THE INFERENCE MACHINE LABORATORY: GRAPHIC TOOLS FOR KNOWLEDGE MANAGEMENT

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ABSTRACT

The Inference Machine Laboratory is a collection of experiments in applying graphic interfaces to various types of knowledge bases. Each experiment involves a canonical representation, invertible transformations into multiple representations, and multiple directly manipulable views of those representations. Initial experiments include RULE*CALC (simple production rules), HAPStation (OPS5-like production rules), RFIX (diagnostics), and TIMLS (frames in PROLOG).

KEYWORDS: expert systems, intelligent interfaces, knowledge acquisition, direct manipulation

INTRODUCTION

The major barrier to successful expert systems development continues to be the acquisition, review, restructuring, and long-term maintenance of large knowledge bases involving complex relationships [1]. Meaningful military and industrial expert systems are expected to require as many as 10,000 "rules" [2], domain coverage of better than 95 %, and an error rate of less than 0.1 %. To achieve these performance figures -- perhaps one to two orders of magnitude beyond the current state of the art -- the next generation of knowledge management tools must enable each individual involved in designing, building, using, and maintaining knowledge bases to view, understand, and manipulate their contents in an intuitive manner.

For simple interactive systems, adequate tools and techniques are already available. The direct manipulation of icons has already lead to successful icon-based interfaces for commercial systems such as the XEROX Star and the Apple MacIntosh [3]. Research activities, such as those in the MIT Media Graphics Laboratory, have shown impressive capabilities for text and video interfaces [4]. More recently, tools such as UNITS [5] and GEN-X [6] have provided effective interfaces to knowledge bases in expert systems.

THE INFERENCE MACHINE LABORATORY

The Inference Machine Laboratory (IML) addresses these performance goals for expert systems by providing each knowledge-base user with a tailored set of directly manipulable views of the knowledge base and by maintaining consistency among the various views. Over the last two years, a family of successively more complex knowledge management systems has been constructed. The early systems have involved simple production rule knowledge bases, and the later systems are based on predicate calculus representations.

Physically, the laboratory consists of two VAX computers, several LISP machines, a color monitor, a color video projector, several mice, a foot-mouse, a DECTALK voice generator, and a Polhemus 3-D graphics pointing device. The half-dozen individuals interacting with the knowledge base are grouped around a small table in front of the projection screen. They are able to select views, make queries against the knowledge base, and modify the knowledge base using the interactive graphics devices.

All of the software systems in the laboratory fit into a common framework (Fig. 1), which supports various kinds of graphic input/output, logic-based knowledge representations, and natural language input/output. In the IML, each system user works with a particular set of windows on the knowledge base. These windows are defined by

- Virtual cameras - to generate shaded images, schematics, tables, graphs, trees, and other diagrams
- Views - to specify the particular image generated by defining the location of the user in the knowledge base,
- Filters - to determine the granularity, or level of detail, in a particular view.

Once a view is presented, the user can modify the knowledge base by pointing at particular elements of the view and indicating changes.

RULE*CALC

The simplest and earliest project in the laboratory is RULE*CALC, a VISI-CALC-style development environment for EMYCIN-class production rules with uncertainty [7]. The rules are laid out in a spreadsheet-like tableau.