Visualization Requirements for Knowledge-Based Systems

CHISEL Lab
University of Victoria, BC Canada
http://chisel.cs.uvic.ca

Margaret-Anne Storey   Polly Allen   Neil Ernst
Visualization and Protégé

• Why visualize information?
• How can visualization help in Protégé?
  – Who are the users?

• Determine requirements for visualization use in Protégé
  – Formative evaluation techniques
  – An introspective Case Study explored
  – Adoption barriers
• Preliminary set of requirements and roadmap
• Discussion
The power of the unaided mind is highly overrated. Without external aids, memory, thought, and reasoning are all constrained. But human intelligence is highly flexible and adaptive, superb at inventing procedures and objects that overcome its own limits. The real powers come from devising external aids that enhance cognitive abilities. How have we increased memory, thought, and reasoning? By the inventions of external aids: It is things that make us smart. (Norman, 1993)
External Cognitive Aids

- External cognition
  - Internal and external representation and processing weave together in thought
- External cognitive aids can enhance cognition
  - Slide rule
  - For multiplication, use of paper reduces the time required by a factor of 5 (for most people)
  - An important class of external cognitive aids that make us smart are graphical inventions and interactive visualizations
Information visualization

• Visualize --
  – To form a mental image or vision
• Visualization is done by humans, it is not done by a computer
  – But the use of computer supported, interactive, visual representations of abstract data can amplify cognition
• Visualizations can help us gain insight into data
Interactive Visualizations that make us smart...

Hyperbolic Trees

http://www.smartmoney.com/maps

SHriMP Views

Attribute Explorer

The Brain
An interactive visualization tool...
Zooming in to one sector

Motivation

Evaluation

Case Study

Roadmap

Discussion
Zooming in to look at Airlines

Motivation
Evaluation
Case Study
Roadmap
Discussion
Jambalaya

Motivation
Evaluation
Case Study
Roadmap
Discussion
Who are the potential Users for visualization?

- Modelers – expert and novice
- Team of modelers (managers)
- End users
Visualization and Protégé

- Why visualize information?
- How can visualization help in Protégé?
  - Who are the users?

- Determine requirements for visualization use in Protégé
  - Formative evaluation techniques
  - An introspective Case Study explored
  - Adoption barriers

- Preliminary set of requirements and roadmap
- Discussion
Empirical Evaluation in KE: Some Challenges

- Lack of incentives to participate: time and effort required
- Amassing enough experts
- Lack of generalizability of results
- Many previous evaluations have focused on characteristics of the models built: system-resources, capabilities
- Needed: more evaluations from the user’s perspective
Summative vs. Formative Evaluation

- **Summative** evaluates a tool against its requirements once it has been developed

  What happens if we don’t know the requirements?

- **Formative** evaluation guides the development/refinement of a tool
Gathering requirements for supporting users through...

- User Surveys
- Contextual Inquiry and Observation Case Studies
  - National Cancer Institute in Washington, D.C.
  - Foundational Model of Anatomy at University of Washington
- Introspective Case Study

The goal: Enough results for generalizations!
Contextual Inquiry in KE

Some tasks performed by knowledge engineers:
- Frequent use of ‘search’ dialog: repeated searches for same 2 terms, moving frequently between 2 focused areas
- Changing the hierarchical relationship to verify modeling: users needed to find concept of interest in the new hierarchy
- Understanding interactions between several relationships, transitive relationships
Case Study Experience

- Real-world problem: Organizational Knowledge Management in Academic Groups
- SHriMPBib: stores bibliographic reference data about academic papers read by the group, and group knowledge about those papers
- Insights into support required for knowledge modelers, knowledge base users, and into visualization support
SHriMPBib

• Technical details:
  – java-based web page with access to Protégé knowledge base.
  – User-viewable ontology project
  – Export to common formats such as BibTeX and Endnote.

• What does Jambalaya show?
  – Modeler:
    • Is the model consistent with the domain?
    • E.g. What relationships need to be there to show what I want?
  – End-user:
    • Who should I ask about subject X?
    • What areas does the group work in/have expertise in?
    • What are the best papers to read for a new group member?
Adoption challenges

- Problem: convince people that this tool will help them
- What are the innovation characteristics of this tool?
  - Relative advantage, compatibility, complexity, trialability, observability
  - Relative to the potential user’s perspective
- Last mile problem: moving software into the hands of the users - not something academia is particularly good at (present company excepted, of course!)
- Questions to keep in mind:
  - What practices are currently used? How can WE adapt to them? (not, “here's a neat tool”)
  - Work on tool interoperability as well e.g. common exchange mechanisms (OWL, SVG, JPG)
Lessons for Large Projects

- Find a champion to spread the message (observability)
- Work with the users - address compatibility
- Active demos and explanations - tackle relative advantage
- Wizards and scripts (complexity, trialability)
Review

• Looked at requirements at a high-level
• Did some evaluations to focus on these
  – Including an introspective case study
  – And literature review
• Examined how to get our tool adopted
• Suggestions for visualization requirements....
User Objectives

- **Expert modelers:** Author new concepts, refinement, reorganization, verification, identify reusable concepts
- **Novice modelers:** Understand existing model (structural level and patterns of instances and relationships)
- **Team support:** Awareness, resolving conflicts, communication
- **Managers:** monitoring (domain and model consistency), verification, work assignment
Some visualization requirements and proposed solutions: A Roadmap

- Flexibility (scripting)
- Scalability (working sets)
- On demand visualization tailored to specific needs (lightweight bookmarks, new abstractions)
- Navigation support (drilling down through multiple relationships)
- Team support (PromptViz, Protégé 2, Live bookmarks)
- OWL (visualizing classification)

- Collaborate with and learn from other visualization researchers in this area

Questions and Discussion
Classes:
- Protein, Organized by Function
  - Protein, Organized by Location
  - Protein, Organized by Origin
  - Protein, Organized by Family
  - Protein Complex Subunit
  - Protein Complex
  - Protein Complex Subunit
  - Protein Complex
  - Paraneoplastic Disease Antigen
  - Nuclear Protein
  - Neurodegenerative Disease Protein
  - Tissue Polypeptide Specific Antigen
- Enzyme
- Cell Adhesion Molecule
- Ligand-Binding Protein
- Chaperone
- Structural Protein
- Regulatory Protein
- Signaling Protein
- Growth Factor
- Cytokine
- Tumor Suppressor Protein
- Oncoplastic Suppressor Protein
- Immunoglobulin Binding Factor
- DNA Repair Protein
- Protein, Organized by Structure
- Protein, Organized by Location
- Protein, Organized by Origin
- Protein, Organized by Family
- Protein Complex Subunit
- Protein Complex
- Paraneoplastic Disease Antigen
- Nuclear Protein
- Neurodegenerative Disease Protein
- Tissue Polypeptide Specific Antigen
Some visualization requirements and proposed solutions: A Roadmap

- Flexibility (scripting)
- Scalability (working sets)
- On demand visualization tailored to specific needs (lightweight bookmarks, new abstractions)
- Navigation support (drilling down through multiple relationships)
- Team support (PromptViz, Protégé 2, Live bookmarks)
- OWL (visualizing classification)

- Collaborate with and learn from other visualization researchers in this area

Questions and Discussion
OWL Visualization
Related work:
E. Rogers, *Diffusion of Innovations*
Gary Kwok-Chu Ng, *Visualization Techniques for Ontology Development*
van Harmelen et al., *Ontology-based information visualization*