Identifying the Relationships Between the Visualization Context and Representation Components to Enable Recommendations for Designing New Visualizations

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Motivation

- What makes existing representations solve challenges?
- Does specific components of a representation solve specific visualization challenges aspects?
- How to understand and describe the relationships between representations components and challenge aspects?
Objectives

- Describe the challenge aspects and the representation components in a manner that allows the characterization of existing representations.

- Characterize existing representation and try to understand the relationships between the challenges and the representation components.

- Use the extracted relationship to build representations and to highlight unsolved challenges.
CHALLENGE ASPECTS
From the visualization process

- What impacts the visualization process, defines the challenges that the representations handle
- The existing visualization process definitions permit to extract the following impacting factors
  - Data type
  - Context of use
  - User’s need (tasks)
- A representation challenge can be describe by a data type, a user need and a context of use
Data type characterization

- **Data volume** [Jankun-Kelly et al. 2014]
  - Low volume
  - Intermediate volume
  - High volume

- **Structural organization** [Hascoët and Beaudouin-Lafon 2001]
  - Unstructured
  - Un-oriented relation
  - Oriented relation

- **Attributes cardinality** [Shneiderman 1996]
  - 1-dimensional
  - 2-dimensional
  - 3-dimensional
  - Multidimensional

- **Attribute structural properties** [Bertin 1967]
  - Nominal
  - Ordinal
  - Quantitative

- **Attribute nature** [Purchase et al. 2008]
  - Characteristic
  - Referential
Tasks

Zoom
Extract
Filter
Detail-on-demand
Overview
History
Relate

Identify
Categorize
Locate
Rank
Compare
Distribute
Distinguish
Cluster
Associate
Correlate

Identify data characteristics
Categorize or classify
Locate boundaries, critical point, features
Rank based on some order
Compare to find similarities and differences
Distinguish regions of different characteristics
Associate into relation
Correlate by classifying

Retrieve value
Filter
Sort
Determine range
Characterize distribution
Find extremum
Find anomalies
Cluster
Correlate
Compute derived value

Identify Value
Access Information
Sort
Compare
Identify Distribution
Distinguish
Associate
Correlate
Create Information

[Shneiderman 1996]
[Keller 1993]
[Purchase 2008]
[Amar 2005]

Our taxonomy
Tasks

- Identify value
- Access information
- Sort
- Compare
- Distinguish
- Identify distribution
- Associate
- Correlate
- Create information
Context of use

- **Platform** [Sundén et al. 2007]
  - Mobile display
  - Standard screen
  - Large-scale display
  - Immersive device

- **User expertise** [Rasmussen 1983]
  - Skill
  - Rule
  - Knowledge
Synthesis

**Challenge aspects**

**Challenge**
- a device
- a user expertise
- activities

**Activity**
- a task
- a data volume
- a data structure
- attributes

**Attribute**
- a structural prop.
- a nature
REPRESENTATION COMPONENTS
Representation components

- Data transformation
  - Filtering
  - Clustering
  - Density computation

- Visual mapping
  - Visual variables
    - Position
    - Color
    - Size
    - ...
  - Linking

- View transformation
  - Focus + Context
  - Navigation
  - Multi-view

RELATIONSHIP BETWEEN CHALLENGE AND REPRESENTATION
Relationship extraction

CHALLENGE

ACTIVITY 1
Cor 2

ACTIVITY 2
A 1

ACTIVITY 3
D 2

ACTIVITY 4
Com 3

position x + position y

colorization

position x + position y

interaction + position x + position y

Data source: Gapminder 2007

Life Expectancy

Gross Domestic Product per Capita

[Image of scatter plot with points colorized and labeled]

[Hans Rosling]
Toward a recommendation tool

Identification of existing representations

Extraction of relationships

Construction of a knowledge repository

Manual use of the repository on new challenges
Conclusion and perspectives

Conclusion

• Definition of a visualization context characterization
  – Data type
  – User need
  – Context of use

• Proposition of a methodology to extract existing relation between representation components and challenge aspects
  – Analysis of existing representations
  – Use of theoretic contribution of representation components

Perspectives

• Implementation of a recommendation tool
  – Express relationships in prolog predicates

• Evaluation of the given recommendation