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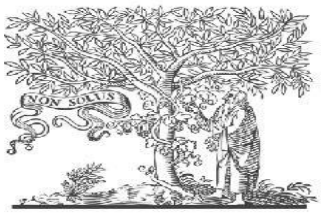

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Definition and general fetures of overlay functions

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Abstract: Overlay is the combined processing of overlaying two or more source layers of the same geographic area, resulting in a derived layer with new geographic data as a topological segments combination of the original geographic data. Overlay is a powerful tool for analyzing many dissimilar and heterogeneous features.

Keywords: Overlay, overlay processing, overlay operations, raster models, logic algebra

Introduction

Overlay is a collaborative overlay processing of two or more initial layers of one geographic area, as a result of which a derived layer is created with new geographic data as a topological segments combination of the original geographic data. Overlay is a powerful device analysis of the set dissimilar and polytypic spatial objects.

There are two main ways to perform overlay operations – on vector models and on raster models of geographic objects. Geographic information systems provide the ability to use a combined path as well. The method choice depends, first of all, on the analysis objectives, on what data already exists, on the required analysis accuracy, operations complexity. Overlay operations may lead to different results. Each overlay analysis way has its own specifics.

In system, based on vector models, topological overlay operations are more complex than in the system, based on raster models. Since spatial data is stored as points, lines and/or polygons, they require relatively complex geometric operations, to display the polygons intersection and create new nodes and arcs with combined attribute values.

Elements of overlay operations are the input layer, overlay layer, output layer (Fig. 1). Spatial objects overlay of input layers allows you to divide them into topological segments and combine new objects from these segments depending on the analysis purpose.

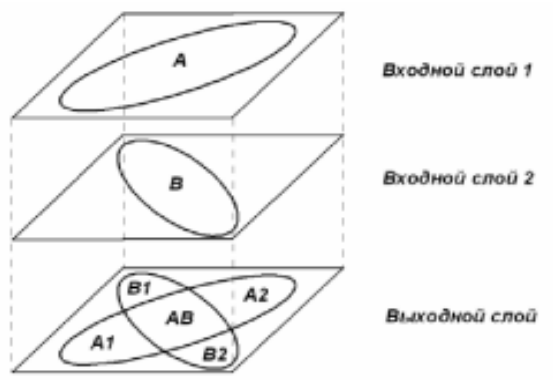

Fig. 1. Topological overlay of vector layers

New polygons are created at the polygons intersection in the input and overlay layers. To overlay a line feature on a polygon feature splits it into two new polygon features. New objects are stored in the output layer; the input layer does not change. Spatial objects attributes in the overlay layer assigned to the appropriate new spatial objects along with the input layer features attributes.

In many cases requires more than two vector data layers manipulation to achieve the analysis goal. Operations are performed in a stepwise manner: two input layers are processed to form a derived layer; this intermediate layer is then processed with a third layer, to form the next intermediate layer, and so on until you reach the desired resulting map layer.

In a system based on raster models, topological overlay operations are simpler than in the system, based on vector models. Each cell in a raster layer is associated with one corresponding geographic location. This makes

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it convenient to combine many layers features in one layer. Typically, many values are assigned to each feature, allowing the user to mathematically combine layers and assign new values to each cell in the output layer.

Logic algebra is used to implement topological mapping in GIS.

In logic algebras, truth values of statements are usually denoted by the numbers 1 (true) and 0 (false). Each logical operation corresponds to a function that takes values 1, 0. Such functions are called logic algebras or Boolean functions.

To determine whether a particular state is true or false, spatial analysis uses the logical operators of Boolean algebra, which are denoted by AND, OR, NOT (NOT) in text format, and respectively ∩, U, ¬ in character format.

The two input topological overlay layers can be thought as two datasets - dataset A and dataset B. The following basic logical operations are defined for them:

• logical operation conjunction A ∩ B – defines two datasets intersection, identifying those entities that belong to both set A and B (true A and B).

• logical operation disjunction A U B – defines two datasets union, identifying those entities that belong to either set A or B (true A or B);

• boolean negation A ¬ B – defines the difference between two data sets, identifying those objects that belong to A, but not B (truly not B).

These relationships can be visualized using Venn diagrams (Fig.2).

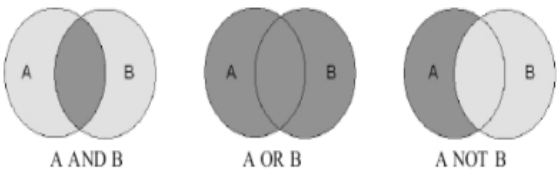

Fig. 2. Venn diagrams

Using basic logical operations, you can describe complex logical functions.

Boolean algebra is used in computing or modeling new objects in topological overlay processing for systems based on vector and raster models. These operations can be applied to all data types - boolean, relative, interval, ordinal, or nominal.

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