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REFERATY SESJI

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6. PROBLEMY OPTOTELEKOMUNIKACJI
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9. PROBLEMY PRODUKCJI I EKSPLOATACJI
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EXPERT SHELL CONCEPTS IN LAN SIMULATION

The formal definition of a Simulation System with an expert shell is proposed. A Simulation System for analysis of LANs developed on the basis of the above theory is described.

1. INTRODUCTION.

The last decade has seen an upsurge in the usage of simulation for determining various LAN parameters. This can mainly be attributed to two major factors, namely

1) The inherent mathematical difficulties encountered during theoretical determination of LAN parameters.

2) The relative ease in approximating various LAN characteristics using computer simulation.

Inspite of its obvious advantages simulation of LANs has remained a specialization of the few. Its lack of popularity among the general personnel dealing with computers arises, as we observed, from a widespread inadequacy in their knowledge of simulation. This often leads to good specialists having to waste time on models trivial for their level of expertise.

Keeping in mind the above, we propose the utilization of expert shell concepts in designing a simulation system which would not only allow an interactive interface between the user and the various models but would also be able to guide an user inexperienced in simulation to the optimal model for his task.

2. BASIC DEFINITIONS

Let S be a simulation system inclusive of an expert shell. S is defined by the three tuple

$$S = \langle M, E, \theta \rangle \text{ , where}$$

$M = \{ M_i \}$, $i = 1,..n$, is the set of LAN models.

The expert shell, E, is defined as

$$E = \langle B, J \rangle \text{ where}$$

B is the knowledge base of the system and J is the set of procedures(programmed modules or units).

$\theta = \{ \theta_i \}$ is the set of problems and is formally defined as

$\theta = \langle \rho, \psi, \varphi \rangle$, where

ρ denotes the problem domain,
ψ denotes the problem range and
φ is the mapping: $\rho \longrightarrow \psi$.
The model M is defined as

$M_i = \langle N, O, A, R, T, W \rangle$, where

N is the model name.
O is the set of objects which constitute the model.
A is the set of attributes and is defined as

$A = \{ A_i \}$, $i = 1, 2, ...n$
$A_i = \langle X, Y, Z \rangle$, where

X, Y, Z are the input, output and internal variables in the

model, respectively.
R denotes the relations between the objects and their attributes.
T denotes the set of model time.
H is the formalization of the procedure for introducing different values to the elements of { O } during the interactive working sessions.

The knowledge base B is defined as

$B = \langle P, F, Q \rangle$, where

$P = \{ P_i \}$, is the set of rules :

$P_i = \langle i, k, H, L \rangle$, where

i is the number the rule is denoted with.(Rules may be numbered according to any predefined sequence or ordering).
K is the category of the object.
H is the object type.
L is the list of attributes C_i, $i = 1, 2, \ldots m$.

$L^{(m)} = \{C_1, C_2, \ldots ,C_m \}$,

m being the length of the list.
Consider for example the rule

(7, " LAN ", " Model Token Ring ", { 100, 200, 300 }),

implies that if the assertions with the attributes 100,200, and 300 hold true then for the category " LAN " there exists rule 7 corresponding to the object type " Model TOKEN RING "..

F is the set of facts $\{ F_j \}$, $F_j = \langle G, C, K \rangle$, where
G denotes the group number, G = 1, 2,..., n,
C is the corresponding attribute from L and
K is the category of the fact.

consider for example
(1, 101, " LAN ", [illegible] ")

Let Q be the set of queries $\{ Q_k \}$, $Q_k = \langle G, K, V \rangle$, where G is the group number, K the category and V the query.

For example:
(1, 101, " How is data transmission being achieved ? ").

3. SYSTEM OPERATION

let K(P), G(F) and K(F) be the conditions applied to the set of rules P and the set of facts F. K(P) classifies the set P with respect to the category K, i.e defines the subset of rules P:

$$\{ P \leq P \mid K(P) \}$$

G(F) and K(F) define the subset of facts f:

$$\{ f \leq F \mid G(F), K(F) \}$$

ıving different group numbers G(F) and a category K(F).
Conditions G(Q), K(Q) applied to the set Q define the subset of queries (strings) Q for the given category K.
Consider the projection $\Pi_{C,\phi}(f) = \langle \tilde{C}, \tilde{\phi} \rangle$, defined on the components of C for the tertiary relation
$A_i = \langle G_i, C_i, K_i, \phi_i \rangle$.
are $\langle \tilde{C}, \tilde{\phi} \rangle$ is the ordered set of elements $C_i \in C$, $f_i \in \phi$.
alogously we define the projection on the set

$$\phi : \Pi\phi (f) = \langle \tilde{\phi} \rangle$$

The elements of $\tilde{\phi}$ are the elements of the user menu. The interaction routine consists of selection of subsets f and ʃrings $q' \in q$ and uses the above defined projections on each of the subsets of f. The interactive routine is supported by a set of procedures Z implemented as program modules.
Let $Z = \{ Z_i \}$ then defining Z_i as
$Z_i = \langle U, D, \Gamma \rangle$, where
U is the set of variables, whose elements can be treated as global or local or free variables

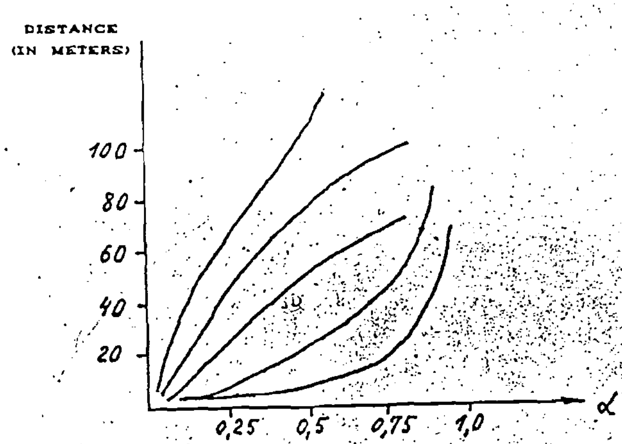
Γ is the set of images created with the help of some graphic package.

The procedure ZCHOICE $\in$ Z allows for four possible responses to the selected $\tilde{\phi}$, namely

1. YES.
2. NO.
3. PROBABLY YES.
4. PROBABLY NO.

If the element $\tilde{\phi}_i$ is selected then the component C_i of the pair $< C_i, \phi_i >$ of the projection $\Pi_C\phi(f)$ is the response $C_i' = < C_i', \alpha_j >$ where α_j is the coefficient of confidence. For the first and the second responses α_j equals 1 and 0 respectively. The coefficient α may be defined by an expert with respect to his level of confidence in the correctness of the assertion. The coefficient α is bound in the interval [0,1]. For the third and the fourth responses the value of α_j is assigned by the user.

The procedure ZGRAPH $\in$ Z plots graphs of corresponding belief functions. Given below is a reproduction of the various curves drawn by ZGRAPH for the assertion " The distance between the work stations in the network is not more than 100 meters."



The value of α_j is determined by the selection of the graph representing the distribution of the assertion ϕ_i.

As the result of the system queries and the responses of the user a list of answers $< C'_{i1}, C'_{i2}, \ldots, C'_{in} > = C'^{(n)}_i$, where n is the length of the list, is obtained.

The above list may also be interpreted with respect to the coefficients of confidence α_i defining the probability of occurrence of various C'_i, i.e in the form

$< (C'_1, \alpha_1), (C'_2, \alpha_2), \ldots, (C'_n, \alpha_n) >$

Denote the mapping $\varphi: C'_i \longrightarrow P$ as $C_i' \in C'^{(n)}_i$ in the subset $\{ P \subseteq P \mid K(P) \}$ and denote the subset P_α thus obtained as the set of active rules.

The subset P_α has the form

$P_{\alpha i} = < i, k, H, L_{(m)} >$.

The component $L_{(m)} = < C_1, C_2, \ldots C_m >$ contains an element C_i equaling one of the elements $C'_{i(n)}$.

The table given below represents the subset P_α.

i	k	H	Lm
i1	k1	H1	< <u>C1</u>, C2, ..., Cm >
i2	k2	H2	< C1, <u>C2</u>, ..., Cm >
.	.	.	.
.	.	.	.
.	.	.	.
in	kn	Hn	< C1, C2, ..., <u>Cm</u> >

Assuming the underlined elements in the table to be equal we get $k_1 = k_2 = \ldots = k_{n-1} = k_n$.

The mapping $\varphi : C'_i \longrightarrow P_\alpha$, is similar to the mapping $\varphi : C'_i \longrightarrow P$. These two operations are implemented by the SEARCH procedure. This procedure is repeated until a rule having the form $P = < i, k_i, H_i, L_{(m)} >$, for which all the elements of the list L correspond to the elements C'_i of the list of answers $C'^{(n)}_i$, for m = n, is not found.

The rules for which the above does not hold are exclud[ed] from the knowledge base. As a result, the rule P_i along with th[e] corresponding coefficient of confidence is obtained. Th[e] coefficient of confidence is calculated as the sum of α_j from th[e] list of answers divided by the length of the list. The procedur[e] ZOBJECT returns the value of M_i from the obtained rule P_i wit[h] the coefficient of confidence α'_i.

The selection of the required model from the library of existing models is done with the help of the procedure ZMODEL. Th[e] procedure ZTONING allows the customization of the model M_i wit[h] respect to the elements A and T from < N, O, A, R, T, W > using M_i.
W, the procedure used for the initialization of the attributes i[s] defined as follows

$$W = N(\lambda_1, \lambda_2, \ldots, \lambda_{n-1}, \lambda_n)\alpha$$

where λ_i is the description of the parameters of the model. λ_i take on the values of the answers C'_i and introduce these values as the model attributes.

For the coefficients of confidence less than 0.75, the procedure ZNEW is activated. This procedure forms an empty W, denoted as W^o. $W^o = N(\lambda^o_1, \lambda^o_2, \ldots, \lambda^o_n)\alpha$, where all λ^o_i are set to zero. When new values are introduced by the user, ZNEW is used to edit and store the newly formed W in the appropriate sector of the library.

In addition to the expert shell the simulation system contains two interacting subsystems - the " modelling " subsystem and the " help " subsystem. The modelling subsystem deals with the simulation of LANs and the " help " subsystem contains usage guidelines and examples.

4. Conclusion

A simulation system named Expert System Simulator (E.S.S) based on the above concept has been designed by the authors. E. S. S has been implemented on an IBM AT compatible, under the operating system MS-DOS. The expert shell was written using Turbo prolog version 2.0 and the models were written in GPSS-PC.

Bibliography

Tanenbaum, Andrew S. Computer Networks, Prentice Hall Inc., [19]88.

Stochastic Modelling in Decision Making, Ed S. Biswas, Khama [Pub]lishers, 1990.

Искуственный Интеллект- В 3-х Кн. К. 2. модели и методы: [сп]равочник / под ред. Д. А. Поспелова - М.: Радио и связь, 1990 [30]4 с.

[М]елихов А. Н. , Берштейн Л. С. , Коровин С. Я. Ситуационные [сов]етующие системы с нечеткой логикой. - М. Наука. Гл. ред. физ. [м]ат. лит. , 1990 - 272с.