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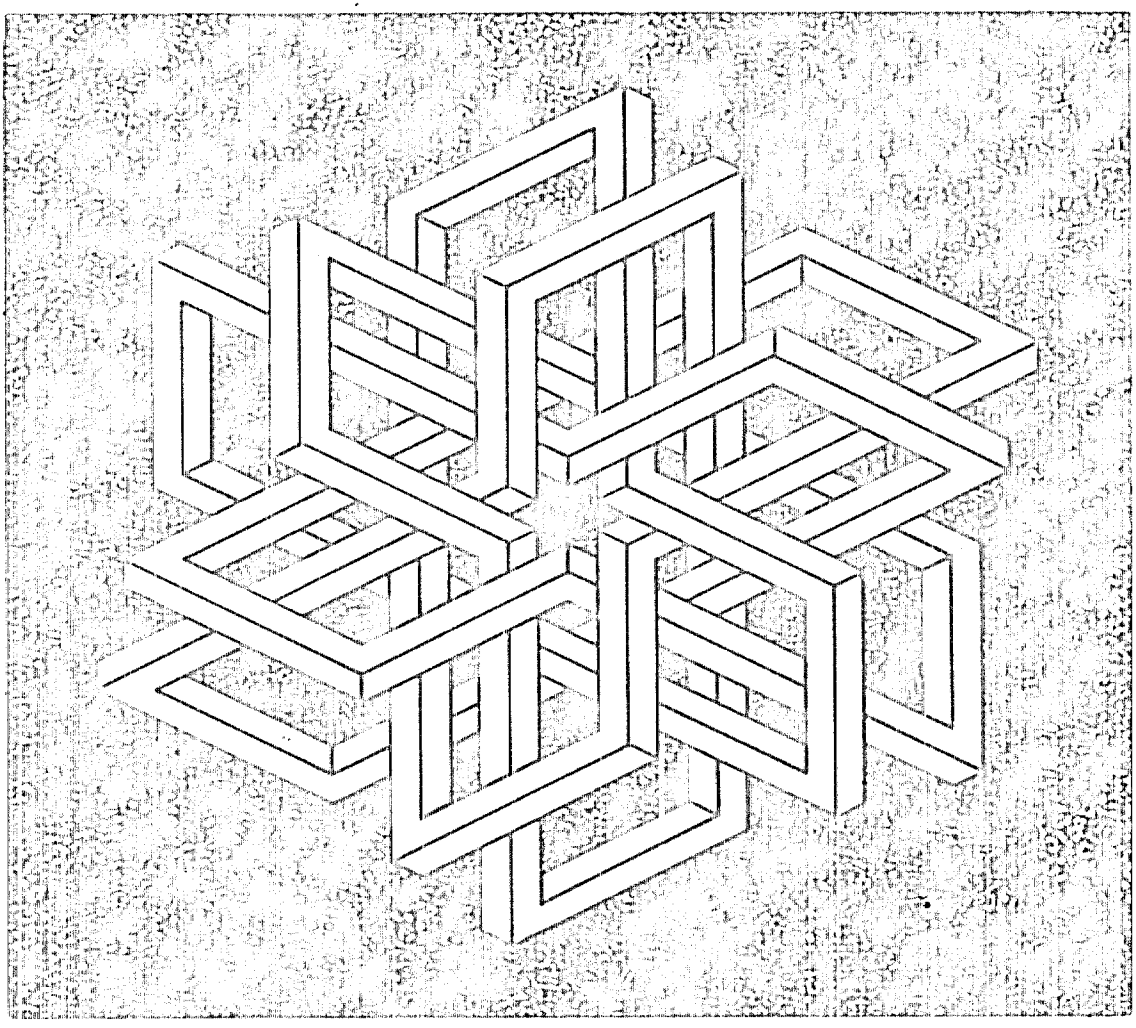

REPORT ON A SYMMETRY-BASED UNIVERSAL GRAMMAR FOR FEDERATION OF MODELS

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One of the most challenging elements of computer science deals with the general disciplines of *representing* information. Information structured using representation techniques is said to represent, or be, a *model*. Many different modeling techniques have been developed, each optimized for some application or set of conditions, and a substantial literature exists concerning modeling techniques and languages. Because virtually everything imaginable is so modeled, and because such representation touches on issues of cognition and mind, the study of models deals with profound questions. For example, a central issue of artificial intelligence is how best to represent, or model, knowledge.

A substantial amount is known about specialized applications, but relatively little progress has been made toward generalized modeling solutions. A fascinating problem is encountered in situations where different types of models must coexist and interact in the same computer environment. An environment in which this is often found is the information infrastructure of large industrial enterprises. In such an application, often thousands of different types of models must work together in some cooperative manner. The industrial application is important because issues of national competitiveness provide a motivation for a robust, well funded national research effort toward solutions for model coordination.

The research is of interest to the society for two reasons. The first concerns the nature of inter-relating models: these models may be geometric models, mathematical models, logical models, in short, models using any scientific or artistic means. (Strictly speaking, these are limited to computerizable forms.) The problem can therefore be stated as a search for understandable means of inter-relating descriptions from differing viewpoints or disciplines. The nature of the society is precisely in this area of studying universal, underlying principles.

Along these lines, some interim results on the epistemological understanding of the problem to inter-relate or index different representations will be reported -- these resulting from a series of international workshops and studies. The long term intent is for the results to form a baseline for a *proposed project of the society* toward indexing (co-relating) various disciplines and activities covered by the society. Presumably, this would use some multidimensional, periodic relationship scheme.

The second item of interest to the society from this research is a proposed approach to the technical requirement for a formal underlying mechanism to be employed in large, integrated computer systems which serve diverse and complex enterprises. In other words, a "universal grammar" or a universal conceptual federation mechanism is discussed.

The mechanism is described in non-mathematical terms. Briefly stated, diverse models are collected into groupings which share some semantic base, logical order, or some other common method. Using the epistemology, a namespace is created in which conceptual metamodels are active (one for each basic type of integrated or unified models). The presentation of the namespace relies on the intuitively accessible concepts of category theory. Concept lattices result as the conceptual view of the metamodel in the namespace.

The problem then becomes one of inter-relating the infinitely periodic space-packings (and their associated assignments) of the concept lattices. A set of grammatic primitives and operators is described; these generate related transforms and manipulations on the lattices as a metalanguage. The state of knowledge about symmetry principles is stretched: interdimensional and multisymmetry transforms are discussed, together with recursive "metastructural" concept lattices of concept lattices. How these features map to computing services is only briefly indicated in this paper (the details are available elsewhere).