Representing domain-level knowledge components using primitives

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We have been developing a domain-level knowledge representation construct in GLIF called macro. A macro is a declarative specification of a high-level concept that is mapped to a procedural pattern of primitive GLIF steps. We developed macros for (1) appropriateness criteria for radiological examinations, and (2) toxicity criteria for cancer clinical trial protocols. Authoring tools for these macros were built using a Java software library we have designed for this purpose. The authoring tools provide an easy way to encode these guidelines that can then be automatically mapped to GLIF.

The Guideline Interchange Format (GLIF) is being developed and refined to facilitate the sharing of computer-interpretable clinical practice guidelines among healthcare institutions [1]. GLIF's design intended to accommodate encoding of guidelines for a variety of types of applications such as disease management, screening, prevention, appropriateness determination, etc. To provide the flexibility to encode such a range of guidelines, GLIF contains a set of low-level or primitive knowledge representation constructs (e.g., steps for actions, decisions, branching, and synchronization). However, authoring of guidelines using these primitive constructs can be cognitively difficult. Further, such guidelines can be visually complex and difficult to follow for the clinical user.

A new class called "Macro" [2] has been introduced into GLIF to facilitate the representation of application-level domain concepts. Previously, we had demonstrated modeling of such concepts as the screening schedule for screening guidelines using macros. A domain concept is represented via a subclass of macro, specific to that concept. The attributes of this subclass (such as screening test, at-risk population) describe the domain concept. These attributes can be mapped into a procedural pattern of primitive GLIF constructs. The high-level representation enhances the usability and comprehensibility of the guidelines and the associated software tools. The mapping to lower-level GLIF constructs preserves the scalability of various software tools such as those for guideline execution and guideline validation.

We have developed macro subclasses for two different types of guidelines that are specified in a structured format by their developers: (a) The appropriateness criteria from the American College of Radiology [3] are guidelines for the selection of suitable radiology tests for a number of clinical conditions. (b) The Common Toxicity Criteria published by the National Cancer Institute [4] can be considered to be knowledge components of clinical trial protocols for cancer treatment. Mappings to the patterns of GLIF steps that represent these two knowledge components have also been designed.

We implemented a software framework, consisting of a set of Java classes, for authoring guidelines using macros. The classes enable new macros to be built, creating forms for their authoring, creating persistent representations of macros as XML/RDF documents, and mapping macros to GLIF patterns. Using this framework, we built forms for authoring appropriateness criteria and common toxicity criteria. These forms replicate the structure of the respective guidelines to make the task of encoding easier.

Further work will involve development of macros for other domain concepts and conduct studies to test for expressiveness of macros, as well as comparison of usability and comprehensibility of macros vs. primitive representations.

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References

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