Towards Actionable Visualisation in Software Development

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Background

Why is software visualisation not widely used in software development?

- Out of touch with developer needs

Prior Work

- Taxonomy and surveys
- Framework to assess tools
- Help users understand tools

Approach

- **Map** needs to solutions in a problem domain
- finely-grained **developer needs**

Eg. Where is this method called?

Question → Problem Domain → Visualisation Tool

Research Questions

What are the goals of this literature review?

- **RQ1:** What are the characteristics of visualisation techniques that support developer needs?
- **RQ2:** How well are various problem domains supported by visualisation?

Filter 346 → 65 design study papers

Collection

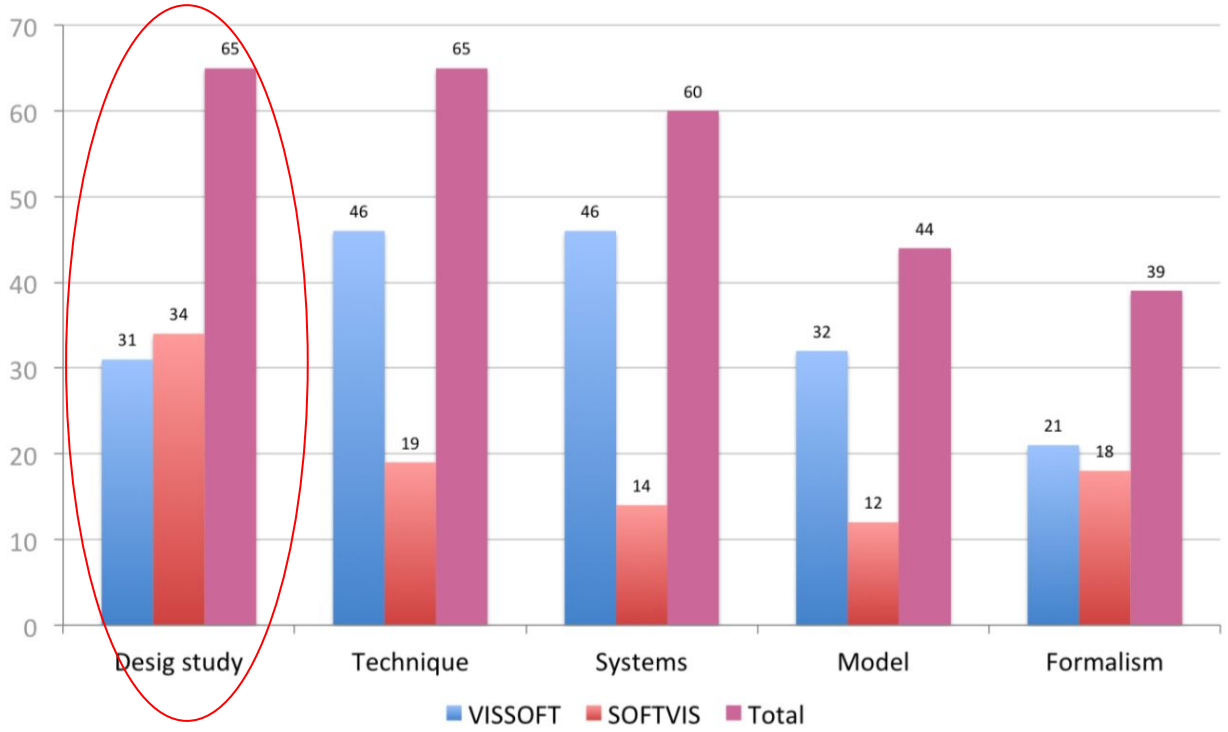

Figure 2. Classification of the 273 SOFTVIS/VISSOFT papers by type.

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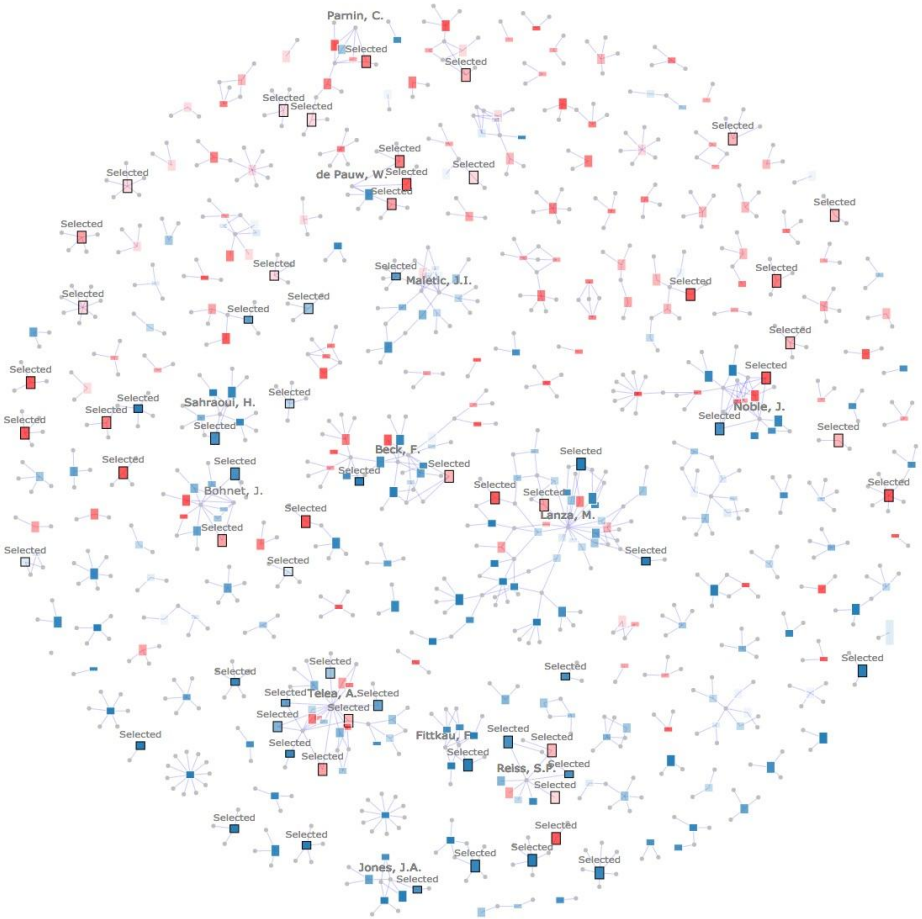
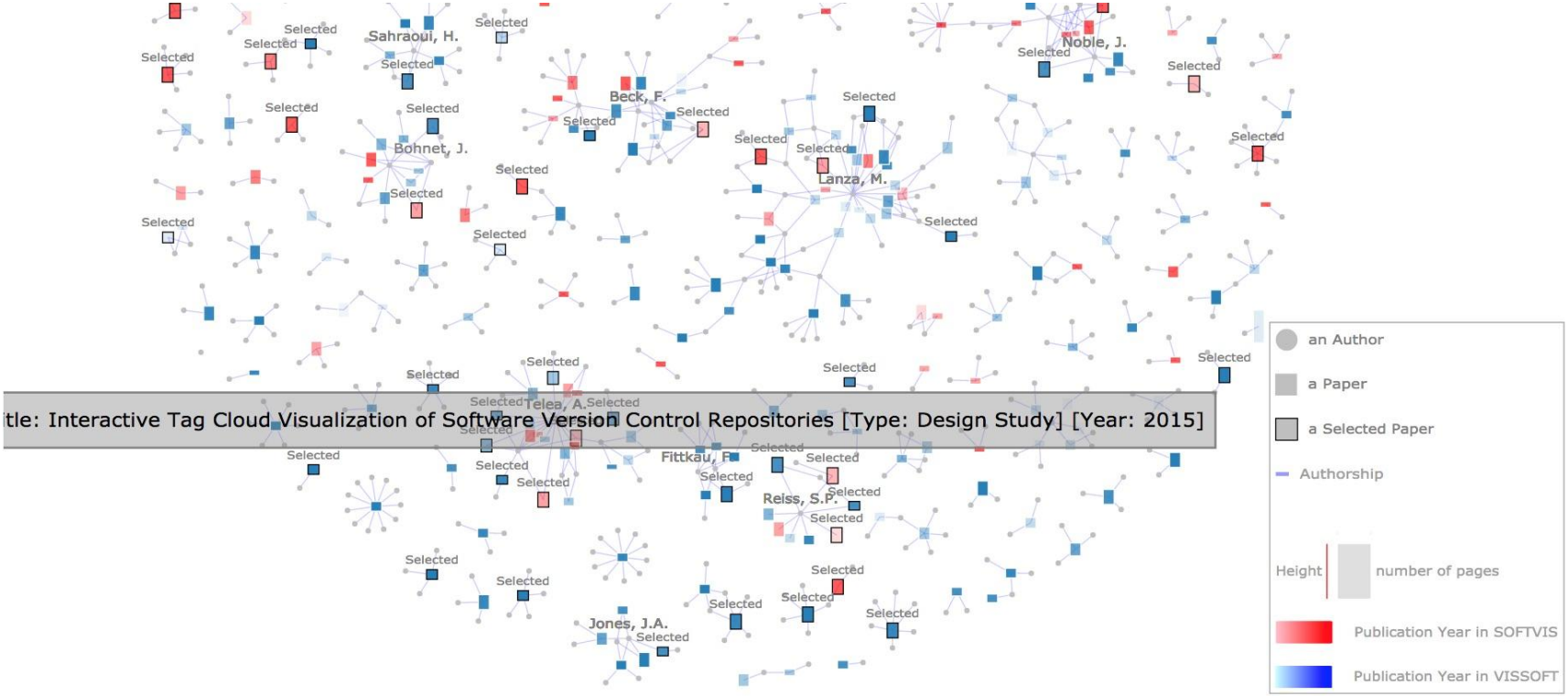
Universe



http://scg.unibe.ch/research/visualisation-review

Universe



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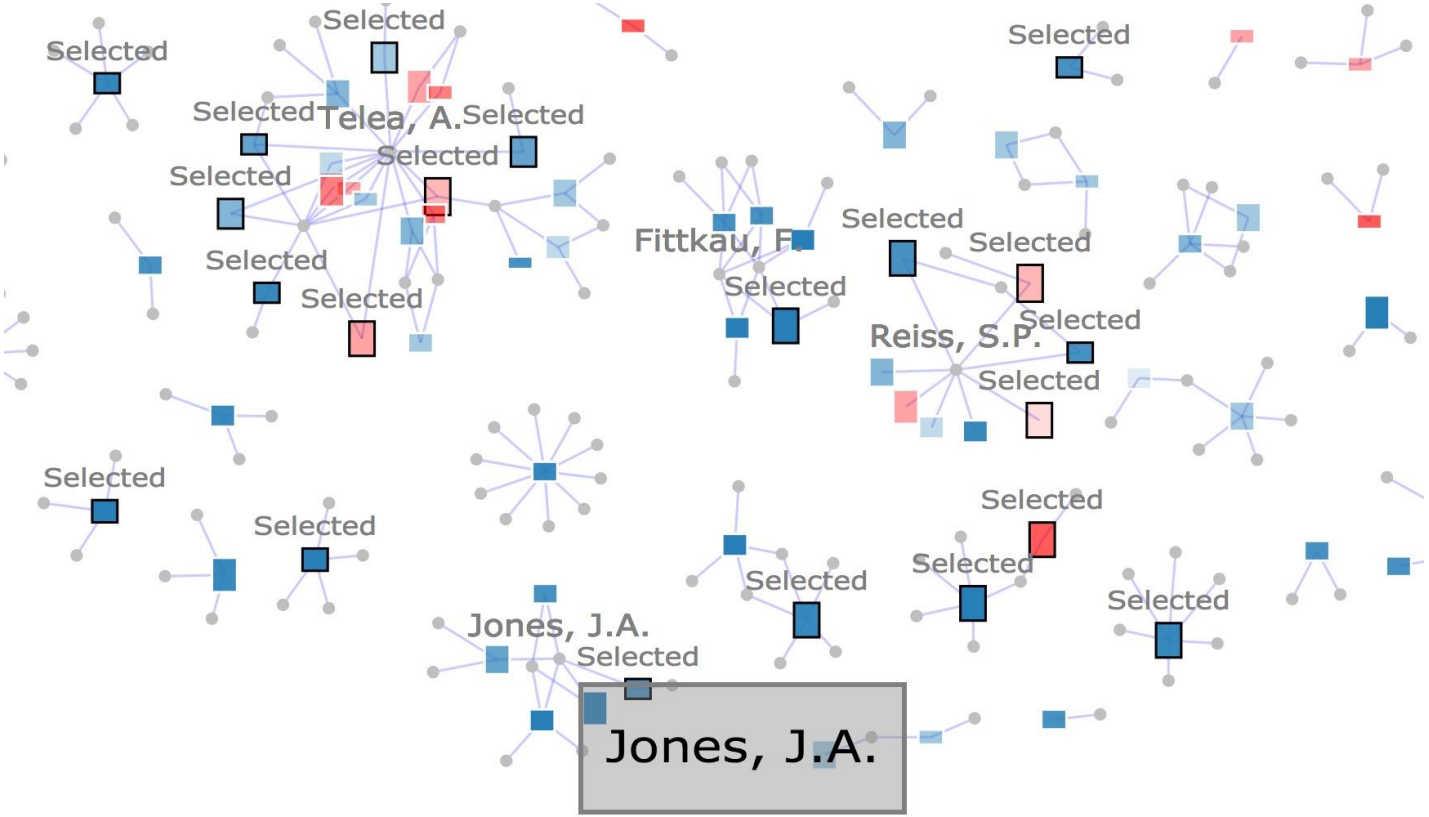


http://scg.unibe.ch/research/visualisation-review

Data Extraction

Attributes

Data Extraction

- **Evaluation:** Task, **Need**, Audience, Data Source
- **Implementation**: **Representation**, Medium, Tool

How?

- Frequent terms
- Questions
- Goals

Extraction - Need

75% stated explicit questions (need)

How were needs identified when questions weren't asked?

How many needs?

Table VII
VISUALISATION TOOLS AND NEEDS INTRODUCED BY PAPERS.

Questions and Goals that Motivate Visualisation
to get a better insight of the control or data flow inside a program
are there modules or self-contained computations?
how the computation reached that result?
which applications are duplicated on multiple nodes?
which developers collaborate?
what happened to our system recently?
how different are work queues on different threads?
to check guidelines and re-engineering of existing software
how the GUI and the underlying code are related?
how a specific code location can be reached via function calls?
how are clones distributed in system structure?
how the system is actually organized?
what test files changed compared to source files at the beginning of a project?
how the dependency relation between a system and its dependencies evolves?
what other programmers are working on?
what are coworkers working on?
what kind of changes have been made?
how many versions contain annotation classes?
where and when a thread waits or releases?
how much time is spent blocking on a specific lock?
when, how, by whom, and why was this code changed or inserted?

Needs Classification

- Classify questions based on general set

- Filter **needs** (finely-grained) within **domain** (coarsely-grained)

Table IX
CLASSIFICATION OF PAPERS BASED ON THE NEEDS.

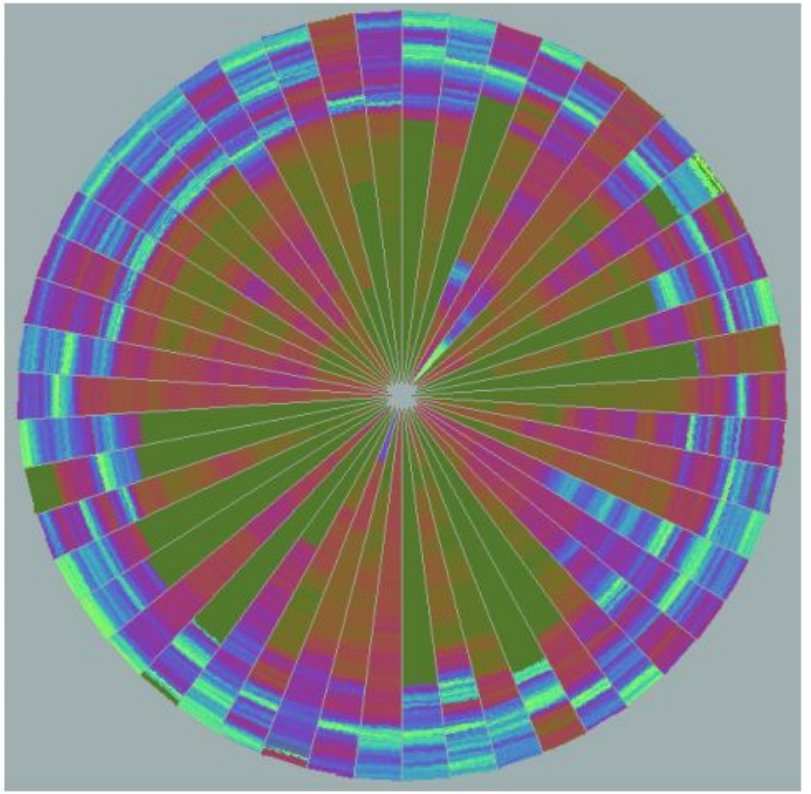
Changes	Building and branching
	Debugging
	History
	Implementing
	Implications
	Policies
	Rationale
	Refactoring
	Teammates
	Testing
Elements	Concurrency
	Intent and implication
	Location
	Method properties
	Performance
Element relationship	Architecture
	Contracts
	Control flow
	Data flow
	Dependencies
	Type relationships

Towards Actional Visualization in Software Development

Extraction - Representation

Dense Pixel

- From Keim’s Taxonomy
- Massive sets of data



Dense Pixel Displays: Circle Segments Technique

from Keim

Extraction - Representation

Transform

- Node links
- Explore relationships

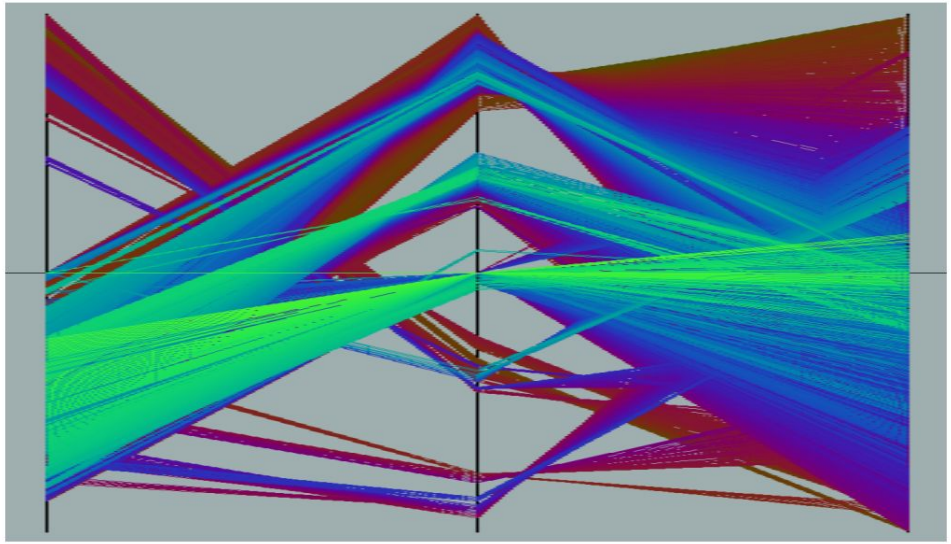


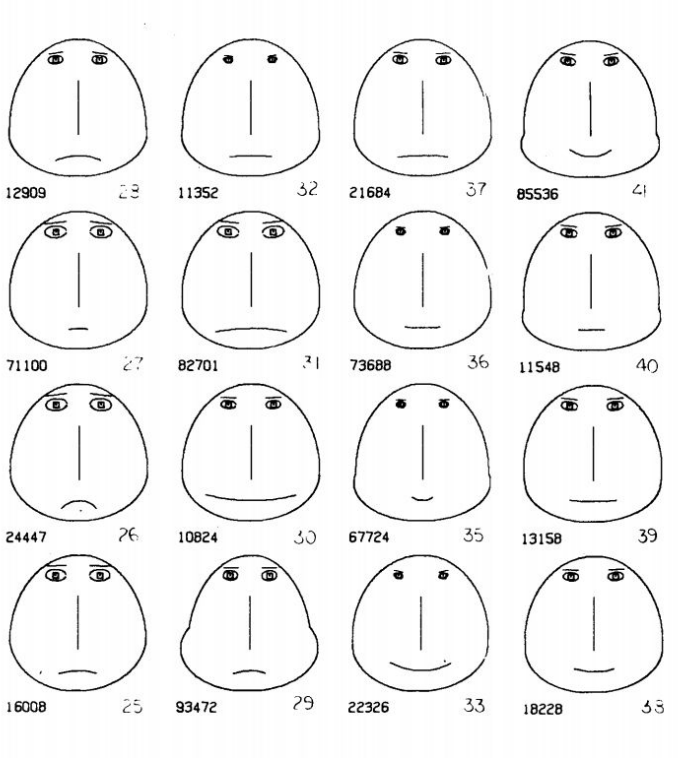
Fig. 2. Parallel Coordinate Visualization ©IEEE

from Keim

Extraction - Representation

Iconic

- Attribute values mapped to icon features



H. Chernoff, “The use of faces to represent points in kdimensional space graphically,” Journal Amer. Statistical Association, vol. 68, pp. 361–368, 1973.

Extraction - Representation

Stacked

- Hierarchical displays
- tree maps

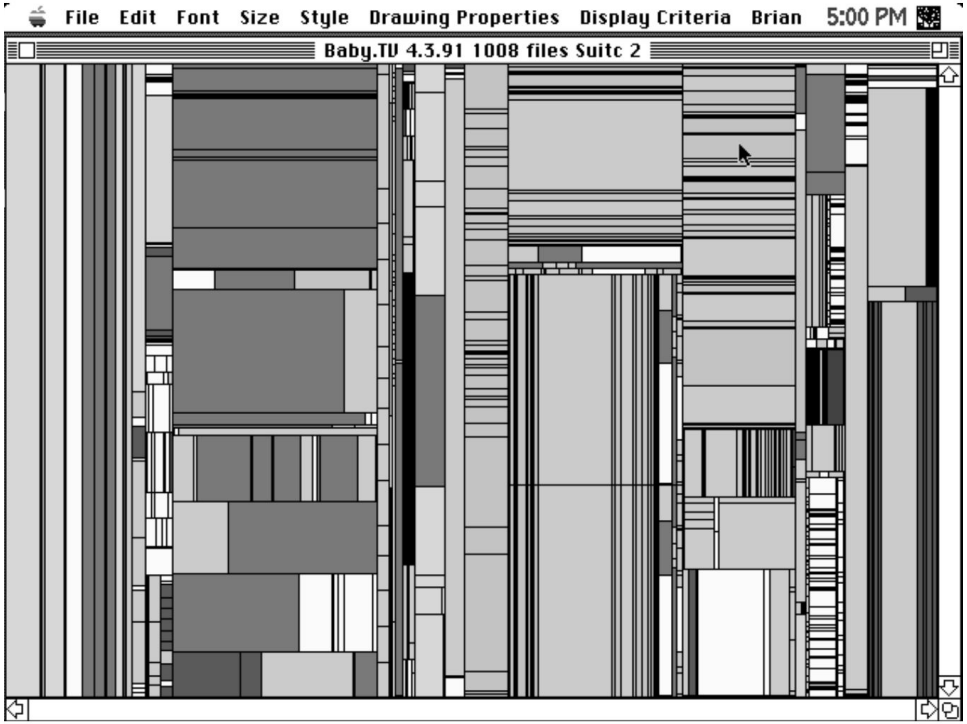


Figure 8. Treemap with 1000 Files

B. Shneiderman, “Tree visualization with treemaps: A 2D space- filling approach,” ACM Transactions on Graphics, vol. 11, no. 1, pp. 92–99, 1992.

Extraction - Representation

Standard

- Bar charts
- X y plots

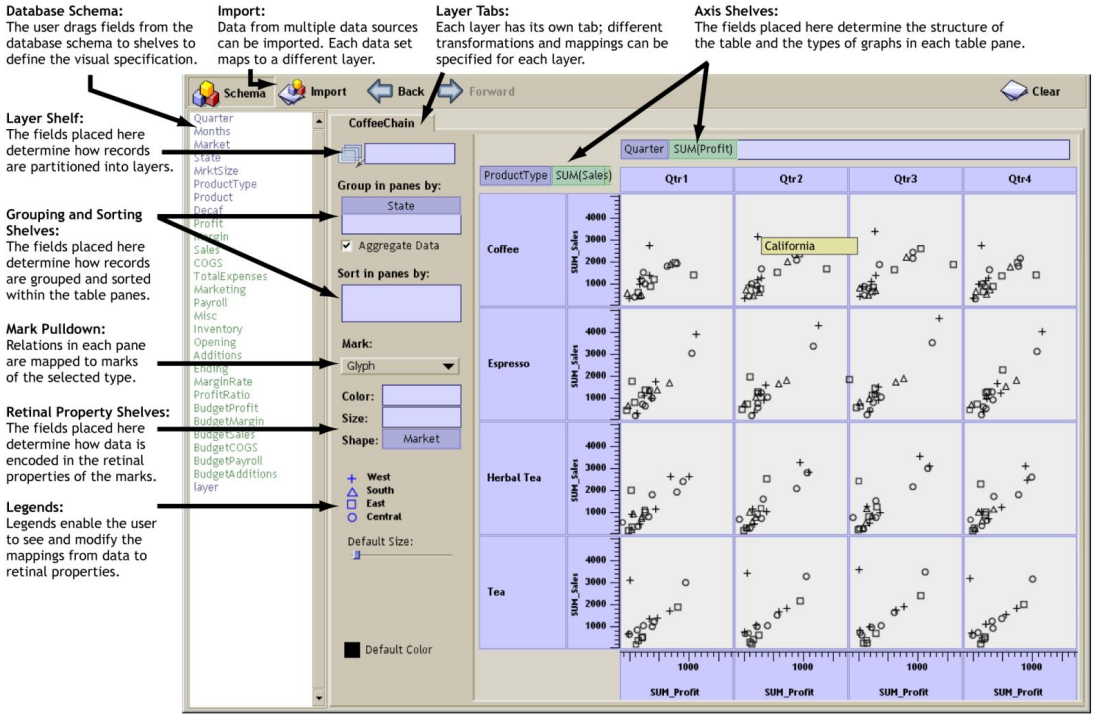


Figure 1: *The Polaris user interface. Analysts construct table-based displays of relational data by dragging fields from the database schema onto shelves throughout the display. A given configuration of fields on shelves is called a visual specification. The specification unambiguously defines the analysis and visualization operations to be performed by the system to generate the display.*

D. Tang C. Stolte and P. Hanrahan, “Polaris: A system for query, analysis and visualization of multi-dimensional relational databases,” Transactions on Visualization and Computer Graphics, 2001.

Conclusion

Analysis of Results

Problem Domain Mapping

Space filled (hierarchical)

- **what: data** multiple attribs
- **what: derived** sum of papers
- **how: encode** area marks and containment for hierarchy and visualization category, rectilinear layout
- **how: reduce** aggregate
- **what: task** view distribution **RQ1**

Figure 6. Mapping type of visualisation used by studies to problem domains.

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Problem Domain Mapping

Double Bar Chart

- **what: data** categorical and quantitative
- **what: derived** sum of papers and needs
- **how: encode** line marks, color
- **how: reduce** aggregate
- **what: task** compare problem domain with needs **RQ2**

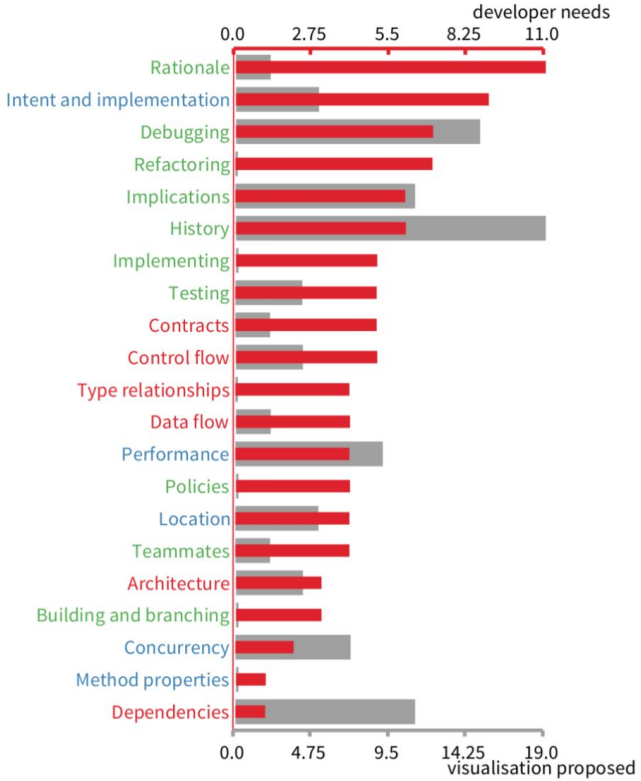

Figure 7. Comparing the degree of importance of developer needs vs. their visualisation support by problem domain.

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Conclusion

Covered:

- History, performance, concurrency, dependencies

Call to action:

- Rationale, Intent, Implementation, Refactoring
- Metaviz (demo at https://www.youtube.com/watch?v=qe5qiS1cmzs

Critique

Threats to Validity

- Bias in paper selection
- Data extraction

Others not mentioned

- ‘primary contribution’ selection
- single source for developer needs (Latoza)

Questions?