THE EU PROJECT GIMMI. AN APPLICATION OF AI-BASED TOOLS FOR DATA CONSISTENCY CHECK.

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ABSTRACT
The paper represents the experience done by the LABSITA using a rule based AI tool, namely GClips, for GI optimization in the framework of the EU project GIMMI[1] (Geographic Information and Mathematical Models Inter-operability - http://services.txt.it/gimmi).

KEYWORDS: interoperability, GI, artificial intelligence.

GIMMI AND THE ARTIFICIAL INTELLIGENCE

Today it is very relevant the presence of an inter-operable network of Geographic Information (GI) and GI-based web-services in the environmental domain. GIMMI, a project started in April 2002, aims at bridging the existing communication gap in the Pesticide Impact Assessment domain between Data Providers (soil, meteorology, agronomy, and pesticide experts), Scientists (chemists, geologists, modellers and academic institutions), Service Providers (local and central governments, public administration bodies, private chemical industries manufacturing pesticides) and Final Users (agronomists, consultants and even citizens in the street). GIMMI allows the elaboration of simulation-based vulnerability maps identifying the most critical areas for pesticide environmental impact. This is achieved by allowing the inter-operability via Web of GI physically distributed environmental protection services, managed locally by their own generators, by providing the proper IT structures to represent and manage temporal knowledge inside a GI system, and by integrating the IT infrastructure state-of-the-art legacy systems for document management and report generation.

Moreover, in these last years we have witnessed important developments in GIS user interfaces, where the implementation of meta-languages has eased complex operations that are by now executed with a simple mouse-click. Nevertheless, the same developments have not yet happened in the implementation of shells for intelligent GIS applications able to emulate human reasoning, such as distinguishing different graphic elements on a map. A system able to recognize and discriminate between different graphic elements, and subsequently elaborate the information they represent, can be a valuable tool in several sectors, such as image interpretation (McKeown 1985, Meisels 1988), data congruency check, and cartographic errors management. Solutions to the problem may be different, but the definition of a base of knowledge of graphic "facts" and of a language for user interaction enables to solve single cases in an easy way.

[1] GIMMI IST-2001-34245 receives funding under the EU IST program (FP5). It has been presented for CPA3 V.1.3 Use of Geographic Information.

The paper describes the experience of LABSITA (http://labsita.arc.uniroma1.it) using a rule based AI tool, namely GClips[2], for GI optimization in the framework of the EU project GIMMI. Since the beginning of the project, the GIMMI partners have had the intention to pay a particular attention to relevant GI activities at European level: for this reason the project is being tailored to contribute and support the creation of a vertical Pesticide Leaching SDI at European level (one of the so-called Thematic Components of the INSPIRE initiative).

In order to solve problems related to data congruency and errors, LABSITA has developed two procedures using the external AI tool GClips. GClips is a rule based language that extends Clips (a RBL developed by the NASA) functionalities to handle geographic objects, to analyze vector data, to graphic reasoning on images, to verify integrity constraints, etc; it comes with a powerful set of built-in graphic oriented operators, and, moreover, users can extend its capabilities by implementing low-level functions developed in C. There are several reasons for which it has been decided to use GClips in the project. All data in GIMMI are referred to homogeneous land units called "plots", defined by unique combinations of different thematic layers such as land use, climatic regions, soil class, etc.; incongruence in a plots map, such as the presence of sliver polygons, may lead to low performances of the entire system.

The two procedures developed:

- A procedure based on GClips to support data providers when registering their geo-data to the system; this procedure basically analyses a set of plots for topological consistency: a wizard was developed that guides the user through the entire process. A java applet, based on CommonGIS[3] as GIS engine, enables the user to select the data to analyze and visualize the results for further reasoning.
  It is worth stressing the concept that GClips does not solve problems, but it highlights them; it is then up to the user taking a decision.
- A second procedure that aims at addressing a more important issue, which reflects the wish of the consortium to acknowledge some of the principles of INSPIRE.
  It has been decided to use the principle of INSPIRE "*There should be agreement on the depiction and position of common features along shared borders between Member States…*" in a more general sense stating that there should be an agreement on the depiction and position of common features along shared borders in order to "… *combine seamlessly*…" plots coming from different providers, but at the same time related to different official administrative units.
  The second procedure of GClips aims specifically to check the congruency of a set of plots against some "reference data"; as GIMMI is a European project it has been decided to use the NUTS statistical areas as reference official administrative units, and specifically the third level, at this stage of the project.
  This choice was posed some problems because the NUTS are extremely generalized (1:1.000.000) while the plots are in the range 1:50,000 – 1:250,000. It has been agreed that a set of plots is congruent against a NUTS polygon if the boundary of the set is inside a buffer around the NUTS boundary: the buffer is calculated according to the positional accuracy of the NUTS dataset, and this accuracy has been determined using a well known "rule of thumb" (Longley et al., 2001) stating that the positional accuracy of

[2] GClips is a trademark of studioAlta srl, an Italian IT sme (www.studioalta.it).
[3] EU-funded project CommonGIS (Common Access to Geographically Referenced Data - http://commongis.jrc.it)

features on a map is equal to a line width (0.5 mm) at the scale of the map, that is 500 meters in our case.
This second procedure basically dissolves the set of plot in a single polygon and compares it against a user defined NUTS polygon: the result is a map (to be visualized and analyzed in CommonGIS) showing those segment of the plots boundary that are not inside the NUTS buffer.

Both the first and the second procedure are provided to the GIMMI system as webservices.

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