and spread the methods of territorial observation and spatial analysis. Indeed, as noticed by (Franklin, 1992), at the beginning of the 90s: about eighty percent of all data stored in corporate databases has a spatial component. Moreover, (Clinton, 1994) wrote, in one of its key executive orders: Geographic information is critical to promote economic

development, improve our stewardship of natural resources, and protect the environment. He established also that modern technology now permits improved acquisition, distribution, and utilization of geographic (or geospatial) data and mapping. Lastly, he emphasized the need to avoid wasteful duplication of effort and promote effective and economical management of resources. For all the reasons that will be briefly developed in this paper, we assume that the GearScape framework, as an extensible and re-usable GIS, is an essential component of the Territorial Intelligence. Indeed, this GIS software can be seen as a front-end able to access and address a distributed network of spatial databases, linked by common standards and protocols to ensure compatibility and interoperability of data and services.

II. Motivation

To sum up, the aim is to be able to integrate several geographic datasets from different data providers, and try to produce richer datasets, creating knowledge and raising analytical level. For easiness reason, this should be realized with an uniform framework so as to facilitate multi-disciplinary collaborations. Numerous systems, either open-source either commercial or proprietary, are nowadays available which cover all sectors of geospatial data handling. According to the GIS software typology presented in (Steiniger et al., 2009), one could classified them all into different categories from WebGIS thin client to Spatial DataBase Management System (S-DBMS). In the huge set of existing GIS software solutions, the one we need has to be a: FOSS, portable and cross-platform, standalone, with geo-spatial batch scripting abilities. To rephrase all those conditions, one could say that the solution has to be developed in Java (so as to take benefits from the wide Java Virtual Machine dissemination and its well-known WORA slogan created by Sun Microsystems: "write once, run anywhere"), it must be a desktop GIS and has to provide a spatial SQL with parameterization ability.

To achieve such an objective, the GDMS layer (Bocher et al., 2008 ; Leduc et al., 2009) has been developed. It is both an API and a spatially enhanced SQL syntax, as close as possible to the SQL-92 standard and to the "Simple Features Specification for SQL" (Herring, 2006a; Herring, 2006b) to guarantee a smooth learning curve. Indeed, spatial languages are suitable tools to define, store and share geo-processing… and among all of them, the SQL (Structured Query Language) is probably the most common and the easiest to use. Indeed, the table paradigm - inherent to the SQL language - has been clearly identified as a very useful tool for Rapid Application Development (RAD). In the way from no interoperability to an ideal one, a syntactic level has therefore been reached. With the GearScape project and more precisely with the GearScape Geoprocessing Language (GGL), the GDMS layer has been enriched with parameterization capability. With GearScape and its GGL, expectation is to go one step further towards the semantic interoperability. Indeed, GGL is a geo-processing adapted development tool that lets users without programming skills create, execute and share their own geo-processes. It includes an editor to assist the geo-process authoring tasks, a wizard to execute the created geo-process and a model builder to link geo-processes so as to produce a bigger and composite one.

III. GearScape in a nutshell

GearScape is a Geographic Information System (GIS). It is software dedicated to storage, retrieval, analysis and mapping of geographic data, that is of spatial feature, with associated alphanumeric descriptive attributes and corresponding metadata such as the coordinate reference system. It is a platform that can be used either in interactive mode (as an example, it implements the WIMP[1] paradigm in a classical but also renewed approach) either in batch mode (as an example, its command line interface has been deployed in a grid computing context).

GearScape is a multi-document application[2] based on four major components that are the Geocatalog, the Geocognition, the layer view (called the "TOC") and the map view. The Geocatalog is a shared list of all datasources addressed by the GDMS layer that can be, as an example, dragged and dropped into the TOC or geo-processed through the spatial SQL in the GGL console. A datasource might be either a remote PostgreSQL/PostGIS table, either a local flat file such as a shapefile. The Geocognition component is a sort of project manager. It is the tool you need if you want to: retrieve an already existing geo-process or add a new one, open an already existing map or create a new one… The TOC is a textual representation of the current map view. It is a tree where each node corresponds to a layer name possibly displayed in the active map view.

One can notice also that, as shown in fig. 1, GearScape's user interface provides all the classical views and

[1] In the human computer interaction context, the WIMP acronym stands for Window, Icon, Menu and Pointing device. It corresponds to a style of human interaction using all these elements.
[2] Based on the InfoNode Docking Windows technology.

tools “required” in a desktop GIS and listed in (Steiniger et al., 2009). In the displayed map view, the selected path section in yellow is a component of a geographic layer called “path” (the red shape in the map and the selected entry in the TOC) that is tagged as editable. In this edition mode, a set of “editing tools” is enabled near the classical navigation tools.

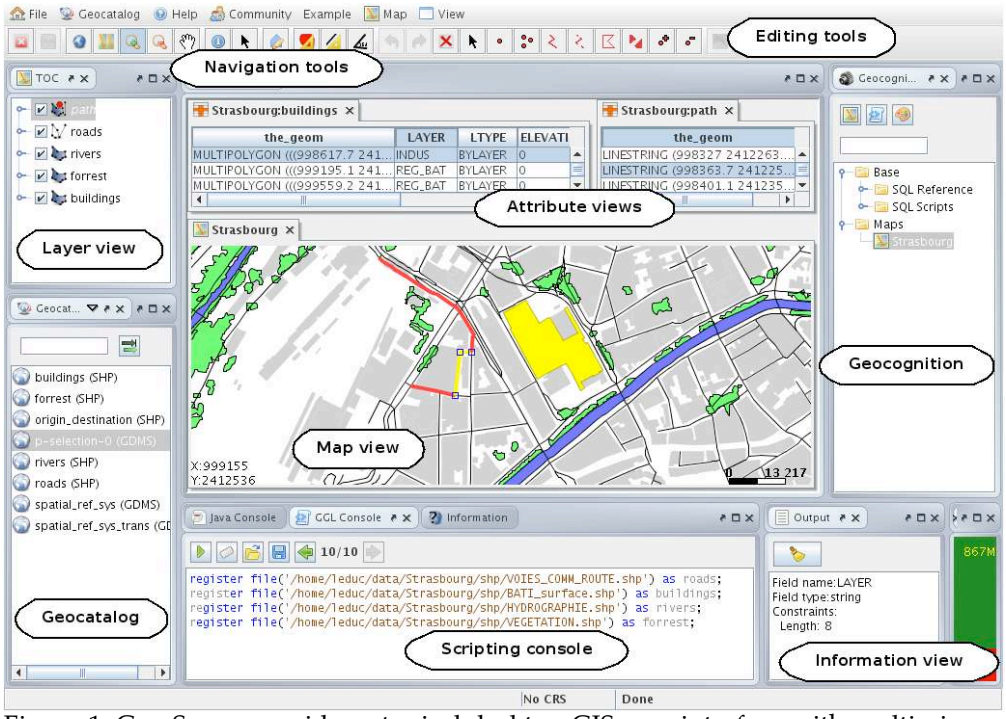

Figure 1: GearScape provides a typical desktop GIS user interface with multi-views such as a map, a layer, an attribute or an information view. It also provides classical tools such as navigation or edition ones.

IV. An extensible geo-processing framework

As it is, GearScape is a quite comprehensive GIS. But, if you need some specific functionality that is not available, it can be extended with your own geo-processing script even if you are an end-user without clear programming skill (because of the easiness of use of the spatial SQL language). However, the analyses defined in spatial SQL are tightly coupled with the data they operate on and therefore it is not possible to apply the same analysis on several data sets without prior modification of the script. To solve this drawback, some extensions to the GearScape SQL implementation have been made that make possible the definition of the structure of the data to be analyzed by a script. Scripts defined this way do not reference concrete data sets but abstract. This abstract input definition can be useful for different tasks. When the script is executed, the system can analyze its abstract input requirements and open a wizard to let the user choose the data that matches the script parameters. Once the wizard is accepted, the script is executed against the data supplied by the user. This way, as no SQL edition is required to execute the script, users without SQL knowledge can benefit from scripts developed by other users.This solution makes possible the execution of a generic geoprocess chain on different data sets, making a generic problem from a concrete one. As a generic problem it may be shared by a greater number of people so the benefits of communication between users rise notably.

V. A simple use case

As a simple use case, it is possible to obtain an indicator of the building density liable to flooding because of an urban river. GearScape embeds, among some others, a geo-processing script called “density” which computes a grid containing the ratio of build areas per cell. Before using such an indicator, it is necessary to identify all the buildings that are near the river. It can be achieved using the spatial SQL join query presented in the GGL console of the fig. 2.

Conclusion

The GearScape framework presented in this paper is one more step towards one of the main ENTI’s objective. As an efficient geo-processing system, it is a useful software tool to develop the territorial information and spread the methods of territorial observation. Indeed, the GGL language embedded in this

platform, as a language that enhance spatial SQL with parameterization, is a convenient and relevant solution to document, share and develop geo-processes in a collaborative way.

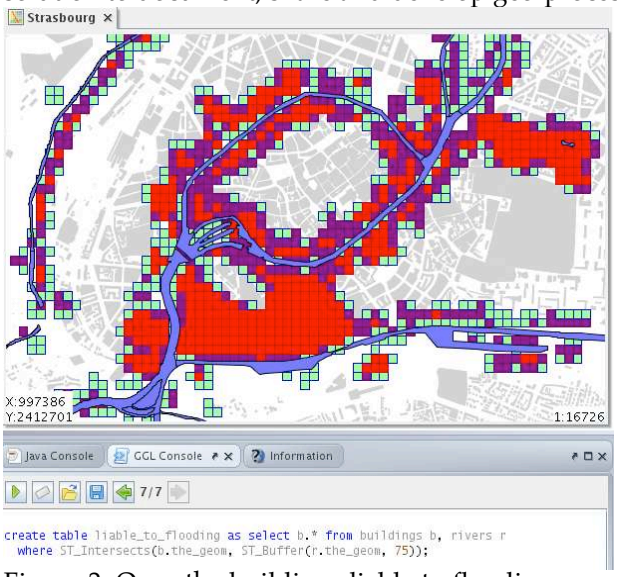

Figure 2: Once the buildings liable to flooding are retrieved, it is possible to use a script shipped with GearScape that produces a grid with density values and apply some cartographic styles to paint in different colors the different densities.

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T. Leduc received his Ph.D. in computer science from Paris VI University, France, in 1999. After a first CNRS Research Engineer position at LSV and LMT – laboratories of ENS de Cachan (France), he get into CERMA laboratory and Institute for Research on Urban Sciences and Techniques - IRSTV (Nantes, France) in 2003. He is one of the 3 original authors of the free and open source geographic information system called OrbisGIS. His current research activities focus on mobility in the urban fabric (acoustic and visual aspects through human being perception filter), motion dynamic mapping, spatial semantic and spatial processing.

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