Placement spatial data in spatial data infrastructure using semantic analysis

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Abstract[1]

The article describes application of if-then rules for semantic analysis of spatial data for placement spatial data in spatial data infrastructure.

1. Introduction

At creation of a spatial data infrastructure (SDI) any level: federal, territorial, municipal, it is necessary to allocate the general for several sources the information [1, 3] and to transfer it to a spatial objects database (BSD DB). Besides, according to the structure offered in [2], by one of basic elements, necessary for creation SDI the metadata base (MB), containing the information on the spatial data (SD) is: a storage place, creation date, the owner and so forth.

Allocation of the general information and its transferring to BSD DB placed in the organisation responsible for storage, actualisation and granting SD – SDI centre, the manager operates, and considering the considerable volumes SD which has been saved up in the course of their long-term creation and use by the various organisations, a stage of formation of BSD DB and MB it is represented rather labour-consuming, and requires automation of the given reason choice of the information. Knowledge of SD semantics, taken out in a separate category and placed in the knowledge base (KB) can be with that end in view used.

2. SDI structure

Starting with this reason, SDI structure shown on fig. 1, different presence KB with if-then rules chosen owing to simplicity of representation of knowledge [4] which allows the administrator to carry out the information analysis about SD the concrete organisation stored in MB_i, and BSD DB, stored MB is offered. As a result of the metadata analysis the decision on carrying over of those or others SD from corresponding SSD DB_i, for formation of uniform BSD DB is made, and the made changes are displayed in MB (fig. 2).

Let's consider the most important if-then rules containing in KB, display knowledge of semantic features SD which can be checked up in the course of the information analysis from MB.

1. Spatial borders of a layer. The given feature can be used for the analysis of the metadata:

- whereas BSD DB is formed for territory of certain level (the subject of the Russian Federation, a city), and the information which is stored in DB_i, can describe the objects which are falling outside the limits given territory (for example if it is created SDI level of the subject of the Russian Federation for Republic Bashkortostan territory, and in DBi is stored information on the objects leaving for given territory, such SD cannot be transferred to BSD DB);

- whereas SD can describe the same type of objects in different areas of territory of certain level SDI, but thus under the layer name, quantity of objects and the attributive information they are identical and can be accepted as duplicated.

Fig. 1. SDI structure

Diagram labels (Fig. 1): SDI CENTRE; KB; ADMINISTRATOR; BSD DB; MD; BSD; metadata; INTERFACE; – Search of SD; – Viewing of SD; – Acquisition of SD; Enterprise 1; Enterprise 2; Enterprise i; MD_1; $SSD\ DB_1$; $User_1^1 \ldots User_1^j$; MD_2; $SSD\ DB_2$; $User_2^1 \ldots User_2^j$; MD_i; $SSD\ DB_i$; $User_i^1 \ldots User_i^j$; SSD; Enterprises; SDI; User 1; User 2; .... ; User N.
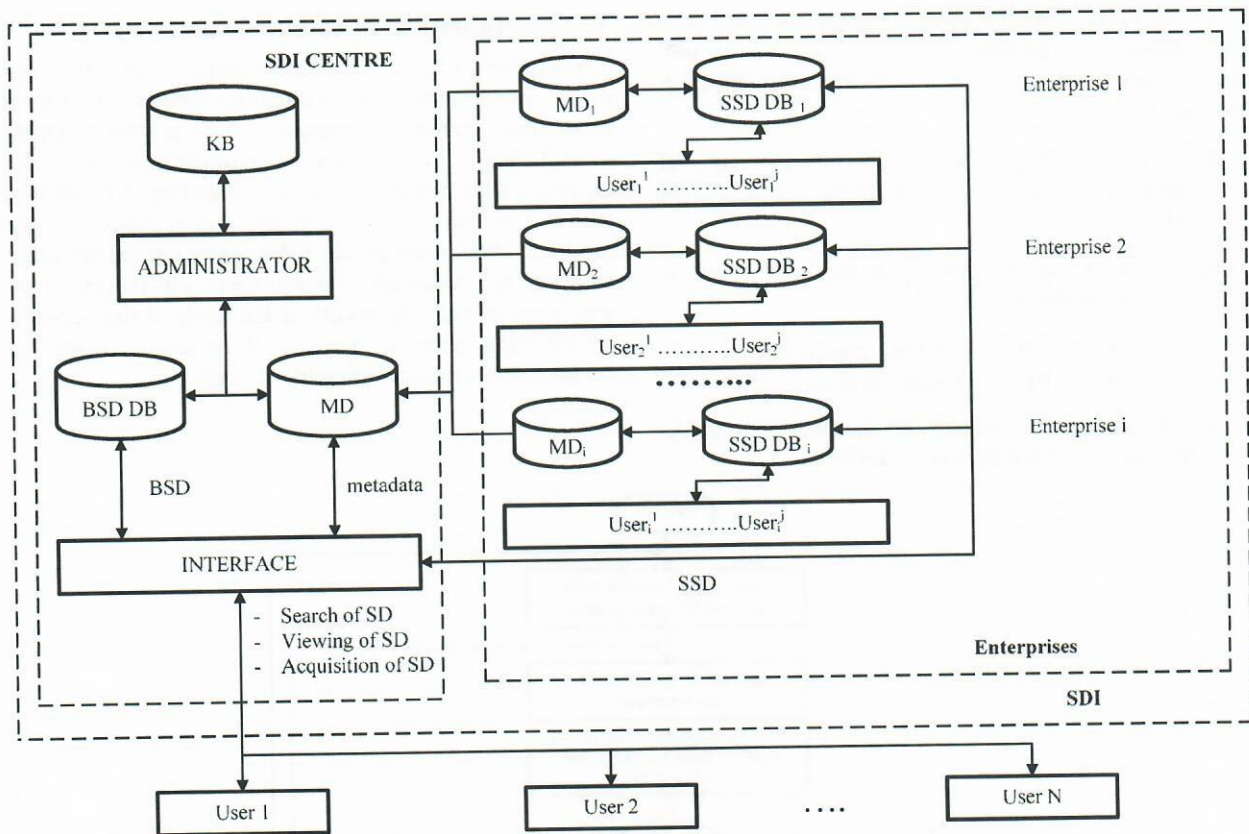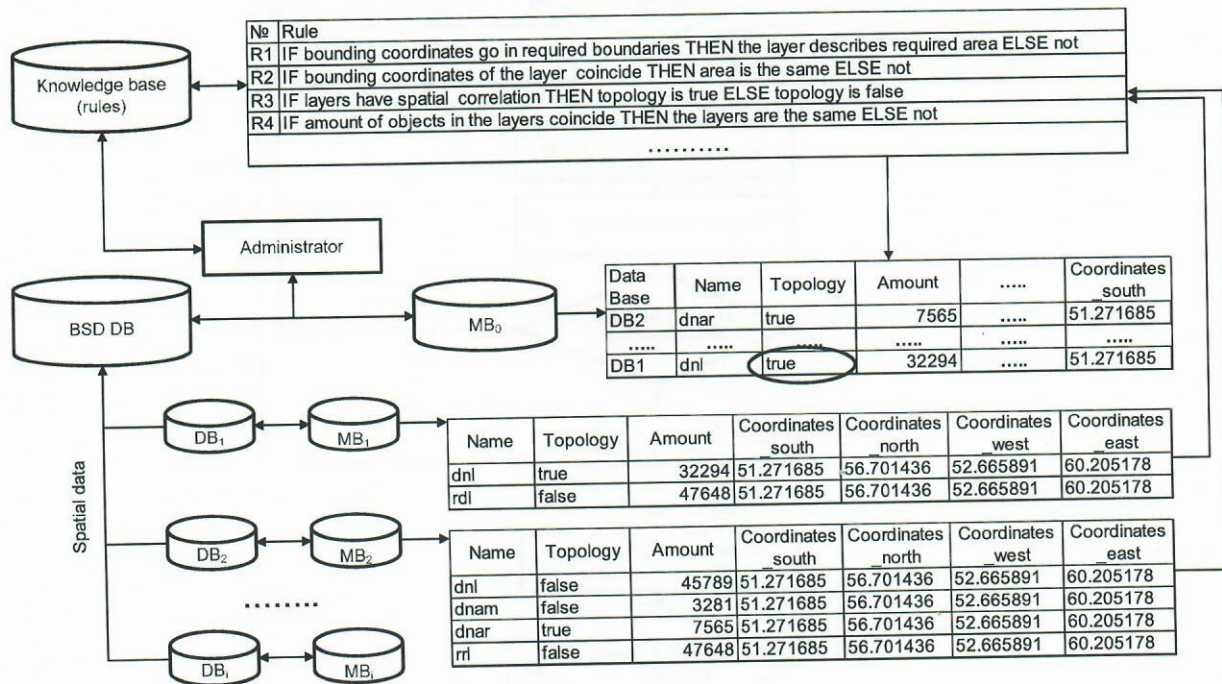
Fig. 2. Application diagram of the if-then rules in the course of SD semantic analysis

Knowledge base (rules):

№	Rule
R1	IF bounding coordinates go in required boundaries THEN the layer describes required area ELSE not
R2	IF bounding coordinates of the layer coincide THEN area is the same ELSE not
R3	IF layers have spatial correlation THEN topology is true ELSE topology is false
R4	IF amount of objects in the layers coincide THEN the layers are the same ELSE not
	....

Diagram labels (Fig. 2): Administrator; BSD DB; MB_0; Spatial data; DB_1; MB_1; DB_2; MB_2; .... ; DB_i; MB_i.

Table near MB_0:

Data Base	Name	Topology	Amount	.....	Coordinates south
DB2	dnar	true	7565	.....	51.271685
.....	.....	.....	.....	.....	.....
DB1	dnl	true	32294	.....	51.271685

Table near DB_1 / MB_1:

Name	Topology	Amount	Coordinates south	Coordinates north	Coordinates west	Coordinates east
dnl	true	32294	51.271685	56.701436	52.665891	60.205178
rdl	false	47648	51.271685	56.701436	52.665891	60.205178

Table near DB_2 / MB_2:

Name	Topology	Amount	Coordinates south	Coordinates north	Coordinates west	Coordinates east
dnl	false	45789	51.271685	56.701436	52.665891	60.205178
dnam	false	3281	51.271685	56.701436	52.665891	60.205178
dnar	true	7565	51.271685	56.701436	52.665891	60.205178
rrl	false	47648	51.271685	56.701436	52.665891	60.205178

2. Number of objects. If in different sources of the information are stored SD with the conterminous spatial borders, describing the same type of objects it is necessary to choose a layer describing the greatest number of objects.

3. Topological relations. Presence or absence given is necessary for considering feature at comparison of quantity of the objects stored in layers as presence of topological relations can reduce quantity of objects in a layer, but thus the quantity of described spatial objects can be same or even big.

In the artificial intellect theory if-then rules can be written down in a kind antecedent → consequent, we will present knowledge of SD semantic features set forth above as follows:

- R1; IF bounding coordinates go in required boundaries THEN the layer describes required area ELSE not;

- R2; IF bounding coordinates of the layer coincide THEN area is the same ELSE not;

- R3; IF layers have spatial correlation THEN topology is true ELSE topology is false;

- R4; IF amount of objects in the layers coincide THEN the layers are the same ELSE not.

3. The algorithm of semantic analysis

The number of SD sources can be big enough and in due course can change, and information volume in each of them considerable, for formation and periodic updating of BSD DB it is necessary to automate process of the analysis of the metadata. The algorithm (fig. 3.) with that end in view is offered, allowing after reception of the metadata about sources and SD to carry out the semantic analysis by consecutive application set if-then rules which are in KB. By results of the analysis the decision on carrying over or copying if structure change is inadmissible, corresponding SD is made.
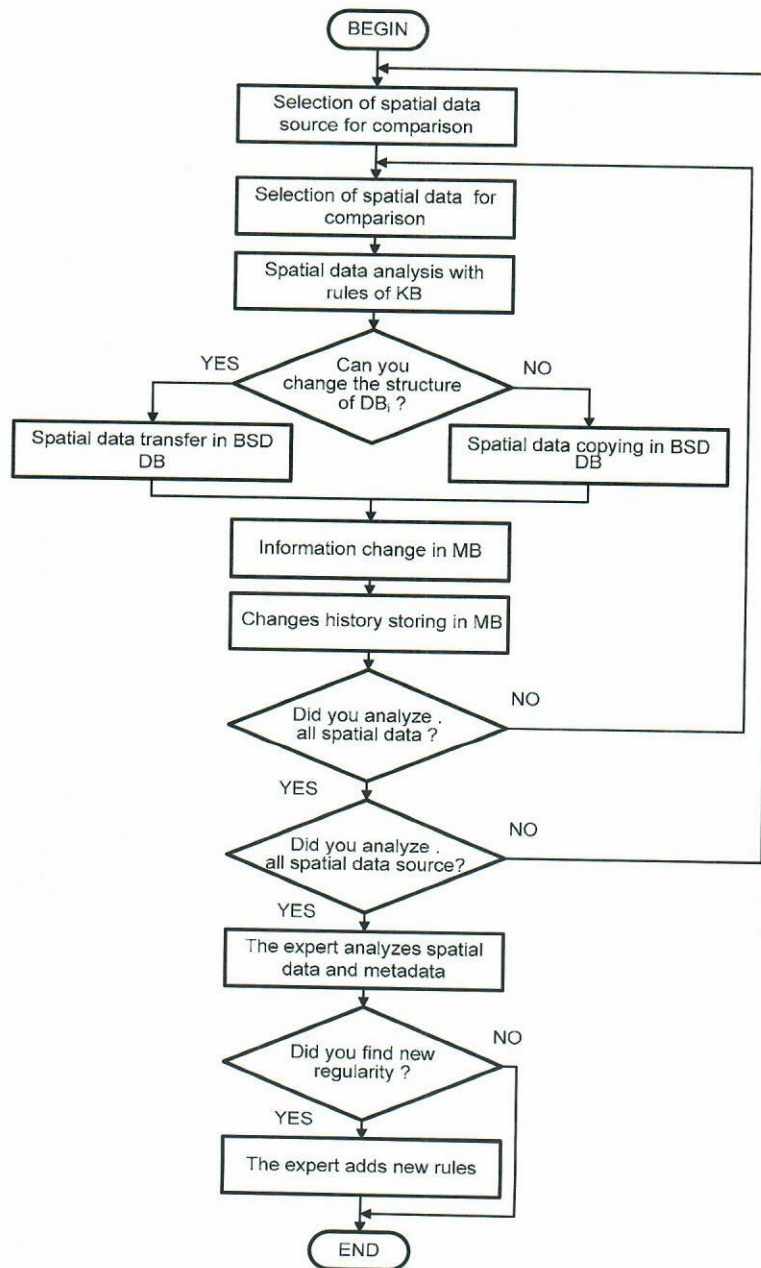

Fig. 3. The Block diagram of semantic analysis algorithm of spatial data

Then the information about SD is updated, and the history of all executed changes is brought in the general MB, for possibility of subsequent use of the received knowledge at addition of a new source of the information in SDI (for example, presence of precisely same errors in SD again added source). After end of the semantic analysis of all necessary SD, stored in the chosen sources the expert of SDI centre reveals new laws on which basis are formed new if-then rules in KB.

4. Conclusion

The offered method of semantic analysis SD based on formalized knowledge, saved up by the expert, in a kind of if-then rules, allows to change operatively structure and maintenance SDI at change of quantity and-or structure of sources of the information and by that to provide users with the actual spatial information on corresponding territory.

References

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