# Generalized map production: Italian experiences

FIG Working Week 2012

Knowing to manage the territory, protect the environment, evaluate the cultural heritage

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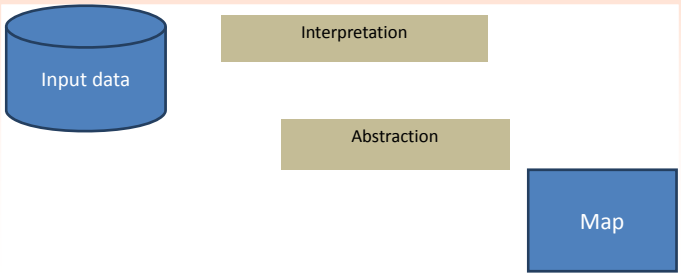
# INTRODUCTION

- Cartographic generalization is the process that allows the creation of maps from an existing ones at larger scale;
- The reuse of existing data for the production of synthetic outputs returns remarkable cost and time benefits;
- The widespread use of digital maps has opened the possibility of automating the process of generalization.

# Cartographic generalization

- The process of cartographic generalization can be identified as a problem of data selection and its abstraction and representation at a generalized scale, → data modelling from the original map into the output map's model;
- Computer related issues → computational complexity or data access and manipulation.
- Dataset partitioning → pre-designed solutions concerning sectors' edges should be developed.




# Automatic generalization

- Creation, with reduced cost and time, updated map products;
- Optimization of data collection at larger scales (Municipality level);
- Growing interest both in Institutional Bodies (end users…) and private companies (producers…).

# Previous experiences

**Piemonte Region**

Maps without information system structure

↓

Development of automated processes for managing the data flow in the generalization process.

# Standardization

- 2004 IntesaGIS documents;
- Gazzetta Ufficiale n°. 48 of February 27, 2012 - S. O. N°. 37;
- DigitPA web site:
  - Adoption of the National Geodetic Reference System;
  - Technical rules for defining the specific content of the Topographical DB;
  - Technical rules for defining the content of the National Directory of spatial data, and the procedure for its setting up and first update.

## Experiment

- Input data is the Topographical DB at 1:1000 and 1:2000 scale of Brescia Municipality
- Goals of the work:
  - Development of a set of utilities, created in ArcGIS/Visual Basic environments aimed to map generalization:
  - Production of a derived map at 1:10000 scale;
  - Production of map features compatible with the representation standards at this scale.

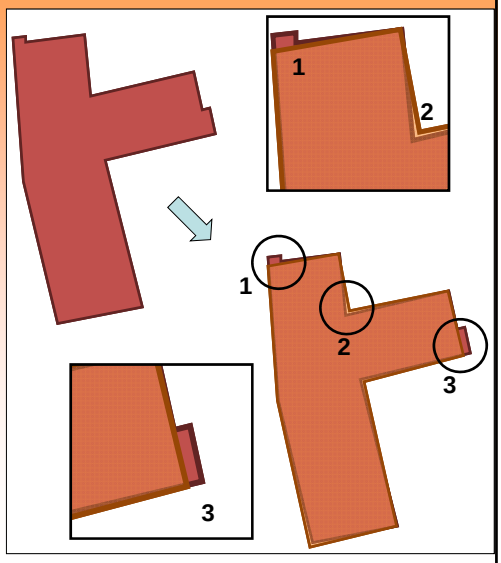
## Issues and Approaches

**Urbanized areas**

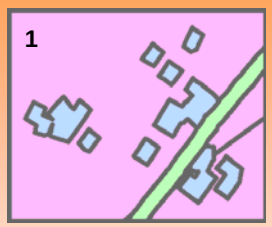
- Generalization of each single building → squaring filter → approximates angles to a right one;
- reduction, in vertices number → “Douglas and Peucker” algorithm;
- removal of shortest sides.

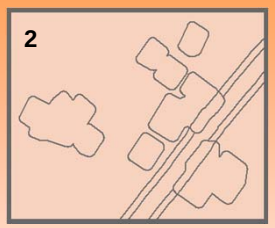
## Urbanized areas

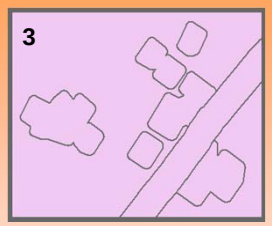
- As in many Italian historical city centers, → building are adjacent to other ones → merging of buildings with neighbouring one within a certain distance.
- The emergence of landlocked polygons is corrected by topological techniques.



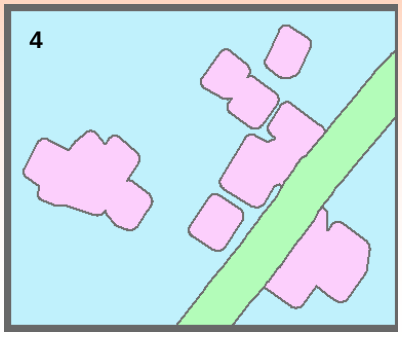

## Urbanized areas




1. Input data;
2. Generalisation;
3. Spatial conflicts resolution;
4. Final result.

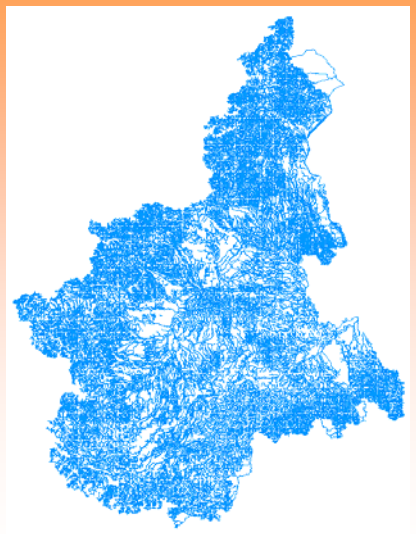


## Linear networks (roads, hydrography…)

- Employment of morphological analysis → extraction of geometric information not explicitly present in the source data model → identification of roadway components, e.g. parking area, junction, ...;
- Graph analysis → enriching the original classification → road network thinning→ eliminate less relevant features;
- River network generalization→ construction of a hierarchical taxonomy → highlighting the less significant watercourses (in terms of scale).

## Hydrography

Strahler's hierarchy

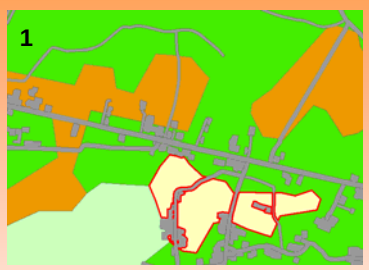


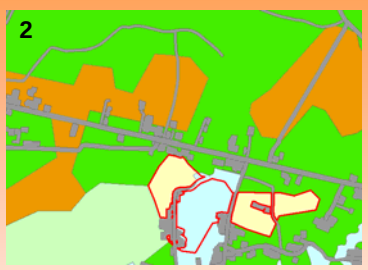
Regione Piemonte Graph according to IntesaGIS regulations

## Fields/vegetated areas

- Application of sequential algorithms → merging of areas with similar neighbouring ones
- Clearings generated inside the new polygons are deleted smaller according to a threshold
- Edges of the new limit are smoothed by a smoothing operator.

## Fields/vegetated areas




1. Input data;
2. Polygon merging according to thematical content;
3. Final result.

## CARTOGRAPHICAL REPRESENTATION

- Derivation of map representation from Topographical DB contents;
- Adopting a symbols legend and a representation similar to the traditional medium-scale mapping of Regional Technical Map (CTR);
- Compatibility with Open Geospatial Consortium (Styled Layer Descriptor specifications - OGC SLD, 2007 and Symbology Enconding - OGC SE, 2006) and IntesaGis regulations;

## CONCLUSIONS 1/2

- The automatic cartographic generalization is a very complex subject;
- Information needed to perform a reliable generalization is contained implicitly in the geometric data to be generalized.
- Algorithms that can extract this implicit information and interpret it in a similar way to an human operator represents the biggest challenge of the automatic generalization.

# CONCLUSIONS 2/2

- The potential impact of automatic cartographic generalization offers clear advantages, both in production and maintenance of map products, to encourage continued research in the field;
- The automatic cartographic generalization, is a very important opportunity to streamline and modernize the national cartography system.

# Thank for your attention!

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