PRODUCTION-FRAME MODEL OF REPRESENTATION OF DATA DOMAIN

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Annotation: One of the most important problems of e-learning system is studied in given paper. This problem is building of data domain model. Data domain model is based on usage of correct organizing knowledge base. In this paper production-frame model is offered, which allows structuring data domain and building flexible and understandable inference system, residing in production system.

Introduction

Learning as regulable process represents controlled knowledge caring from tutor (teacher, adviser, expert) to trainee (to the pupil, student or listener). There are a number of the theoretical and practical questions concerning adequacy of these technologies of learning, and also knowledge and skills control in conditions of organization of educational process with usage of training means, in particular, computer information technologies.

The great demand of new modern forms and transfer methods and control of knowledge is the practical proof of necessity of creation and introduction of corresponding intellectual computer training systems. Therefore, questions of development and perfection of their methodical, mathematical, algorithmic, program and software for realization of required functionalities, adaptations to specific trainee features take on vital importance.

Native and foreign scientists, such as D. A. Pospelov, V. V. Popov, I. N. Kuznetsov, B.A.Sazonov, I.V.Makarova, V.P.Tikhomirov, M.Minsky, D. Blum and others were engaged in problems of usage and development of technologies of representation and controlling of knowledge transfer. The analysis of works of listed authors on a researched question has revealed insufficient workup of mathematical models, methods and representation algorithms and knowledge transfer in the computer systems, interfering creation of the universal program systems based on knowledge.

Problem statement

E-learning systems consist of combination of three components: trainee model, learning process model and data domain model (a course, area of learning) [1].

The trainee model contains the information of his personalities, preferred to him strategies of learning, typical errors. The learning process model ensures formation of information model, presentation of the information and evaluation test of trainee potential. This model contains knowledge about planning and organization of learning process, about general and individual strategy of learning.

Data domain model (DDM) is defined by set of entities. Concepts or themes, to each of them corresponds unit of a teaching material which is not requiring (from the point of view of the teacher) partition on subtheme can be considered as entities of data domain (DD) in learning systems. Each theme is described by a set of parameters (attributes), which are important for learning process controlling. Thus, following demands are made to data domain model:

1. Possibility to reflect relationships between elements

2. Possibility of obtaining of a holistic image of knowledge

Creature of such data domain model presents a development of knowledge base (KB) - formal warehouse of addresses and types of entities. KB contains information reflecting regularities of given DD and permitting to predict and deduce new facts, which are not presented in DB.

Selection of knowledge representation language is the main problem in creature of KB. In this case frame system will be knowledge representation language, which meets the requirements made to DDM.

Object of the paper: creature of a data domain model which would allow forming the curriculum, taking into account personal trainee requirements.

Urgency. The given approach is based on usage of production-frame DDM in learning system. Such system can be considered as unified hierarchy of frames

The offered approach is self-organizing i.e. components of system set structure of data domain. The hierarchic combination of frames can be naturally extended by production rules for assigning of data domain dynamics.

Hierarchic frame knowledge representation like object-oriented approach gives an opportunity of frequentative usage of knowledge due to inheritance. Inheritance from frame hierarchies allows extending bases, and efficient knowledge clusterization around slots of frames allows reducing to minimum problems of the concordance of knowledge bases.

1 Background

The structure for the description of the theoretical unit consisting of characteristic of their values is called as frame. Characteristic is called as slots, and values - fillers of slots. Slot can contain not only concrete value, but also a procedure name, permitting to calculate it by the given algorithm, and also one or several rules with which help this value can be found.

Set of frames modeling any data domain, represents hierarchic structure in which frames are connected. There is a frame keeping the most general information, true for all remaining frames on the top level of hierarchy.

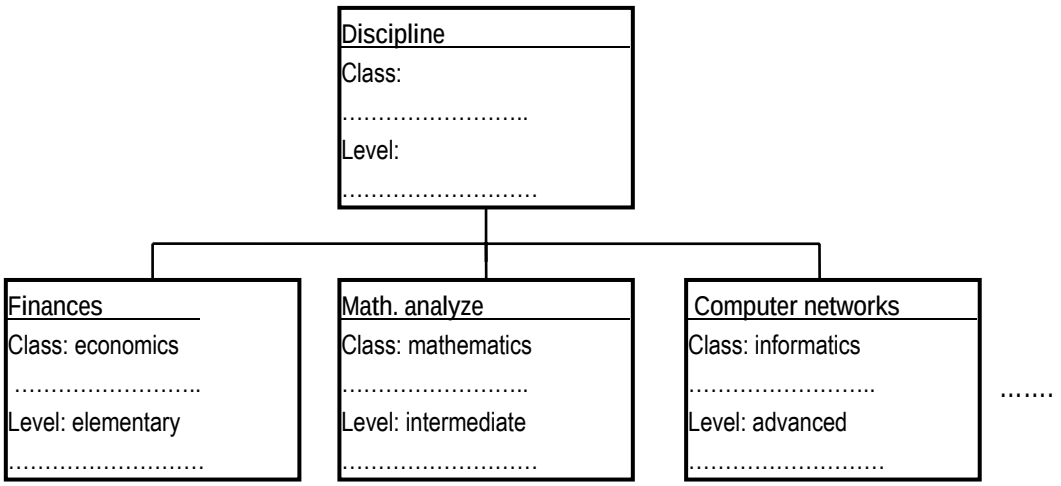

Fig.1 – Fragment of knowledge base describing data domain

Frames have ability to inherit characteristic values from the parents located on a higher hierarchy level. Characteristics values of frames can be transmitted on default to the frames located below of them in hierarchy, but if last contain eigenvalues of characteristic data they are considered as true data. This circumstance allows easily taking into account different elimination in frame systems [4].

DDM has static character, has few eliminations and connections between objects change infrequently. Described properties are realized in frame systems of knowledge representation in the best way. Values of slots are represented in the single copy in the system, as it is included only in one frame describing the most general concept from all those which contain the slot with data a name. Such property of frames systems enables to reduce a memory capacity, which is necessary for their placement in the computer. Besides economies of memory, presentation in KB the relationships existing between concepts of data domain concern to advantage of such model.

Under "Class" we understand scientific area, "Level" - a knowledge level of trainee, "Volume" - volume and the form of stated materials. Given attributes can be obligatory or not obligatory.

2 System of inference

Flexible and simple system of inference is necessary for representation DDM. Data domain model will interact with the trainee model by means of inference of production rules. Inferences of production system have search functions in KB, follow-up of operations above knowledge and obtaining of the conclusions. They describe knowledge in the form IF - THAT

There is a problem of mixing of rules with different properties in production system, at a solution of a problem of inference in several application areas. That fact essentially decrease efficacy of machining. However usage of a frame model in DDM in given model of learning process structures data domain that excludes mixing rules with different properties.

3 Production-frame knowledge representations

The architecture of production-frame hierarchy bases on frame knowledge representation in which frame hierarchy with relation of representation and active slots is taken for the base, and the inference is made by production rules. Such approach allows combining naturally in one model static knowledge about solving problems in the form of values of slots, structural knowledge of data domain by the way of inheritance hierarchies.

Thus, the frame system can be shown as:

$$W : S \to I$$

where I — set of frames, $S = \{S_i\}$, $i = \overline{1,n}$ — finite set of slots is presented as follows $\langle v, d, \{D_j\} \rangle$, including the current value of the slot $v = \langle v_1, v_2, ... v_l \rangle \in T$ and a default value $d = \langle d_1, d_2, ..., d_k \rangle \in T$, demons procedures {Dj}.

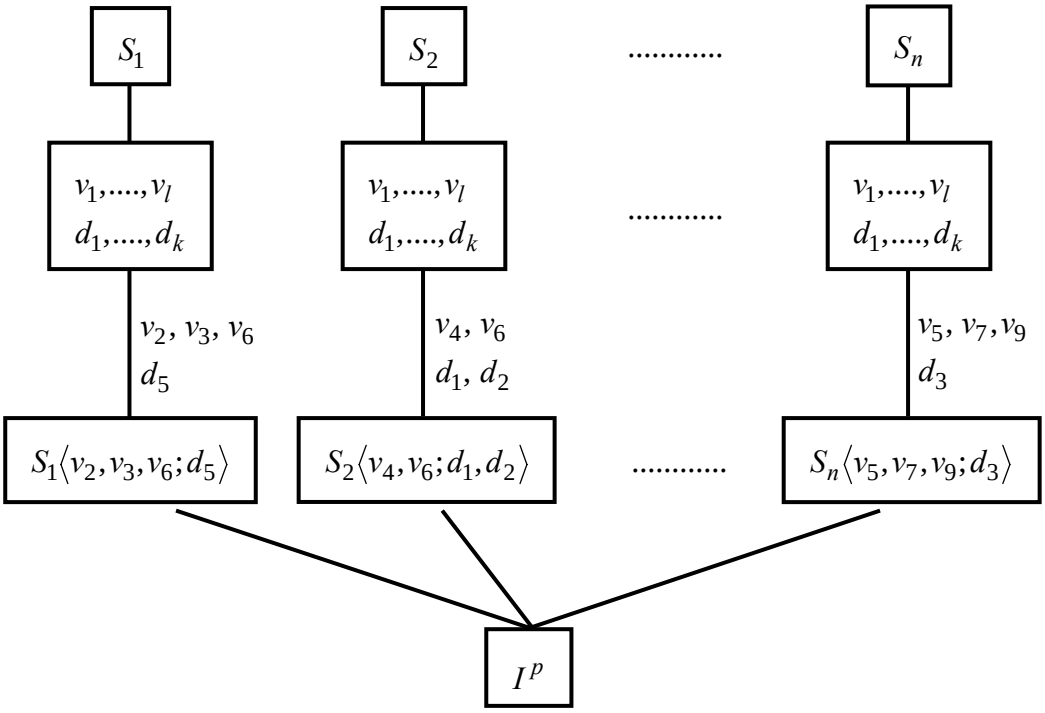

Fig. 2 – Example of inference of production system

Relation of inheritance is induced by the slot with the reserved name *parent*: $F : G \Leftrightarrow \|F(parent)\| = G$. Typical for frame systems the operation of the specification of the frame on a sample can be realized by implicit

inclusion in a model rule $F(parent) \leftarrow match(F,G)$. By consideration of multiple inheritance *parent slot* is supposed list type, and $F:G \Leftrightarrow G \in \|F(parent)\|$.

The Inference about values of output parameter (resultant frame I_P) implements under condition of accurate values of data-in (the frame of the query $I_з$), consisting of a subset $v \times d$) and is presented in such way:

$$L:\begin{cases} IF\ \left\langle v_1^1, ..., v_l^1; d_1^1, ...d_k^1 \right\rangle\ THEN\ S_1^p \\ IF\ \left\langle v_1^2, ..., v_l^2; d_1^2, ...d_k^2 \right\rangle\ THEN\ S_2^p \\ ..... \\ IF\ \left\langle v_1^n, ..., v_l^n; d_1^n, ...d_k^n \right\rangle\ THEN\ S_n^p \end{cases}$$

The resultant frame I_p represents combination v and d, which belong to different frames. Thus I_p - inference of production system can be presented as:

$$\left\langle S_1^p, S_2^p, ..., S_n^p \right\rangle \rightarrow I^p$$

Conclusions

In given paper the approach which represents creature of DDM of a learning system is developed. DDM is a knowledge base organized on the basis of production-frame knowledge representation language. Creature of frame hierarchy of knowledge base allows to present knowledge in the structured form with preservation of property of inheritance. That is actual at construction of DD of adjoining subjects. The production system ensures a flexible and understandable inference which allows generating a inference proceeding from personal trainee requirements. Representation DDM by a production-frame model allows reducing memory capacity necessary for filing.

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