A Knowledge Task-Based Framework for Design and Evaluation of Information Visualizations

> Robert Amar John Stasko

GVU Center Georgia Institute of Technology





### **Representation Primacy**

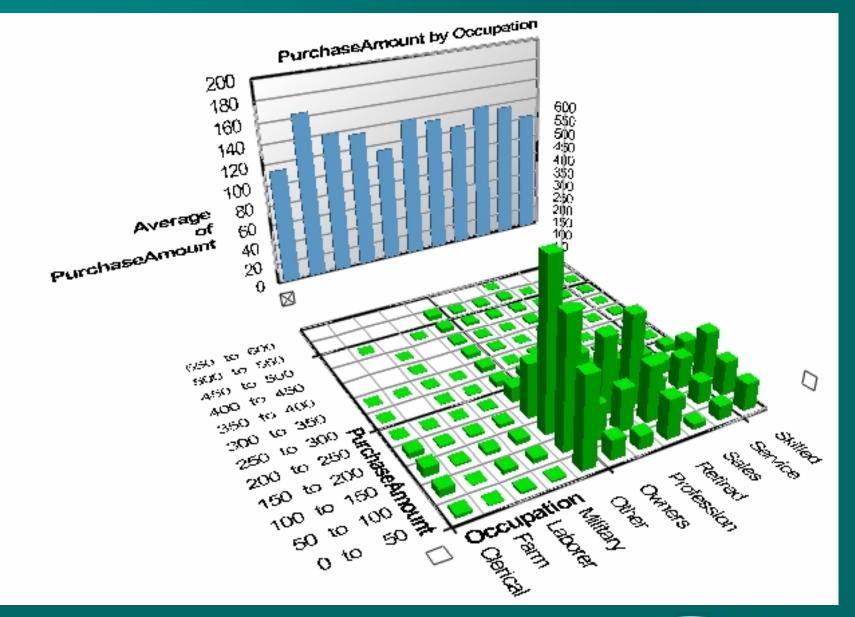
On the whole, InfoVis has been concerned more with

faithfully representing data

than with

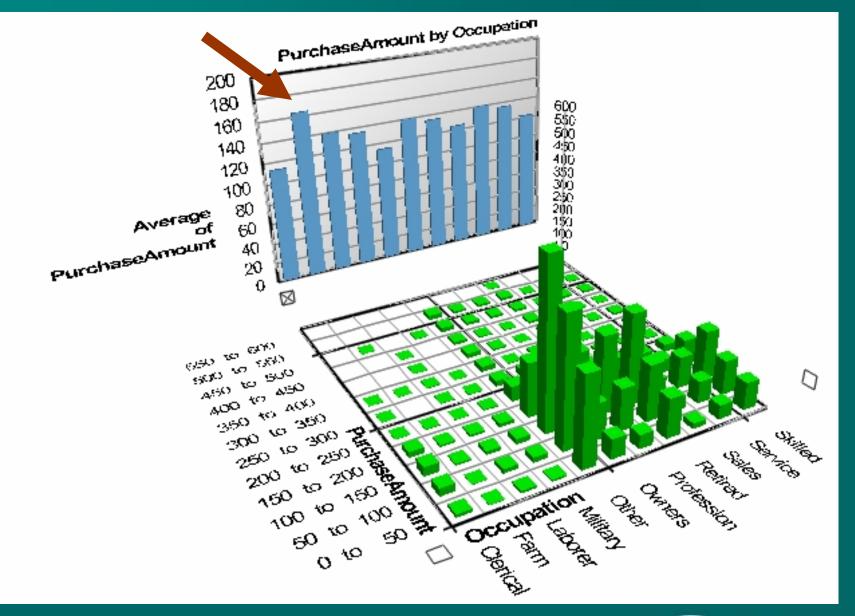
facilitating analytic processes.





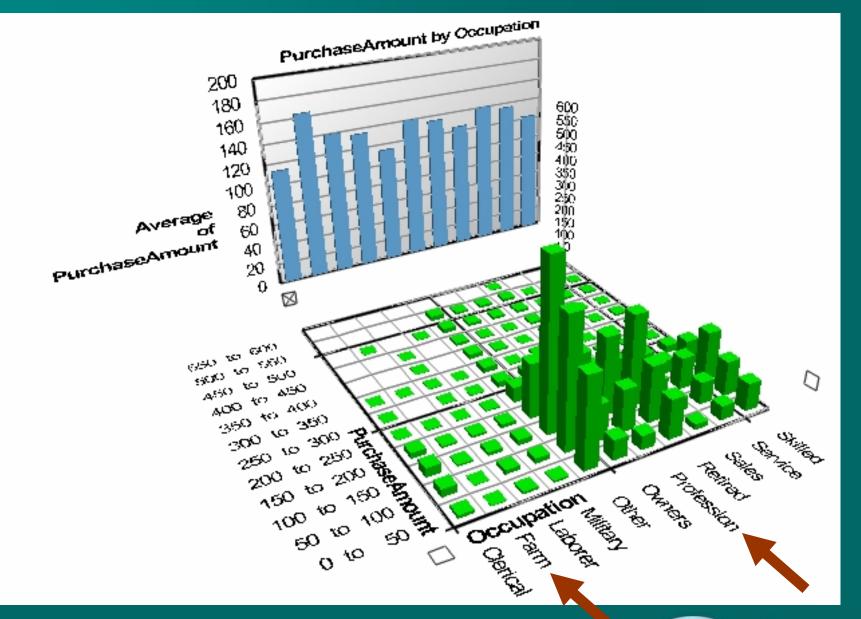
SeeIT (Visible Decisions) Grocery Store Spending Survey Visualization





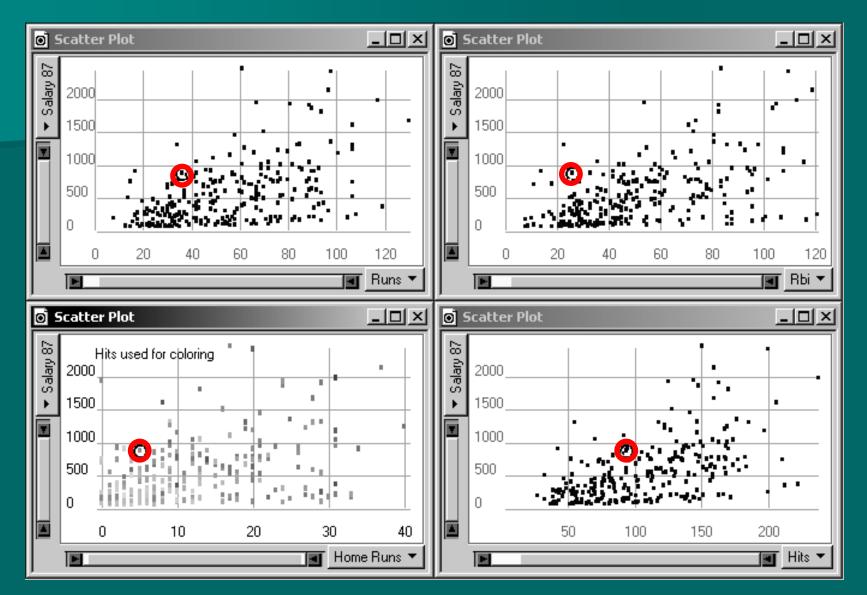
SeeIT (Visible Decisions) Grocery Store Spending Survey Visualization



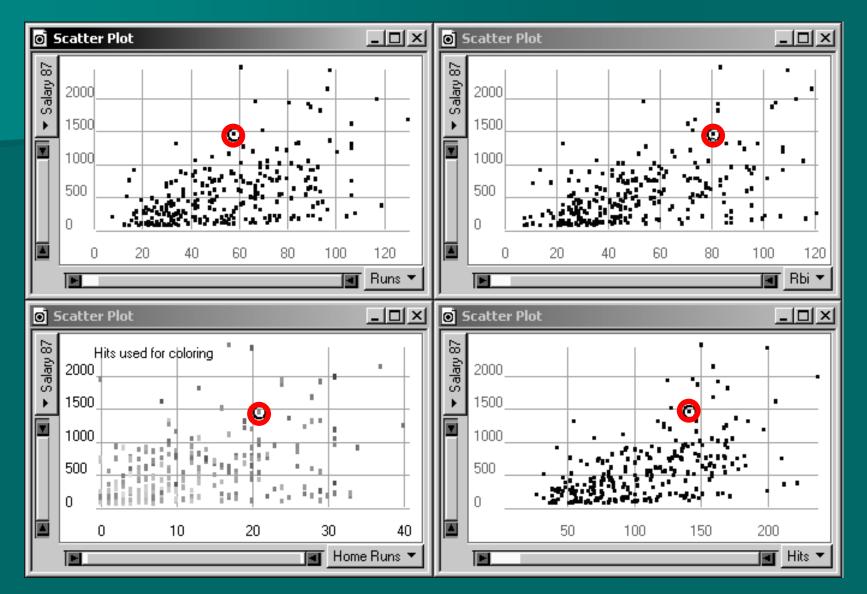


SeeIT (Visible Decisions) Grocery Store Spending Survey Visualization

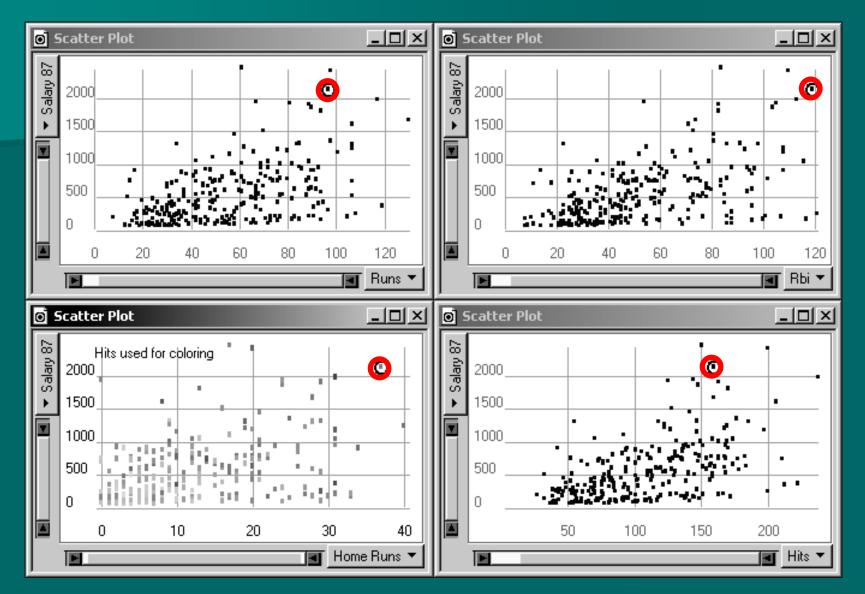




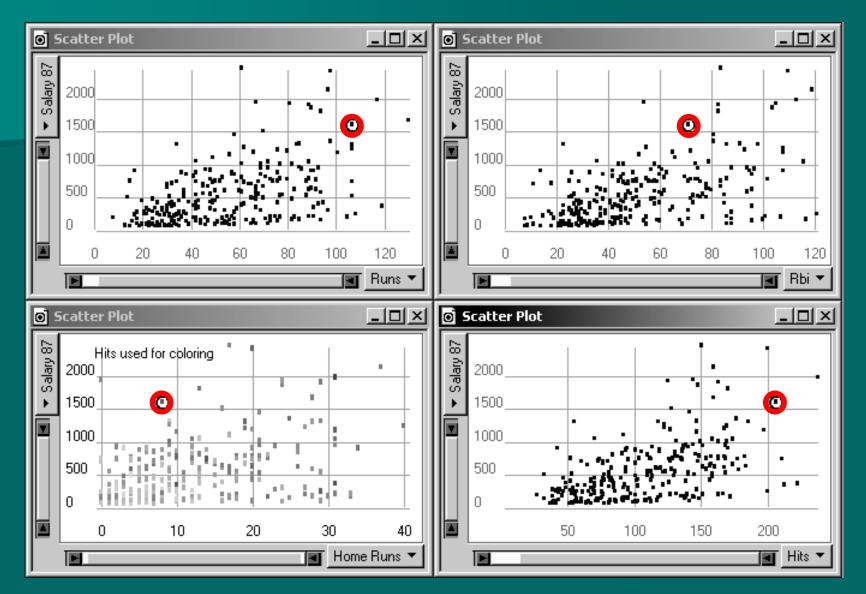




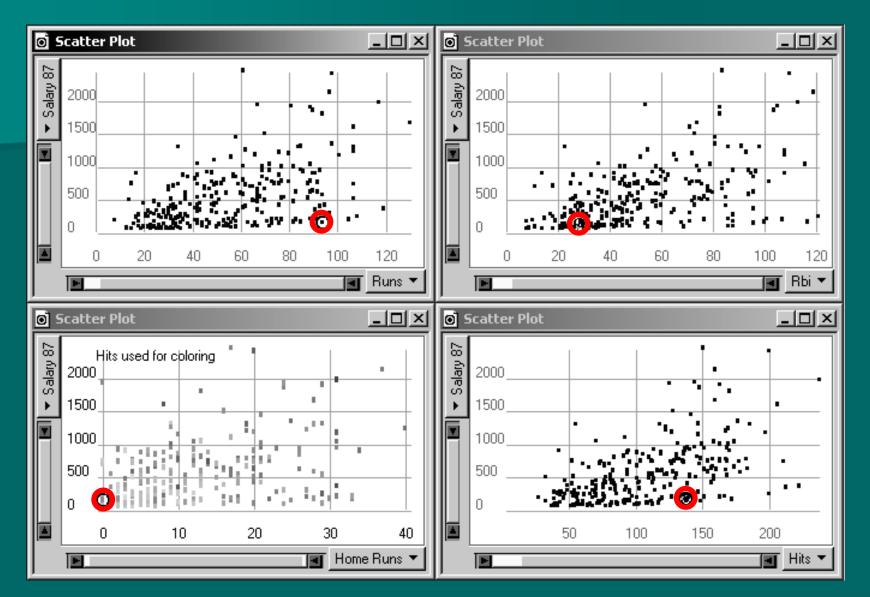














### Not Just Information Anymore

"[Managers] *think* they understand the relationships between cause and effect in their organizations. But in fact, the links between actions and results are infinitely more complicated than most managers suspect..."

David Freedman Harvard Business Review

### Can we help?



### **User Analytic Goals**

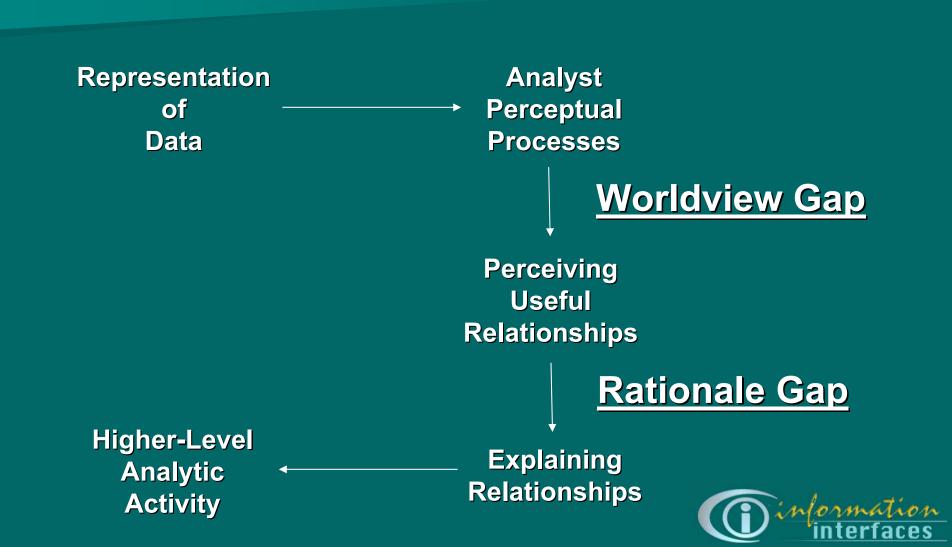
Complex decision-making

- Learning a domain
- Identifying the nature of trends

Predicting the future

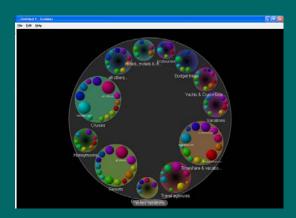


### The Analytic Gaps



### Bridging the Gaps

 Six knowledge tasks for designers for bridging analytic gaps
 – Grouped according to which gap they fill (worldview, rationale)



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### Knowledge Task Summary

Worldview Tasks "Do we show the right things to the user?"

- 1. Domain parameters
- 2. Multivariate explanation
- 3. Hypothesis confirmation

Rationale Tasks "Will the user believe what they see?"

- 1. Expose uncertainty
- 2. Concretize outcomes
- 3. Formulate cause/effect



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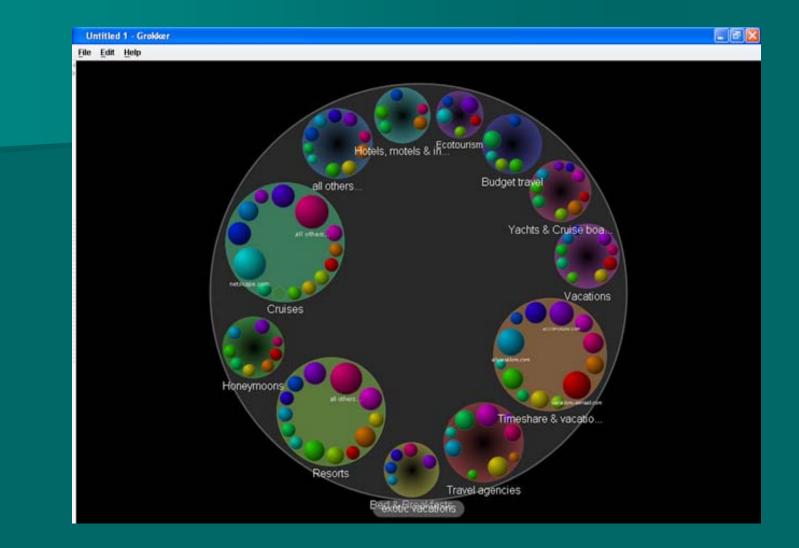


Worldview Task 1: Determine Domain Parameters

Facilitate acquisition and transfer of knowledge and/or metadata about domain parameters



#### Worldview Task 1: Determine Domain Parameters



Grokker 2 (Groxis) WWW Map for "Exotic Vacations"

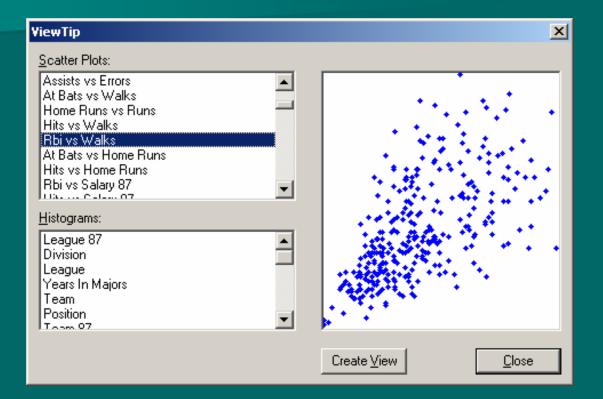


Worldview Task 2: Multivariate Explanation

Support the discovery of useful correlative models – especially those involving many variables



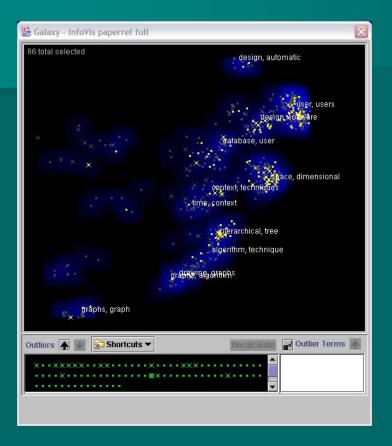
#### Worldview Task 2: Multivariate Explanation

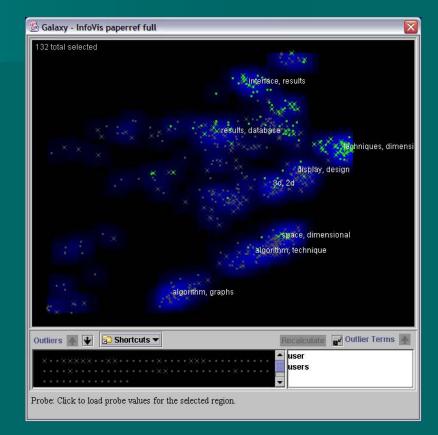


**Spotfire Pro 4.0** View Tips



#### Worldview Task 2: Multivariate Explanation





#### **IN-SPIRE (PNNL)** Dynamically Adjustable Categorization



Worldview Task 3: Confirm Hypotheses

Provide facilities for users to formulate and confirm hypotheses about the data set



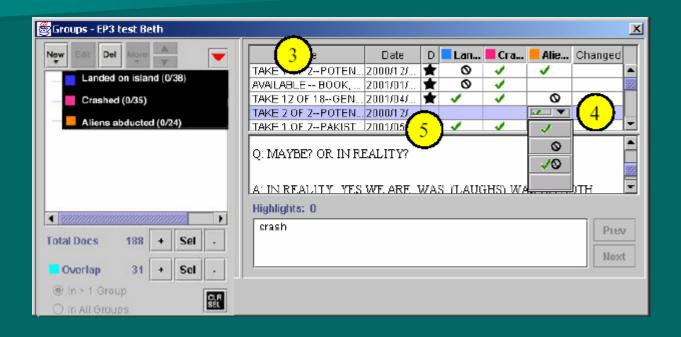
#### Worldview Task 3: Confirm Hypotheses

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InfoZoom 3.71 (HumanIT) Retail Data Visualization



#### Worldview Task 3: Confirm Hypotheses



**IN-SPIRE (PNNL)** Hypothesis Verification



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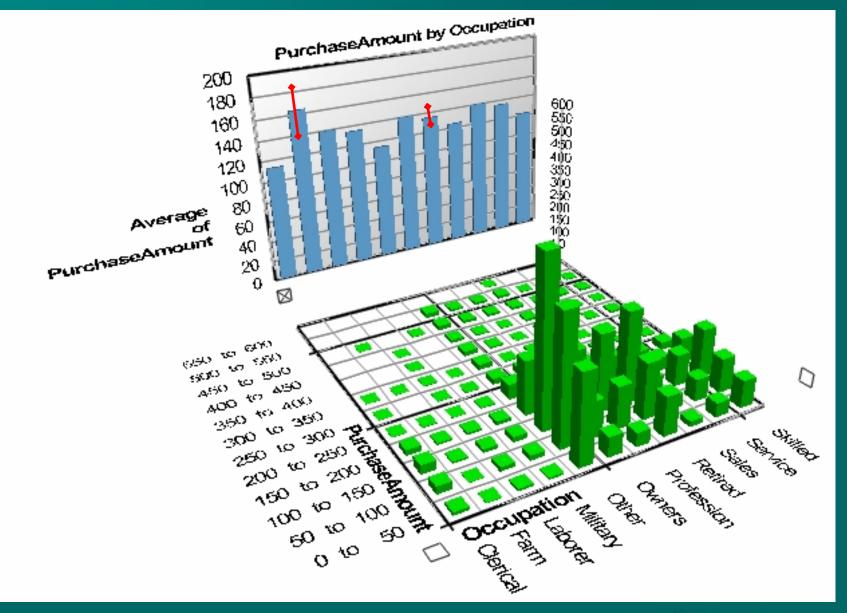


Rationale Task 1: Expose Uncertainty

Expose the sources and effects of uncertainty in data measures and aggregations



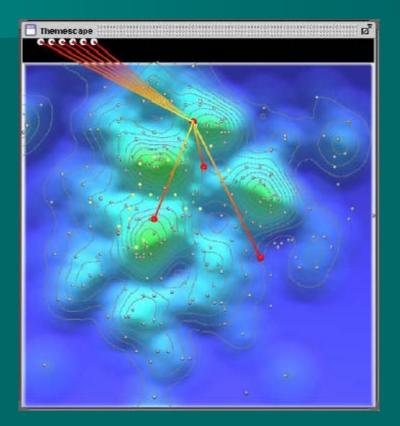
#### Rationale Task 1: Expose Uncertainty



SeeIT (Visible Decisions) Grocery Store Spending Survey Visualization, Augmented



#### Rationale Task 1: Expose Uncertainty



**ThemeExplorer (Diakapoulos et al., InfoVis '04)** Explicitly Representing Uncertainty in a Themescape

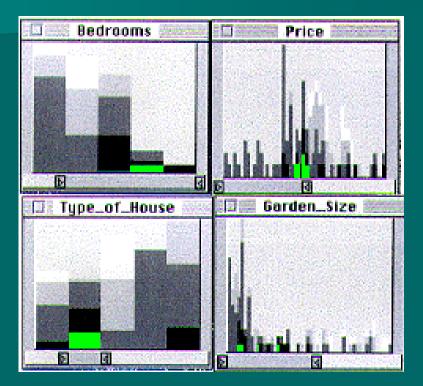


Rationale Task 2: Concretize Relationships

Show the elements comprising relationships and translate into real-world outcomes



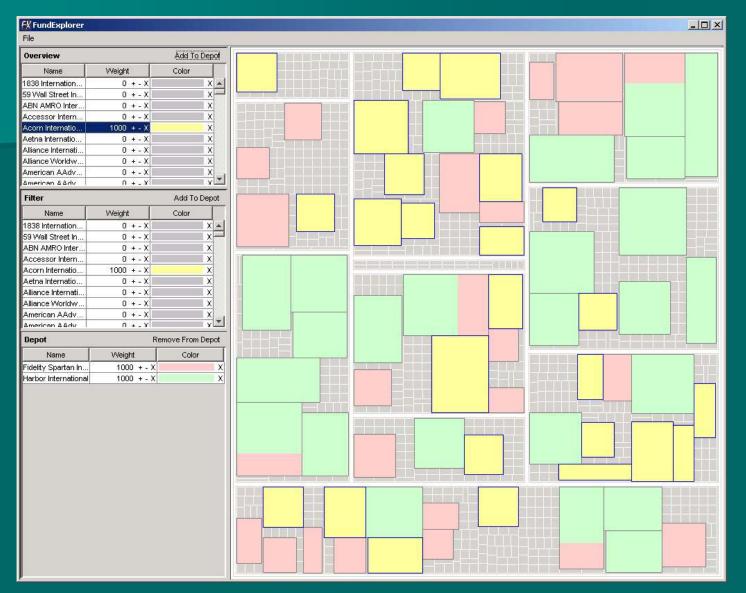
#### Rationale Task 2: Concretize Relationships



Attribute Explorer (Tweedie et al., CHI '94) House Searching



#### Rationale Task 2: Concretize Relationships



**FundExplorer (Csallner et al., InfoVis '03)** Mutual Fund Diversification Tool

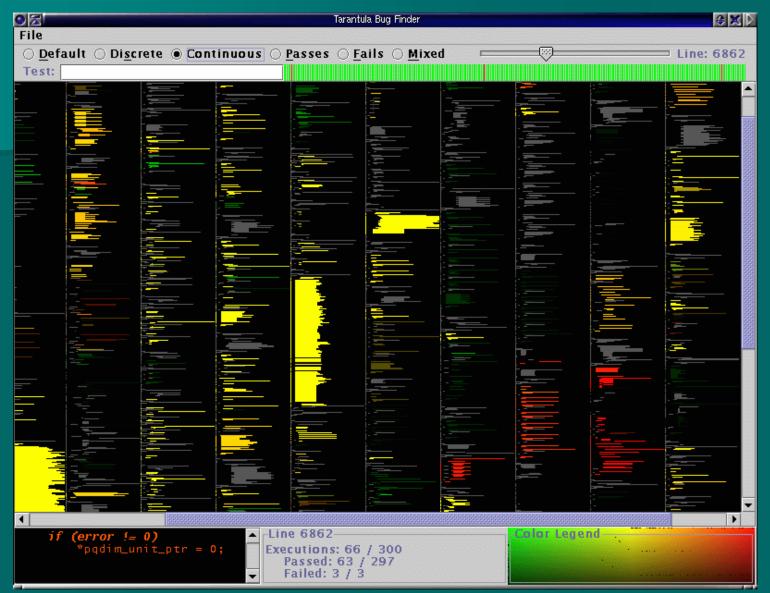


## Rationale Task 3: Formulate Cause and Effect

Clarify the source and nature of possible causations



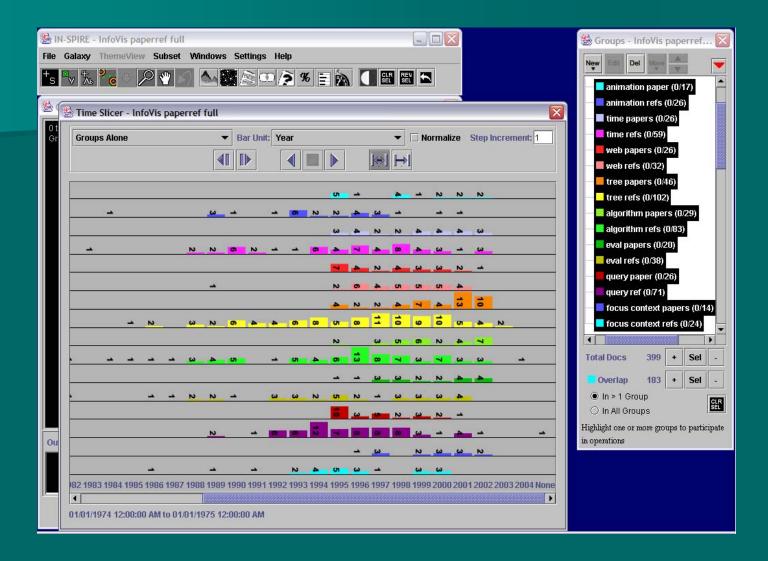
#### Rationale Task 3: Formulate Cause and Effect



Tarantula (Eagan et al., InfoVis '01) Software Fault Visualization



#### Rationale Task 3: Formulate Cause and Effect



**IN-SPIRE (PNNL)** Time Evolution of Document Themes



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### Using the Tasks

Generate novel user and system subtasks
Identify shortcomings in data
Discover useful representations
Heuristic evaluation of analytic capability



### **Future Directions**

# Conduct case studies of design and evaluation

Rethink lower-level tasks and task taxonomies in an analytic light



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