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Volume II: Applications

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Generalized net model of an object type data bases with intuitionistic fuzzy estimations

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Abstract

The present GN-model represents functioning and the results of the work of an Object Data Base with evaluations of the objects. The estimation reflects the degree of the effectiveness and the non-effectiveness of the Object Data Base.

Keywords: object database, generalized net, modelling, intuitionistic fuzzy sets, evaluation.

1 Introduction

The goal with object data bases is to preserve the direct correspondence between the objects, as seen in reality, and their database representation. The user works with the separate objects by easily identifying them. Hence, the following definition of the object data base system can be perceived: The user works with the separate objects by easily identifying them. Hence, the following definition of the object data base system can be perceived:

Object database system = Database management system + Object-oriented system

The main characteristic of every DB is the data model. Informally, data object model is a model based on the fundamental concepts from the object-oriented programming languages. Object base is considered a set of sustainable objects, shared among multiple users, whose behaviour, status and relations are

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described by an object data model. Respectively, an object data management system is a collection of programs that allow the definition and processing of an object database. These definitions are rather general and exhibit the lack of such an uniform object-oriented data model as the relational model. Every object database system interprets its basic functionalities in its own way. This leads to the plethora of different definitions of an object DB. In the object DB, two types of complex objects exist: structured and unstructured.

In current paper we construct Generalized Net (GN, see [3, 4]) model of the Object-Type Data Base (ODB). Tenth GN models were described in a series of papers, collected in book [7]. These GN-models describe the way of functioning and the results of the work of different types of Expert Systems (ESs, see, e.g., [1, 6, 11, 12]). Some types of these ESs are introduced for a first type as possible extensions of the ESs, which extensions can be described by the GNs and which can obtain real applications. The first four from the nine GN-models describe ordinary ESs; the fifth and seventh - ESs with priorities of their Database (DB) facts and Knowledge Base (KB) rules, so, the separate facts and/or rules can be changed at the time of the ES functioning. Sixth GN-model describes an ES containing not only facts, but also metafacts, that can be represented by rules, but in the present form they are more useful and more quickly applicable. Eighth GN-model represents Intuitionistic Fuzzy ES (IFES see [2]; for the intuitionistic fuzziness see [8]). On its base the Ninth GN-model is constructed so that it represents functioning of an ES working with temporal facts and answering to the temporal questions [5]. The tenth GN-model (see [9]) represents extension to the later ES. In [10] is described GN-model of ESs with Frame-Type Data Bases.

2 A GN-model

The present GN-model is shown on Fig. 1.

Let Δ be the Object-Type Data Base. Each object is an ordered tuple:

$$C = (i, c, V),$$

where:

- i – the identifier of the object;
- c – constructor;
- V – value of the object.

For clarity the places are marked by tree different symbols: a, b and c such that:

- α-tokens ($\alpha_1, \alpha_2, \ldots$) together with its descendants of all generations obtained after splitting will go to the a-places;
- β-tokens (β_1, $\beta_2, \ldots$) will go on b-places;
- α_0-token that permanently stays in place a_0 with initial characteristic

$$x_0^{\alpha_0} = \text{“}\Delta\text{”},$$

i.e., $x_0^{\alpha_0}$ is a set of objects;

- γ-token will go on *c*-places.

Let current α-token (α_p) enters place a_1 of the GN with an initial characteristic

$$x_1^{\alpha_p} = \text{“Query for the ODB”},$$

where p is the current number of the α-token which enters place a_1. Let $x_{cu}^{\alpha_i}$ denotes the current characteristic of the α_i-token.

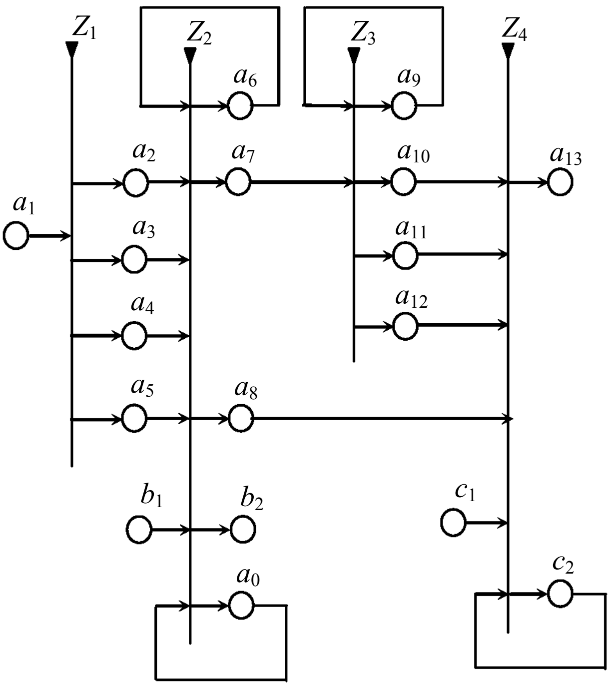

Figure 1: GN-model of the queries processing in the ODB
with evaluations for ODB' effectiveness

The transitions of the GN are the following (see Fig. 1).

$$Z_1 = \langle \{a_1\}, \{a_2, a_3, a_4, a_5\}, r_1, \wedge((a_1))\rangle,$$

where

$$r_1 = \begin{array}{c|cccc} & a_2 & a_3 & a_4 & a_5 \\ \hline a_1 & w_{a_1,a_2} & w_{a_1,a_3} & w_{a_1,a_4} & w_{a_1,a_5} \end{array}$$

and

w_{a_1,a_2} = "There is a *Select query*",

w_{a_1,a_3} = "There is a *Delete query*",

w_{a_1,a_4} = "There is an *Insert query*",

w_{a_1,a_5} = "There is a *Modify query*".

The α-tokens can that enter places a_2, a_3, a_4 and a_5 obtain the characteristic respectively:

"*Select query*" in place a_2,
"*Delete query*" in place a_3,
"*Insert query*" in place a_4,
"*Modify query*" in place a_5.

From place b_1 enter β-tokens with characteristic

$$x_1^{\beta_j} = \text{"conditions of integrity of the data".}$$

The β-tokens that enter from place b_1 merge with α_0-token in place a_0 so they enter in ODB.

$$Z_2 = \langle \{ a_0, a_2, a_3, a_4, a_5, a_6, b_1 \}, \{ a_0, a_6, a_7, a_8, b_2\}, r_2, \vee(a_0, a_2, a_3, a_4, a_5, a_6, b_1)\rangle,$$

where

$r_2 =$

	a_0	a_6	a_7	a_8	b_2
a_0	*true*	w_{a_0,a_6}	w_{a_0,a_7}	w_{a_0,a_8}	w_{a_0,b_2}
a_2	*true*	*false*	*false*	*false*	*false*
a_3	*true*	*false*	*false*	*false*	*false*
a_4	*true*	*false*	*false*	*false*	*false*
a_5	*true*	*false*	*false*	*false*	*false*
a_6	*false*	w_{a_6,a_6}	w_{a_6,a_7}	*false*	*false*
b_1	*true*	*false*	*false*	*false*	*false*

and

$w_{a_0,a_6} = w_{a_6,a_6}$ = "There are more than one object that have to be revised and that is not used by the moment for the current token",

$w_{a_0,a_7} = w_{a_6,a_7}$ = "There is an object that have to be revised",

w_{a_0,a_8} = "There is not any object for the request",

w_{a_0,b_2} = "A condition of data integrity is rejected".

The α-tokens can split to two tokens – the same token α and another α-token. The token in place a_7 obtains the characteristic

$$x_1^{\alpha} = \text{"number of the used object, criterion"}$$

and the characteristic

"unfulfilled query",

in place a_8. The other α-token (if such exists) does not obtain any characteristic in place a_6.

When there are α-token in places a_3, a_4, a_5 on the next time-step α_0-token obtains the characteristic

$$x_{cu}^{\alpha_0} = \begin{cases} \left(x_{cu-1}^{\alpha_0} - \left\{\left[x_0^{\alpha_j}\right]\right\}\right) \cup \left\{x_0^{\alpha_j}\right\}, & \text{when the } \beta\text{-token from place } b_1 \text{ or } \alpha\text{-token from place } a_5 \text{ represents a } \textit{Modify query} \text{ and the condition of data integrity are satisfied;} \\ x_{cu-1}^{\beta_0} - x_0^{\beta_j}, & \text{when the } \beta\text{-token from place } b_1 \text{ or } \alpha\text{-token from place } a_3 \text{ represents a } \textit{Delete query} \text{ and the condition of data integrity are satisfied;} \\ x_{cu-1}^{\beta_0} \cup \left\{x_0^{\beta_j}\right\} & \text{when the } \beta\text{-token from place } b_1 \text{ or } \alpha\text{-token from place } a_4 \text{ represents an } \textit{Insert query} \text{ and the condition of data integrity are satisfied;} \end{cases}$$

where $[x_0^{\alpha_j}]$ denotes the object of Δ which has the same object as the object $x_0^{\alpha_j}$ and

$$x_0^{\alpha_j} = \text{"object".}$$

$$Z_3 = \langle \{a_7, a_9\}, \{a_9, a_{10}, a_{11}, a_{12}\}, r_3, \vee(a_7, a_9)\rangle,$$

where

$$r_3 = \begin{array}{c|cccc} & a_9 & a_{10} & a_{11} & a_{12} \\ \hline a_7 & true & false & false & false \\ a_9 & w_{a_9,a_9} & w_{a_9,a_{10}} & w_{a_9,a_{11}} & w_{a_9,a_{12}} \end{array},$$

and

w_{a_9,a_9} = "The object is complicated and must be processed until reaching atom",

$w_{a_9,a_{10}}$ = "The query is satisfied",

$w_{a_9,a_{11}}$ = "The query is not satisfied",

$w_{a_9,a_{12}}$ = "The query is rejected".

The α-tokens entering places a_{10}, a_{11}, a_{12} obtain the characteristics respectively:

"$!\,x_1^{\alpha}$" in place a_{10},

"$\neg !\,x_1^{\alpha}$" in place a_{11},

and "rejected query" in place a_{12}.

$$Z_4 = \langle \{ a_8, a_{10}, a_{11}, a_{12}, c_1, c_2\}, \{a_{13}, c_2\}, r_4, \vee(a_8, a_{10}, a_{11}, a_{12}, c_1, c_2)\rangle,$$

where

$$r_4 = \begin{array}{c|cc} & a_{13} & c_2 \\ \hline a_8 & false & true \\ a_{10} & false & true \\ a_{11} & false & true \\ a_{12} & false & true \\ c_1 & false & true \\ c_2 & w_{c_2,a_{13}} & w_{c_2,c_2} \end{array}$$

and

$w_{c_2,a_{13}}$ = "There is result for a query",

$w_{c_2,c_2} = \neg\, w_{c_2,a_{13}}$.

When there are no any α-tokens in places a_6 and a_9 in place c_2 is calculated the IFS estimation $\langle \mu, \nu \rangle \in [0, 1]\times[0, 1]$ (see [3, 4]). The estimation reflects the degree of the effectiveness of the ODB (μ) and the non-effectiveness of the ODB (ν), and:

$$\mu = \frac{p_i}{n},$$

$$\nu = \frac{t_i}{n}$$

where:

p_i is the number of satisfied queries – this is the number of α-tokens that enter place a_{10},

t_i is the number of non-satisfied queries – this is the number of α-tokens that enter places a_8 and a_{11},

n is the total number of queries.

The degree of uncertainty $\pi=1-\mu-\nu$ represents those cases where the queries are rejected.

The characteristic of the γ-token from place c_1 contains two threshold values for the μ (M_{min} and M_{max}) and two threshold values for the ν (N_{min} and N_{max}).

If

$$\mu > M_{max} \;\&\; \nu < N_{min},$$

then the ODB works effective.

If

$$\mu < M_{min} \;\&\; \nu > N_{max},$$

then the ODB doesn't work effective.

The α-token entering place a_{13} obtains the characteristic

"Rezult of a query".

Hence, on the basis of the γ-token in place c_2 the system is able to prepare statistical data. These estimations can be used in the procedures for the data integrity of the ODB.

3 Conclusion

The present GN-model represents the processing of the queries in the ODB with evaluations for ODB' effectiveness. The intuitionistic fuzzy evaluations [5] in the characteristics of the tokens enables various analysis and statistical techniques to be applied to the process of working. The purpose of such analysis would be to find ideas for improving and optimizing the process.

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The papers presented in this Volume 2 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems.
It may be viewed as a result of fruitful discussions held during the Tenth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2011) organized in Warsaw on September 30, 2011 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT - Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bystrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, and the University of Westminster, Harrow, UK:

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The consecutive International Workshops on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGNs) have been meant to provide a forum for the presentation of new results and for scientific discussion on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems have also been included. The Tenth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2011) is a continuation of this undertaking, and provides many new ideas and results in the areas concerned.

We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.

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