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Demonstration: Integrating Protégé into an Intelligent Medical Training System

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In the SlideTutor Project, we are using Protégé to help us develop, evaluate and deploy an Intelligent Medical Training System. SlideTutor is an adaptive, multimedia system designed to train future pathologists. The system builds on the well-described paradigm of the Model Tracing Intelligent Tutoring System, providing individualized, knowledge-based coaching to students as they search and interpret virtual pathology slides. More than just an educational system, SlideTutor is designed to function as a laboratory for collecting and analyzing data about how students learn to perform the immensely complex task of visual disease classification. In all aspects of our research, Protégé has become an integral and indispensable tool.

At the Protégé 2003 Conference, we reported on our general architecture for intelligent tutoring of classification problem solving – a set of abstract PSMs developed in Jess, that use our Protégé Domain Ontology, to create a Dynamic Solution Graph for model-tracing. In this demonstration, we will show examples from the past year of development to highlight some of the other ways we are using Protégé, including:

- ***SlideAuthor Protégé plugin.*** This new tab plugin allows SlideTutor content developers to create annotated virtual slides for our system. The plug-in incorporates a commercial virtual slide viewer (www.xippix.com), but uses Protégé classes and instances from our Domain Ontology to constrain the authoring and annotation process. This insures that all cases used by our system exemplify the feature-specifications we've created for diseases in our knowledge base.
- ***Development of teaching content*** as a separate Protégé knowledge base. This protégé project contains the context-specific hints delivered by SlideTutor when students don't know what to do next, and the alerts that identify and explain incorrect student actions. Context-specific values are incorporated into text templates, and accompanied by instances that describe generic tutor actions (such as flashing an object in the interface or moving the viewer and annotating evidence). Tutor action instances correspond to client code that is specific to the particular interface. The pedagogic behavior of the tutoring system and interface can therefore be changed by simply modifying the pedagogic knowledge base.
- ***SlideTutor knowledge validation applet.*** In this project, we used the Protégé-API to create a web-based method for external validation of facts and relationships in the Domain Ontology. The system employs a set of question templates randomly instantiated with instances from the Domain Knowledge Base. These question templates provide a spectrum of stringency and complexity, to elicit potential semantic inconsistencies that could effect performance of our tutoring system.
- ***Web-based protocol analysis.*** We are collecting detailed data about student behavior and tutor responses and capturing this data in relational format. We are currently working on a web-based analysis system that provides query capabilities to SlideTutor researchers. Queries will be constructed using values retrieved from the Domain and Pedagogic Ontologies. As our system grows and changes – we can explore how students learn the skills that are encoded in the Domain Ontology and how the instructional interventions encoded in the Pedagogic Ontology effect learning.
- ***Interactive Algorithmic Interface.*** A major part of the SlideTutor project involves the evaluation of methods for knowledge-based training. Our newest SlideTutor interface instantiates SpaceTree (www.cs.umd.edu/hcil/spacetreel/) with classes and instances from the Domain Ontology to visualize the entire diagnostic problem space as students work through a specific case. In our first major formative evaluation we are testing our two existing interfaces – the original case-focused interface, and the new algorithmic, knowledge-focused method – and comparing the effect of interface on learning gains.

Throughout the talk we'll discuss our experiences with integrating Protégé into our research, and describe the potential for knowledge-based medical training systems that build on the Protégé resources.