Visualization Requirements for Knowledge-Based Systems

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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

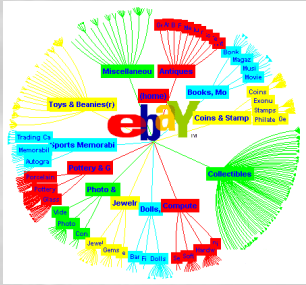
- External cognition
  - Internal and external representation and processing weave together in thought
- External cognitive aids can enhance cognition
  - Slide rule
  - For multiplication, use of paper reduces the time required by a factor of 5 (for most people)
  - An important class of external cognitive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

Information visualization

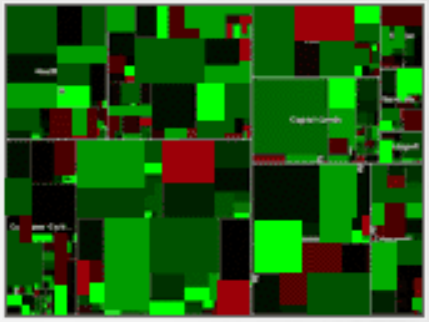
- Visualize --
  - To form a mental image or vision
- Visualization is done by humans, it is not done by a computer
  - But the use of computer supported, interactive, visual representations of abstract data can amplify cognition
- Visualizations can help us gain insight into data

Interactive Visualizations that make us smart...

Hyperbolic Trees

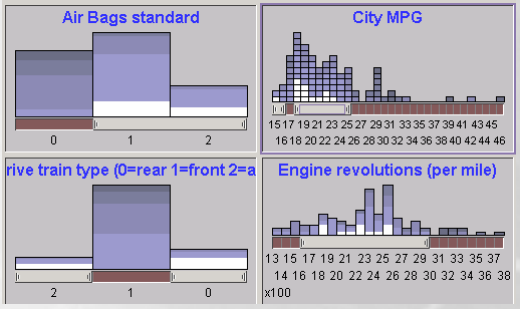


http://www.smartmoney.com/maps



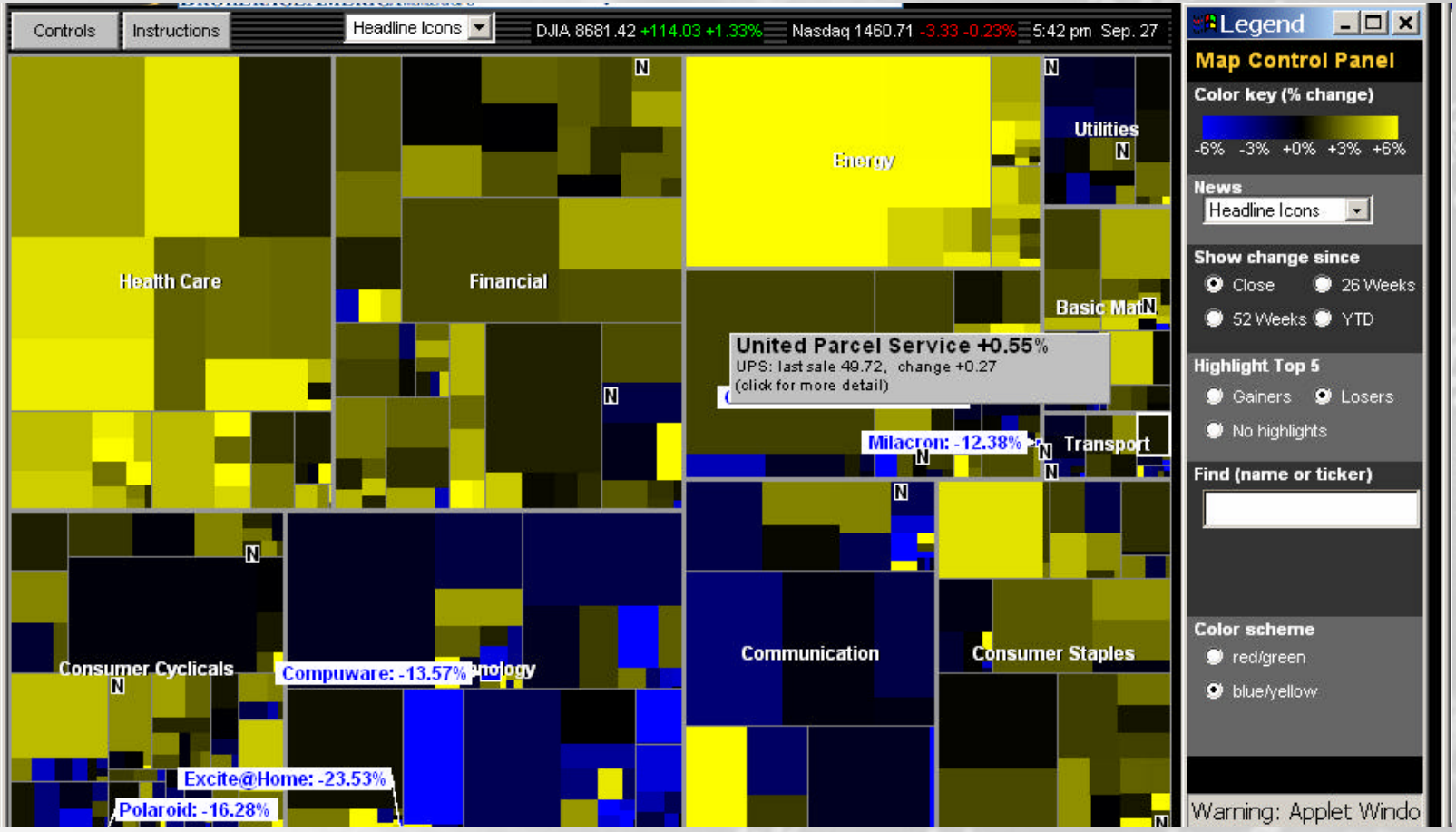
SHriMP Views

Attribute Explorer

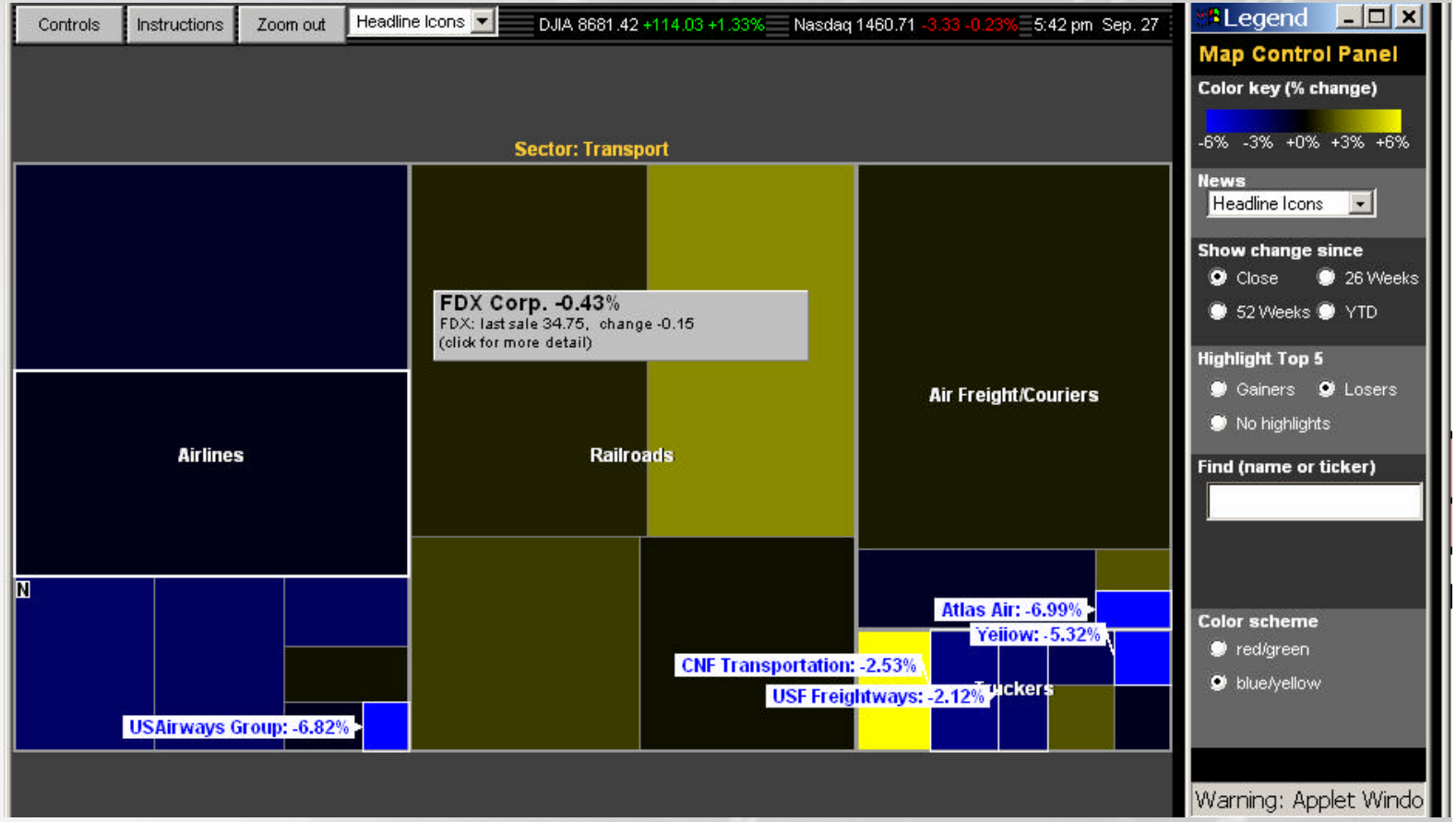


The Brain

An interactive visualization tool...

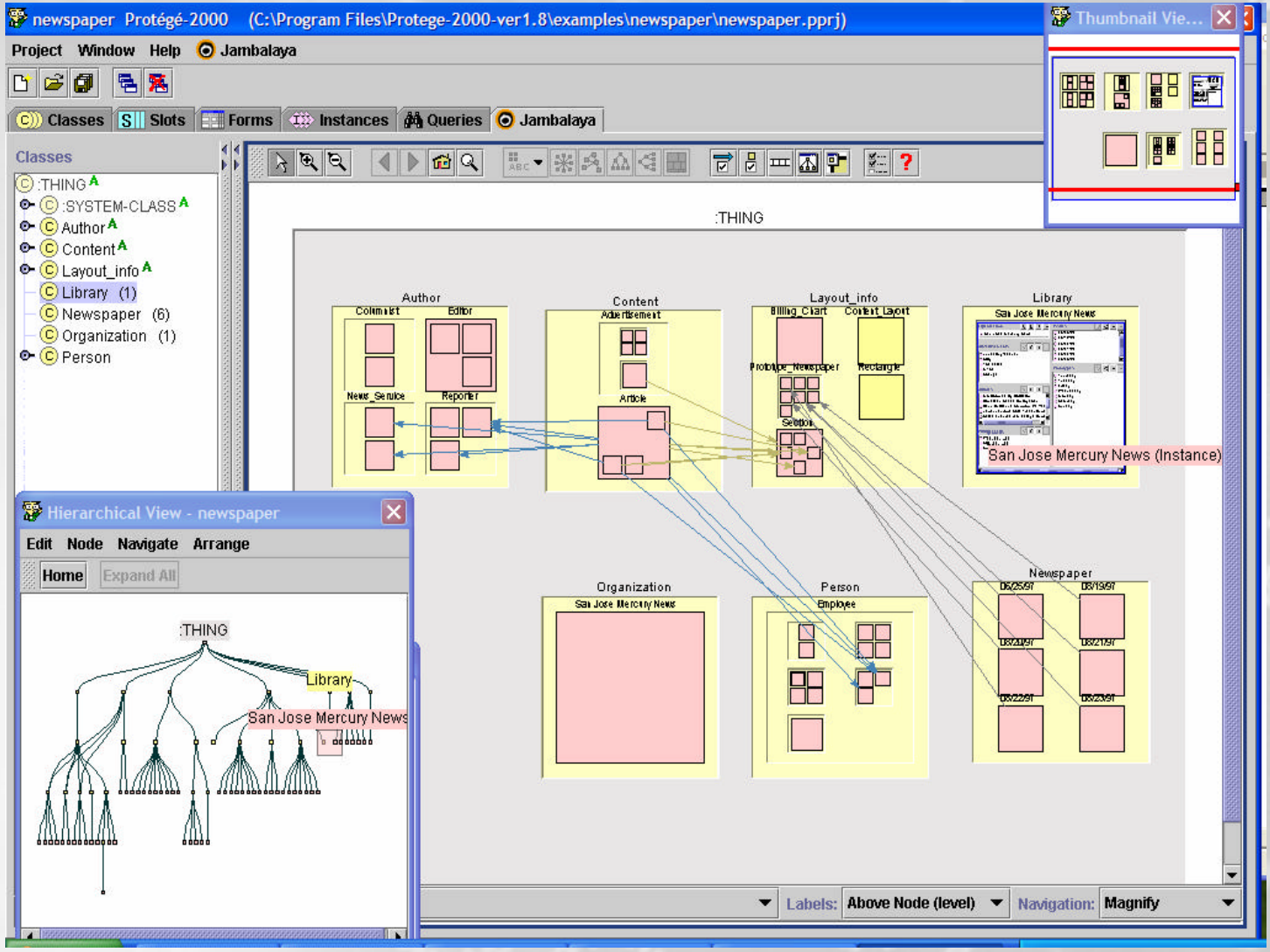


Zooming in to one sector



Zooming in to look at Airlines

Jambalaya


newspaper Protégé-2000 (C:\Program Files\Protege-2000-ver1.8\examples\newspaper\newspaper.pprj)
Project Window Help Jambalaya
Classes Slots Forms Instances Queries Jambalaya
Classes
:THING
:SYSTEM-CLASS
Author
Content
Layout_info
Library (1)
Newspaper (6)
Organization (1)
Person
Thumbnail Vie...
:THING
Author
Columnist
Editor
News_Service
Reporter
Content
Advertisement
Article
Layout_info
Billing_Chart
Content_Layout
Prototype_Newspaper
Rectangle
Section
Library
San Jose Mercury News
San Jose Mercury News (Instance)
Organization
San Jose Mercury News
Person
Employee
Newspaper
Hierarchical View - newspaper
Edit Node Navigate Arrange
Home
Expand All
:THING
Library
San Jose Mercury News
Labels: Above Node (level)
Navigation: Magnify

Who are the potential Users for visualization?

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

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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:

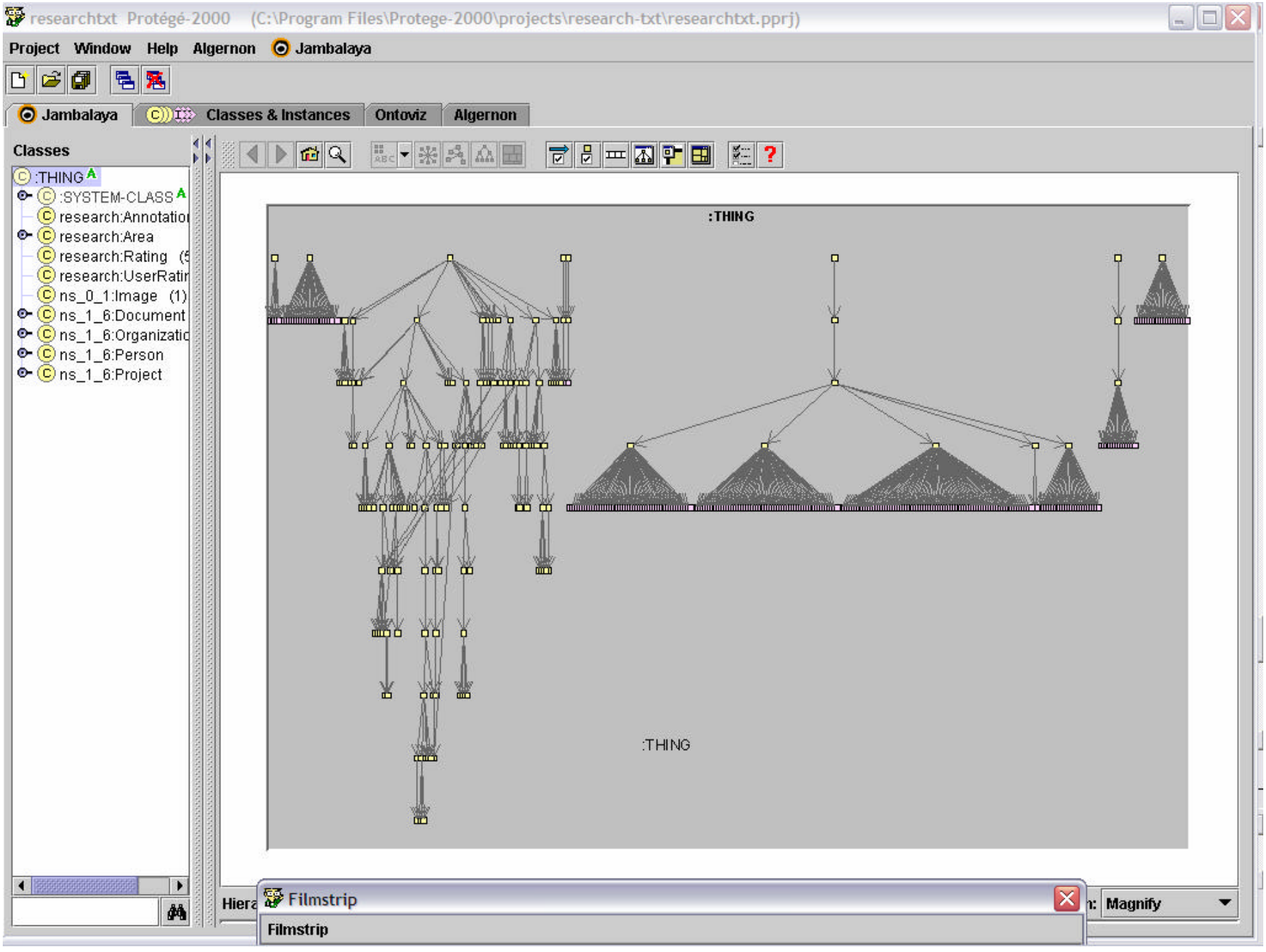
- Frequent use of ‘search’ dialog: repeated searches for same 2 terms, moving frequently between 2 focused areas
- Changing the hierarchical relationship to verify modeling: users needed to find concept of interest in the new hierarchy
- Understanding interactions between several relationships, transitive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

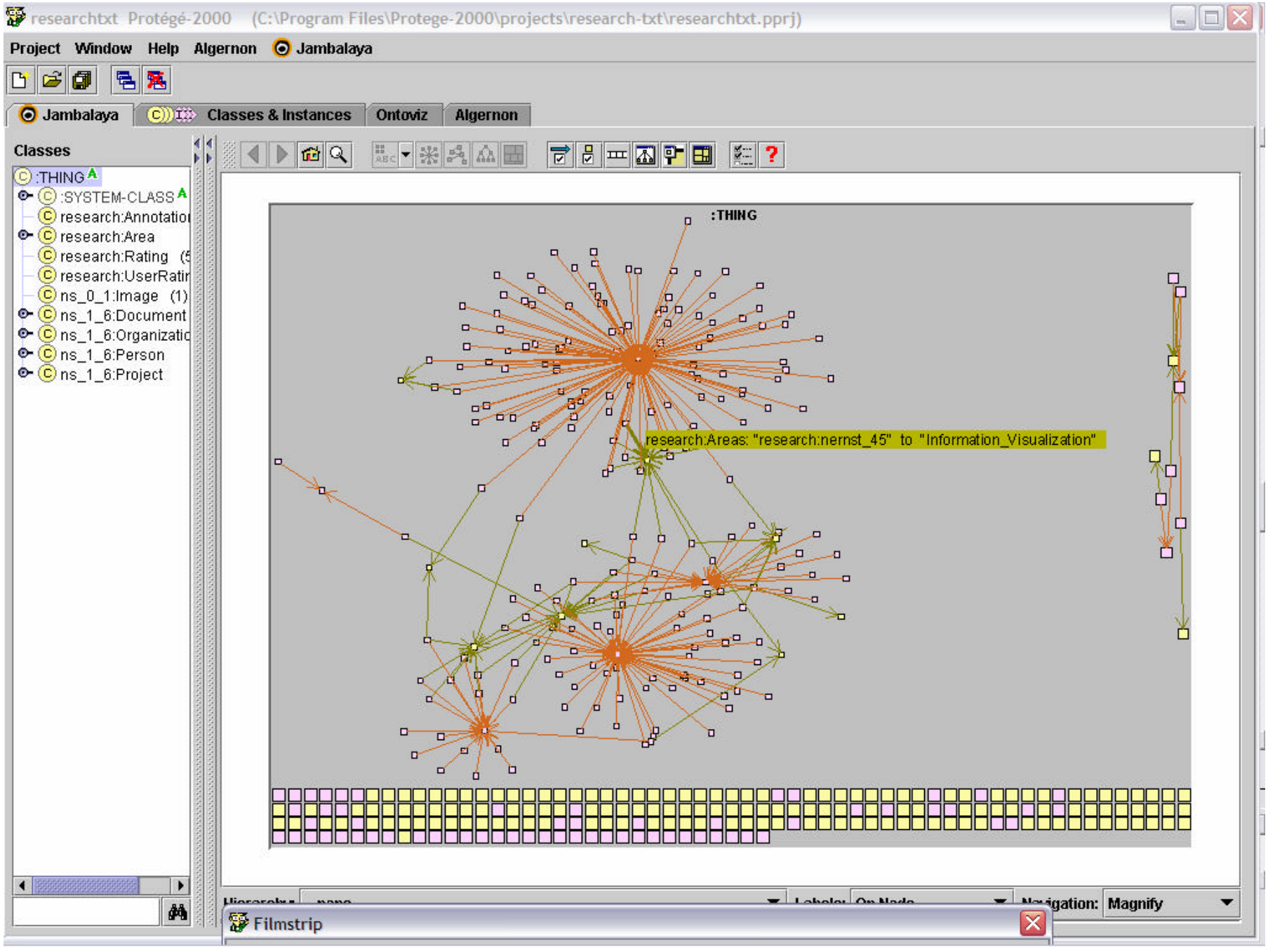
Case Study Experience

- 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?


researchtxt Protégé-2000 (C:\Program Files\Protege-2000\projects\research-txt\researchtxt.pprj)
Project Window Help Algernon Jambalaya
Jambalaya
Classes & Instances
Ontoviz
Algernon
Classes
:THING
:SYSTEM-CLASS
research:Annotatio
research:Area
research:Rating
research:UserRatin
ns_0_1:Image (1)
ns_1_6:Document
ns_1_6:Organizatio
ns_1_6:Person
ns_1_6:Project
:THING
:THING
Filmstrip
Filmstrip
Magnify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ns_1_6:Person
ns_1_6:Project
:THING
research:Areas: "research:nernst_45" to "Information_Visualization"
Navigation: Magnify
Filmstrip

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

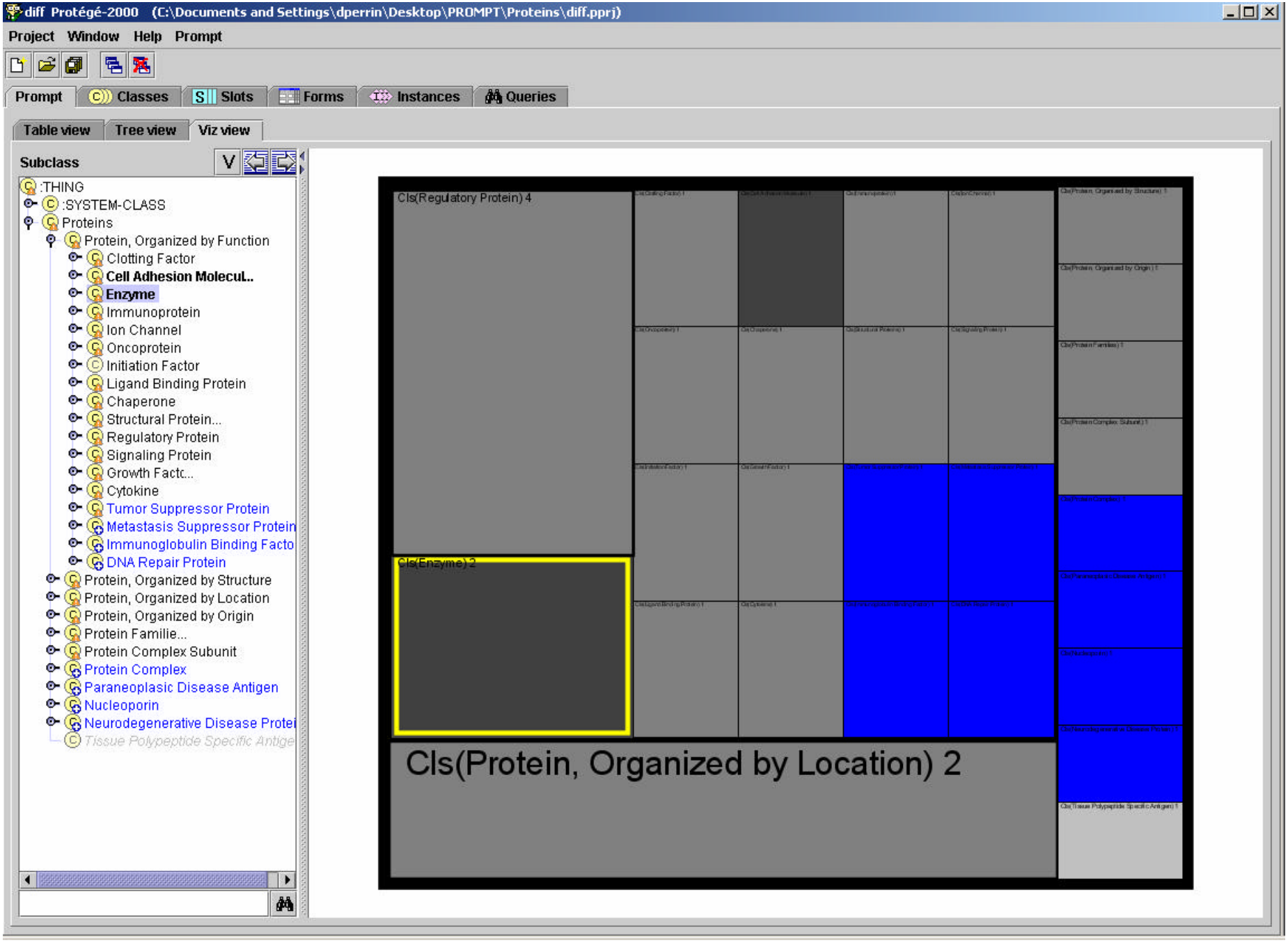
- Expert modelers: Author new concepts, refinement, reorganization, verification, identify reusable concepts
- Novice modelers: Understand existing model (structural level and patterns of instances and relationships)
- Team support: Awareness, resolving conflicts, communication
- Managers: monitoring (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


diff Protégé-2000 (C:\Documents and Settings\dperrin\Desktop\PROMPT\Proteins\diff.pprj)
Project Window Help Prompt
Prompt
Classes
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Instances
Queries
Table view
Tree view
Viz view
Subclass
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:SYSTEM-CLASS
Proteins
Protein, Organized by Function
Clotting Factor
Cell Adhesion Molecul..
Enzyme
Immunoprotein
Ion Channel
Oncoprotein
Initiation Factor
Ligand Binding Protein
Chaperone
Structural Protein...
Regulatory Protein
Signaling Protein
Growth Factc...
Cytokine
Tumor Suppressor Protein
Metastasis Suppressor Protein
Immunoglobulin Binding Facto
DNA Repair Protein
Protein, Organized by Structure
Protein, Organized by Location
Protein, Organized by Origin
Protein Familie...
Protein Complex Subunit
Protein Complex
Paraneoplasic Disease Antigen
Nucleoporin
Neurodegenerative Disease Protei
Tissue Polypeptide Specific Antige
Cls(Regulatory Protein) 4
Cls(Enzyme) 2
Cls(Protein, Organized by Location) 2

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Questions and Discussion

OWL Visualization

camera Protégé (C:\Program Files\Protege2\projects\camera.pprj)

Project Edit Window Help Jambalaya

OWLClasses | Slots | Forms | Instances | RDQL Queries | Jambalaya

Classes

- :THING
- :SYSTEM-CLASS
- Range
- PurchaseableItem
- BodyWithNonAdjustableShutte
- Window (2)
- Viewer
- Money
- SLR

Arc Filter - camera

- :FROM
- :OWL-DISJOINT-CLASSES
- :OWL-LOGICAL-OPERANDS
- :OWL-SLOT-EQUIVALENT-SLC
- :OWL-SLOT-SOME-CLASSES
- :TO
- Template: :DIRECT-INSTANCES
- Template: :DIRECT-SUBCLASS
- Template: :FROM
- Template: :OWL-DISJOINT-CL

Display All | Hide All

Switch to Advanced Mode

Root

:OWL-ANONYMOUS-ROOT

WindowPurchaseableItem

∀ body BodyWithNonAdjustableShutterSpeed

Body ⊓ (shutter-speed = 0)

{ThroughTheLens WindowOnTopOfCamera}

viewFinder ∋ ThroughTheLens

Camera ⊓ (viewFinder ∋ ThroughTheLens)

Money

:OWL-LOGICAL-OPERANDS: "Camera ⊓ (viewFinder ∋ ThroughTheLens)" to "Camera"

Large-Format

WindowOnTopOfCamera

Body shutter-speed = 0

BodyWithNonAdjustableShutterSpeed

ThroughTheLens

Camera

Viewer

SLR

Range

Lens

Digital

Hierarchy: -- none -- | Labels: Above Node (level) | Navigation: Magnify

Related work:

E. Rogers, *Diffusion of Innovations*

Gary Kwok-Chu Ng, *Visualization Techniques for Ontology Development*

van Harmelen et al., *Ontology-based information visualization*

CFP: Visualizing Information for Knowledge Engineering Workshop at KCAP 2003, October 23-25.

See http://www.cs.uvic.ca/~nernst/vike for more details