Reminders

• Next class’s reading response
  - Two papers on visualization & provenance
  - Only need to choose one

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Power of Visualization

\begin{align*}
&\text{Graph 1: } y_1 = x_1 \\
&\text{Graph 2: } y_2 = x_2 \\
&\text{Graph 3: } y_3 = x_3 \\
&\text{Graph 4: } y_4 = x_4
\end{align*}

[F. J. Anscombe]
Supporting the Analytical Reasoning Process in Information Visualization

Y. B. Shrinivasan, J. J. van Wijk

Presented by: Surya Kiran Juthuka
Sensemaking

• Seeking/finding/gathering information
• Organizing/analyzing information
• Forming new knowledge and **informing further action**
Data Analysis and Visualization

Data → Computation → Data Products → Perception & Cognition → Knowledge

Specification

[Modified from Van Wijk, Vis 2005]
• Data analysis and visualization are **iterative** processes
• Exploration is important in understanding data
Figure 6. The Aruvi prototype. The alphabet labels describe the interaction interfaces of the prototype explained in the Prototype section. The numeric labels are used to describe an analysis process presented in the Use Case section.

The alphabet interface allows the analyst to compare the digital camera attributes for different years. The user plots the number of cameras with a specific attribute value, such as Megapixel range increased every year until 2005 and has remained static since then. The user records the findings in the knowledge view using a mind map. The mind map is a diagram used to represent ideas linked to and arranged radially around a central idea [9]. The user records the central idea - trend analysis - in note 1 (see figure 6(1)).

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The use case demonstrates how a digital camera dataset (565 cameras with 15 attributes) is explored using the Aruvi prototype. The user might perform tasks such as detecting trends and finding cameras that meet user requirements. To perform trend analysis, the user compares the digital camera attributes for different years. The user uses the scatterplot in the data view for this comparison.

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History Tracking

The granularity of the history tracking can be chosen in various ways. For instance, all changes to the visualization specification can be captured. However, some heuristics on specification change detection can be applied to avoid too much low level detail. For instance, when the user continuously changes the filter in the dynamic query interface, the changes are reflected in the visualization (scatterplot) but are not captured by the history tracking module. We found it to be convenient just to capture the visualization state when the mouse pointer leaves the dynamic query interface and if at least one of the filters has been changed. Other heuristics, like detection of (not necessarily continuous) change patterns could be used and will be studied in the future. The base model itself does allow for a variety of choices here.

USE CASE

We now present a simple use case where a user explores a digital camera dataset (565 cameras with 15 attributes) using the Aruvi prototype. There are several tasks that the user might perform with the data, such as detecting trends and finding cameras that meet user requirements. To perform trend analysis, the user compares the digital camera attributes for different years. The user uses the scatterplot in the data view for this comparison.

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Aruvi

• Data View
  - “Normal” Visualization
  - Can manipulate, filter visualization through this view
• Navigation View
  - History Tree (left to right with branching)
  - Includes links to visualization states
• Knowledge View
  - User-defined view that captures the thought process
  - Includes links to visualization states
Differences between paper types

• Evaluation
  - Databases: Running times, storage costs, query workloads
  - HCI/Visualization: use cases, user studies, analysis of feedback

• Research contribution:
  - Databases: new algorithm or technique
  - HCI/Visualization: new visual representation or interaction style
Visual Analytics and Provenance

• Workflow provenance: the result has a well-defined set of computational steps

• Visual analytics provenance: how a user perceives, interacts with, and makes sense of a visualization is important in understand the outcome (a decision)
  - Key part is how users perceive and interact with a visualization
  - The provenance of the computation by itself (how the visualization was generated) is only part of the story
Visual Analytics and Provenance

- Perceive: understand what the user sees
- Capture: capture user interactions as provenance
- Encode: how to represent the provenance
- Recover: making sense of captured provenance
- Reuse: (semi-)automatically apply learned information from provenance to new tasks

[CHI 2011 Workshop on Analytic Provenance, W. Dou et al.]
Characterizing Users’ Visual Analytic Activity for Insight Provenance

D. Gotz, M. X. Zhou
Semantics of Captured Information

Rich Semantics

Tasks - $T_i$

Sub-Tasks - $S_i$

Actions - $A_i$

Poor Semantics

Events - $E_i$

[D. Gotz and M. Zhou, 2008]
Action Taxonomy

**Exploration Actions**
- Data Exploration Actions
  - Filter
  - Inspect
  - Query
  - Restore
- Visual Exploration Actions
  - Brush
  - Change-Metaphor
  - Change-Range
    - Zoom
    - Pan
  - Merge
  - Sort
  - Split

**Insight Actions**
- Visual Insight Actions
  - Annotate
  - Bookmark
- Knowledge Insight Actions
  - Create
  - Modify
  - Remove

**Meta Actions**
- Delete
- Edit
- Redo
- Revisit
- Undo

[D. Gotz and M. Zhou, 2008]
Provenance Review (continued)
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