Knowledge Representation and Inference Environment: KRINE,  
--- An Approach to Integration of Frame, Prolog and Graphics.  

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ABSTRACT  
It is well known that an expert system is an intelligent computer program intended to solve complex problems by means of inference using domain specific knowledge extracted from human experts in the domain. Especially, in order to develop an expert system for intelligent CAD, we will have much difficulty in describing the design knowledge including pattern matching procedures, in applying the design knowledge by trial and error or in displaying design objects dynamically. If only conventional object-oriented or frame-based knowledge representation tools are used, To cope with these problems, the following mechanisms were integrated with the frame-based knowledge representation system; (a) PROLOG programming functions with direct frame data unifier, (b) frame data recovery for backtracking of inference and (c) design object display functions by interpreting frame data directly. This paper describes the design philosophy, mechanisms and examples of integrated knowledge representation and inference environment (KRINE).  

1. INTRODUCTION  
Recently, many research efforts have been expended on software systems, that solve complex problems by means of inference using domain specific knowledge extracted from human experts (expert system). Tasks of expert systems range widely from diagnosis problems to design problems. In particular, in case of an expert system to solve design problems, hierarchical representation of design objects, representation and application control of design knowledge, and dynamic display and interactive editing of design objects (man-machine interface) are deemed essential.

UNITS (Smith et al. 1980, Stefik 1979), LOOPS (Bobrow et al. 1980) and Smalltalk (Goldberg et al. 1980) can offer functions related to hierarchical representation of design objects. However, because design knowledge requires explicit search and manipulation of hierarchical structure patterns among design objects and because simulations require dynamic display of the design object’s structures, these conventional knowledge representation tools are not sufficient.

To cope with these problems, the authors have made a new knowledge representation and inference environment (KRINE) that integrates several knowledge representation paradigms. This is because different paradigms are appropriate for different purposes. KRINE has fundamental frame-based knowledge representation mechanisms (object-oriented, procedure-oriented and manipulation oriented) and also integrates the following mechanisms; (i) PROLOG programming mechanisms with frame unification functions (logic-oriented) and rule representation mechanisms based on the PROLOG programming mechanisms (rule-oriented), (ii) Frame-based graphic environment, where frame data are directly interpreted and dynamically displayed.

At first, this paper shows background, design issues and basic concepts of KRINE knowledge representation paradigms as the design philosophy. Next, it shows system structure and KRINE mechanisms. They are fundamental frame mechanisms, frame-based logic programming mechanism and frame based graphic environment. Finally, KRINE knowledge representation examples are mentioned.

2. DESIGN PHILOSOPHY  
2.1 Background for KRINE  
The problem solving tasks for expert systems can be classified into several categories, such as diagnosis problem, analysis problem, planning problem or design problem (Stefik et al. 1982). The design problem can be defined as the creation of an apparatus that consists of a lot of parts by applying design operations to its abstract specification. This problem is classified as one of the most difficult problems for expert systems.