

USING EXPERT METHOD IN ORDER TO MAP GENERALIZATION

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Abstract

As we know it today Generalization is simplification of map information, so that information remains clear and uncluttered when map scale is reduced. Therefore generalization involves a reduction in detail, a resampling to larger spacing, or a reduction in the number of points in a line. Traditionally this has been done manually by a cartographer, but with the advent of semi-automated and also automated methods of generalization in GIS systems, this work is being done less manually. Nowadays many researchers are working on automated generalization methods but they cannot access to satisfactory results. By using of expert methods in GIS we can improve generalization skills. This article specially focuses on planning multi scale SDI that can produce and present different map scale automatically. On the other hand we plan to generalize different scale maps in the SDI by real time processing. In order to access this aim, we should change the defined conceptual model in order to use expert system in map generalization. If we define logical relationship between different objects in one layer then we will have complex generalization analysis in the current database to produce real time multi scale maps in SDI.

1- introduction

As stated earlier Generalization is defined as simplification of map information, so that information remains clear and uncluttered when map scale is reduced. On smaller scale maps there is simply not enough room to show all the available details, so features such as streams and roads often have to be represented as single lines, and polygon features like cities, have to be shown as points. This called generalization. When features are generalized, their level of detail is reduced to avoid cluttering the map, but their overall shape and position is retained. For example, a small scale map of a coastline will not show every cove that you might see on a large scale map and may be omitted features completely. The main opinion of this consideration is using expert system in map generalization and creating multi scale map presentation by the same data layer in real time processing. In the other hand in map generalization process we can use and implement some techniques by real time processing. In this method we should prepare data and use programming language to achieve our aims. The most important step of this method is ranking every feature in the data preparing steps. Then we could write some programs in order to use expert methods. In order to plan and using expert system three deferent models which are known as conceptual, logical and physical models should be implemented. Recently new development in object oriented systems leads to some progress in Generalization but it's not sufficient. In expert systems, we can define several rules to change map objects based on manual experience in manual map generalization. With increasing number of generalization rules, our system is converted to intelligent system and can perform advanced generalization analysis. In this research we show that whit 20% increase in map generating cost, we can be able to produced real multi

scale map layer for most of SDI information. This export system is able to produce and show every map scale real timely. This method is based on simple planning and programming.

2- Fundamental and basics

Generalization process is very essential and several conditions that are very costly and time consuming should be considered. Commonly generalization is implemented in five steps below:

- choosing a categorization system appropriate for the representation of objects and classifying them;
- selecting the objects to be represented within each category;
- generalizing or eliminating quantitative attributes;
- replacing of area symbols with point or line symbols;
- Simplifying the outlines of objects.

Here we used the mentioned procedures but we implemented new methods that are similar to DLG-tree models. This method emphasizes on two subjects:

- Data preparation and ranking before using in SDI
- Creating some programs in order to select and show data layer based on representation scales

In data generation and preparation we have to create information based on GIS standards. Data preparation based on GIS standards is very expensive and some of users just create topological data without paying attention to GIS standards. Although it is very simple but creating GIS ready information are very time consuming. In these methods we should extract all data layers, sort them and define relations between all of them. For example in case of liner features such as roads at first we have to rank all the roads based on the land use application and roads conditions. Then we should determine relationship between Roads vertices and segments. In this example the first step, ranking all the roads based on the land use application, is known as GIS ready standards that differs related to the data layer types.

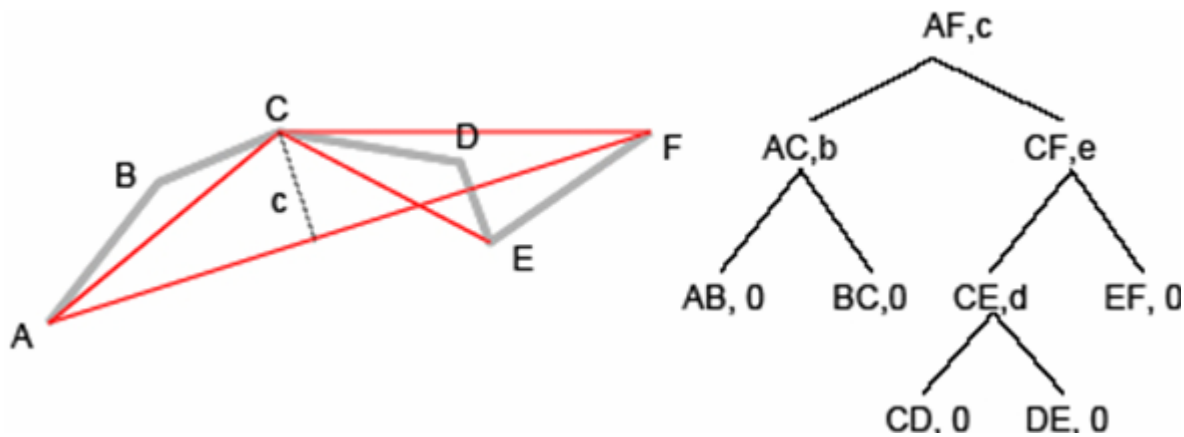


Figure 1: DLG- tree algorithm

The final step of this method is writing some programs in order to implement map generalization. The system with such specifications is called expert system. Characteristics of such a system are as follows:

- Thinking like human mind
- No need to programming
- Having the capability of connection to other systems
- No need to training because of simplicity of working with this system
- It can be learning from environment
- It is an interactive system
- It can predicate the future

With respect to expert system specifications that were defined, we have not expert system in GIS but we can train our system by some methods such as knowledge base models. Knowledge base models can be created by several methods such as programming. To access this aim we should follow three deferent models that are known as conceptual model, logical model and physical model which are explained in the following.

2- Methodology

For creating multi scale SDI we should implement three different models. In the first model, conceptual model, we should determine different feature classes and consider influence or important of different map scale. Basically at this step we should divide and classify features to their particle and determine their rank and value in the map. We should create several numerical fields in data base. In the planning process we define rank ID, class ID, super class and important percents. These IDs show object values in all map scale and are determined based on importance of objects in the maps. For example we can write number 1 for village, number2 for center of some village, number 3 for small city, number 4 for center of some city and number 5 for province center. In the visualization step we can generalize map layer using these IDs. This process is implemented based on several conditions such as graphical constrains. In the Second model, logical model, every map scale detail and constrain should be determined. Level of details on a map is directly related to the map scale and map aims. Also it shows the quantity of geographic information. Large scale maps typically show more detail than small scale maps, nevertheless there is no standard rules for determining how many features should be shown on a map. However, this is a cartographic decision depending on the purpose of the map and the number of symbols which should be drawn on the map without visual clutter. The main procedures of making conceptual model are as follows:

- Extraction of data layers for each scale
- Classifying data layers (points, lines and polygons).
- Ranking every layer based on spatial values or importance in deferent scales.
- Determining shape, color, orientation, and size.
- Determining aims and map kinds.
- Determining map details in every scale
- Determining spatial parameters
- Determining non spatial parameters
- Determining spatial and non spatial sources (when is needed)

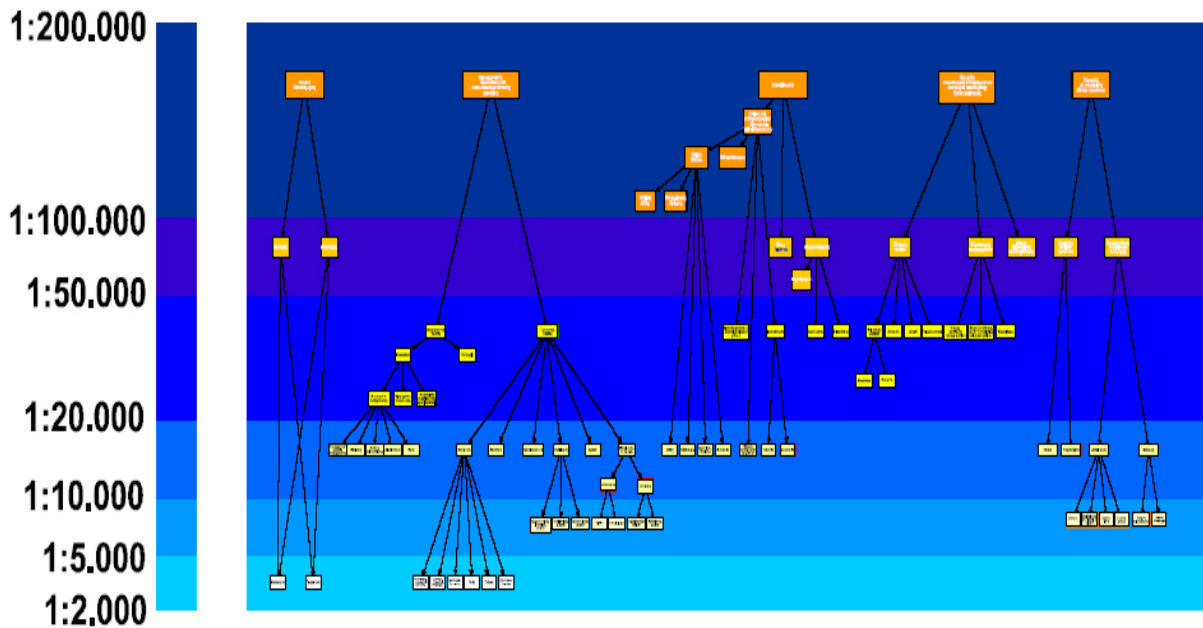


Figure 2: map data layer based on scale

In this article we consider 1/2000 scale data layers and we have data layers such as residential area, police station, military area, training area, clinic, hospital, university, park, jangle, orchard, truism, musing, storage, social service and so on as depicted in the table 1:

Table 1: polygon data layer in 1:2000 scales

Layer Name	Unique Code	Rank	Attribute	Land use	attribute
polygon Feature		1		Residential	Residential
		3		Police station	Police station
		3		Military area	Military area
		2		Training Area	Training Area
		3		Help center	Help center
		3		Clinic	Clinic
		3		Hospital	Hospital
		2		University area	University area
		2		Orchard	Orchard
		2		Green Area	Green Area
		2		commercial	commercial
		2		School	School
		2		Service	Service
		3		Tourism	Tourism
		2		Transportation	Transportation

	3		Storage	Storage
	2		Social Service	Social Service
	2		Sport	Sport
	2		entertainment	entertainment
	3		Park	Park
	2		pool	pool
	2		Lake	Lake
	3		Other	Other

Table 2: Linear data layer in 1:2000 scales

Layer Name	Unique Code	Land use	Attribute	Rank
Line Feature		Routs		
		Hydrology Network		
		Electricity Network		
		Oil Pipe		
		Contour Line		
		Gas pipe		
		Water pipe		
		Telephone Line		
		Sewer Pipe		

Table 3: Point data layer in 1:2000 scales

Layer Name	Unique ID	Rank	Land use	Attribute
Point feature		1	Tower	
		1	Sewer well	
		1	Well water	
		1	Water entrance	
		1	Telephone monitor	
		1	Electricity tower	
		2	Fire tap	
		1	Grand control Pointe	
		1	Height control pointes	
		1	Lights	
		1	Phone	

	1	Tree	
	1	Water	

Each of above data layer should be located in the separated file and has related data for implementing SDI. We can define various ranking in the same data layer. For example in order to ranking building in the constructed feature layers we have to define several ranking for the same feature based on its area, performance, value and so on. Consequently we might have over 100 data layers in topographic maps that have to create and prepare based on conceptual model design.

After defining the conceptual model, the next step is definition of logical model. In this step we should plan for showing map details. The most crucial process in this step is definition several map scales based on Rank ID. By using these scales we can define some constrains in order to view major objects at different scales. For example in order to show major cities we can use rank number 4 but we should define a distance constrain. For example if distance between two cities is less than x , then select and show one of them which have more population. Definition of weed distance and fuzzy tolerance are performed in logical model. The main propose of logical model is matching conceptual model with current software capability.

The main parts of logical model are known as:

- Software Consideration
- Hardware consideration
- Data consideration
- Cost consideration
- Time consideration
- Technical consideration
- Accuracy consideration
- Algorithm or Conditional consideration

In order to implement above considerations in this paper, we have to extract relations between data layers and map scales. Then we should evaluated software capability and programming that are needed for generalization. These programs apply logical conditions on the presented layers.

Last step in automatic generalization is designation of physical model. In this step we should perform prior design on the current system. Using programming is an essential component of this step to handle map generalization process. For creation of maps in different scales automatically, one should define different rules by programming. Some of them generalize map objects and the other are used to select visual elements. These programs are consisting of some codes that run constrains on the shown map. This constrains divided to seven different sections that are as follows:

- Structural constrains
- Thematic constrains
- Geometric constrains
- Conceptual constrains
- Topological constrains

- Graphical constrains
- Relational constrains

Each of these constrains is divided again to several parts. Using expert system, we can define most of the above mentioned constrains but not all of them. In visualization process, based on map scale and layer importance, some features such as point features are just selected to present on the screen. For example in hydrologic network we should determine rank number for every part of network. In multi scale SDI we can show hydrologic network based on rank number. Some feature, such as roads in the network, should be simplified based on roads shape and importance. Using road class and rank number we can show generalized maps on the screen. Some features, such as similar land use and land cover (park, Forest Park, different agriculture), should be merged together and create an overall class feature. We can dissolve polygon features base on class number or overall class number. In some cases such as contour generalization we should define structural constrains based on other layer. These processes are so complicated and need more time processing and advanced programming. In this paper we are consider map generalization process using object oriented ability to define logical rules for creation of multi scale SDI by real time processing. Programming for map generalization could be varying from simple programming to very difficult and complex one. If complex algorithms such as graphical constrain are used, then generalization process could be time consuming. These processes should be performed separately and their results are imported into SDI to represent a valuable multi scale map presentation. Most of these algorithms are embedded in nowadays soft wares. In Figures 2 and 3 simple presentations of a residential region witch are implemented based on ranking constrains by a very simple programming are shown.

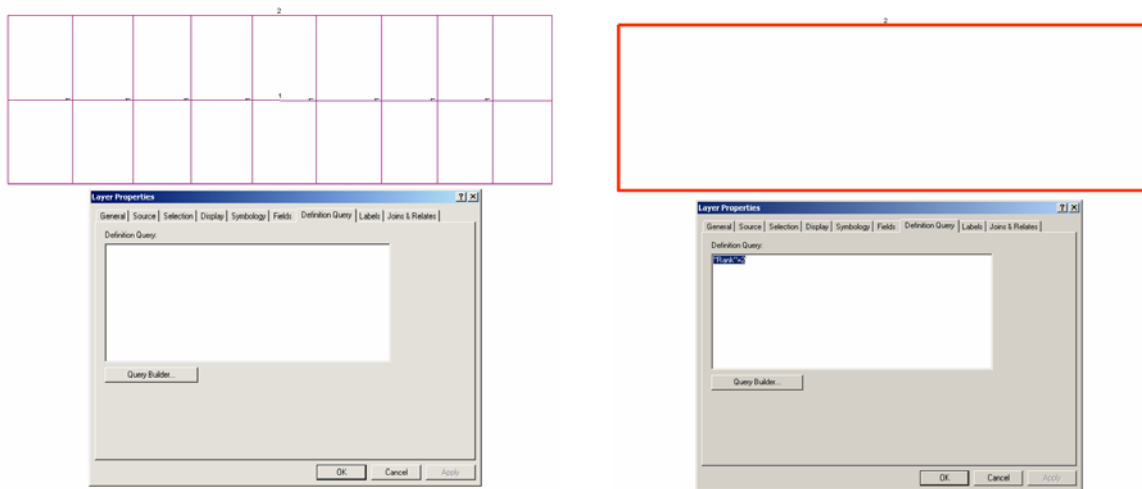


Figure 3: Generalized map detail based on ranking methods

Some algorithms which are needed in real time generalization are divided into 4 categories:

- Presentation algorithm that is executed based on ranking feature
- Graphical algorithm which determines minimum distances between deferent features
- algorithms which define geometrical and topological criteria by real time processing
- Algorithms which export the current map by post processing to avoid from real time processing in map presentation.

The first group algorithms are act based on DLG-tree algorithm but classification and ranking are implemented on data preparing process. The second group algorithms are based on presentation which usually is implemented by graphical interface and sometimes should be done by programming. We can see it in raster presentation. These algorithms need powerful CPU and also enough time for real time process. The third algorithm is used to implement geometrical and topological criteria and is implemented by Graph theory. These algorithms are very complex and in this project we prefer to implement them by preprocessing. The fourth group algorithms face to export data processing. In some condition in order to attain suitable exported results from current SDI we should use of them.

4- Conclusion

The above discussions are about generating NSDI using real time processing and to reach this aim we should perform two main processing. At first we have to prepare and generate data based on GIS standards. Also we should add some field such as ranking to every data layers. Then we should use some programming language in order to map presentation. The main step in these processes is planning and designing in map design steps. To achieve this aim we have to pass three deferent models. The main opinion of this paper is ranking all features in data production process and using simple programs to presented maps in deferent scales. Using these methods on some data layers such as hydrological networks and especially in complex region such as residential area is successful. In this consideration are estimated that with 20 percent increase in map production process and simples queries and programming as expert system, could be created multi scale map presentations in NSDI.

5- References

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