Comparative Visualization: Interactive Designs and Algorithms Depending on Data and Tasks

Tatiana von Landesberger[1], Kathrin Ballweg[1],
Hans-Jörg Schulz[2], Natalie Kerracher[3], Margit Pohl[4]

VIS Tutorial 2018

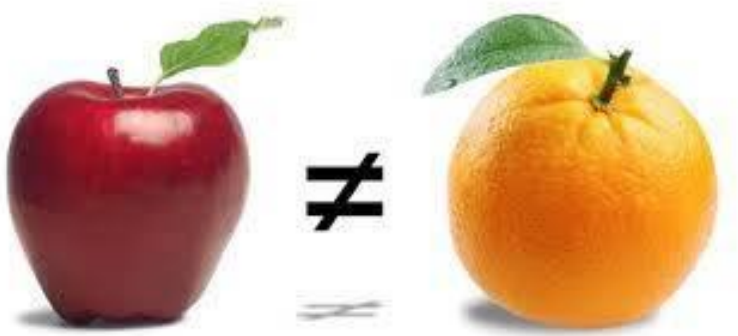
TECHNISCHE UNIVERSITÄT DARMSTADT

AARHUS UNIVERSITY

Edinburgh Napier UNIVERSITY

1. TU Darmstadt, Darmstadt, Germany
2. Aarhus University, Denmark
3. Edinburgh Napier University, UK
4. TU Wien, Austria

PART I: INTRODUCTION



https://www.theodysseyonline.com/compare-apples-oranges

Hans-Jörg Schulz

- Associate Professor at Aarhus University, Denmark
- Research Topics:
  - Progressive Visual Analytics
  - Visual Analytics of Network Data
  - Spatiotemporal Visualization
  - Visualization for Biomedicine
  - Tree Visualization (visit http://treevis.net)

Tatiana von Landesberger

- Habilitation in 2017
  @ TU Darmstadt, Germany
  Topic: “Visual Data Comparison”
- Head of the Visual Analysis and Search Group @ TU Darmstadt since 2011
- Research Topics:
  Visual Analysis and Comparison of
  - Networks
  - Movement Data
  - Biologic data
  - Medical data
  - Financial Data

Natalie Kerracher

- KTP Associate at Edinburgh Napier University and ZoneFox Ltd.
- Research Topics:
  - Temporal graph visualisation
  - Visualisation tasks and classifications
  - Security visualisation

Kathrin Ballweg

- PhD student @ TU Darmstadt since 2015
- Master in Computer Science @ TU Darmstadt
- Research Topics:
  - Perception and cognition factors in visual network comparison
  - Guidelines for visual network comparison

Margit Pohl

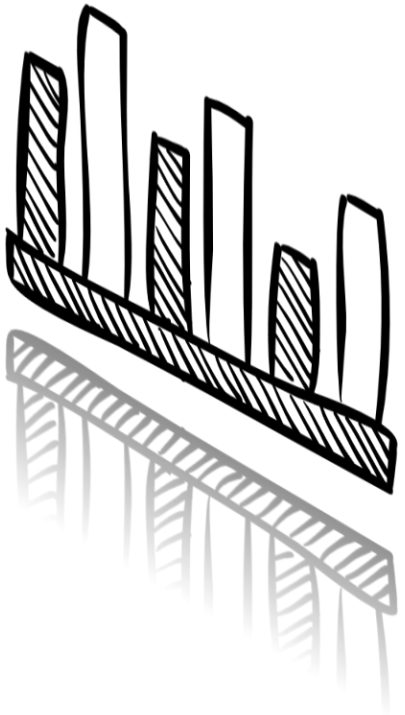
- Associate Professor in Computer Science at Vienna University of Technology
- Master in Computer Science and PhD in Psychology
- Research Topics: Human-Computer Interaction, Visualization, Cognition

Now, who are you? ;-)

- Practitioner / Academic?
- Beginner / Professional?
- Visual / Analytical?

- Overview / Detail?

ON COMPARISON…



Comparison is…

…an examination of two or more items to establish similarities and dissimilarities.

- Merriam-Webster Dictionary

…a consideration or estimate of the similarities or dissimilarities between two things or people.

- Oxford Dictionary

…the fact of considering something similar or of equal quality to something else.

- Cambridge Dictionary

…the process of considering how things or people are similar and how they are different.

- Macmillan Dictionary

Comparison is…

…an examination of two or more items to establish similarities and dissimilarities.

- Merriam-Webster Dictionary

…a consideration or estimate of the similarities or dissimilarities between two things or people.

- Oxford Dictionary

…the fact of considering something similar or of equal quality to something else.

- Cambridge Dictionary

…the process of considering how things or people are similar and how they are different.

- Macmillan Dictionary

Comparison is…

…an examination of two or more items to establish similarities and dissimilarities.

- Merriam-Webster Dictionary

…a consideration or estimate of the similarities or dissimilarities between two things or people.

- Oxford Dictionary

…the fact of considering something similar or of equal quality to something else.

- Cambridge Dictionary

…the process of considering how things or people are similar and how they are different.

- Macmillan Dictionary

Comparison is…

…an examination of two or more items to establish similarities and dissimilarities.

- Merriam-Webster Dictionary

…a consideration or estimate of the similarities or dissimilarities between two things or people.

- Oxford Dictionary

…the fact of considering something similar or of equal quality to something else.

- Cambridge Dictionary

…the process of considering how things or people are similar and how they are different.

- Macmillan Dictionary

Comparison is…

…the process of considering…

How do we do this?

…similarity, equality, or dissimilarity…

With respect to what?

… between two or more items.

Cardinality!

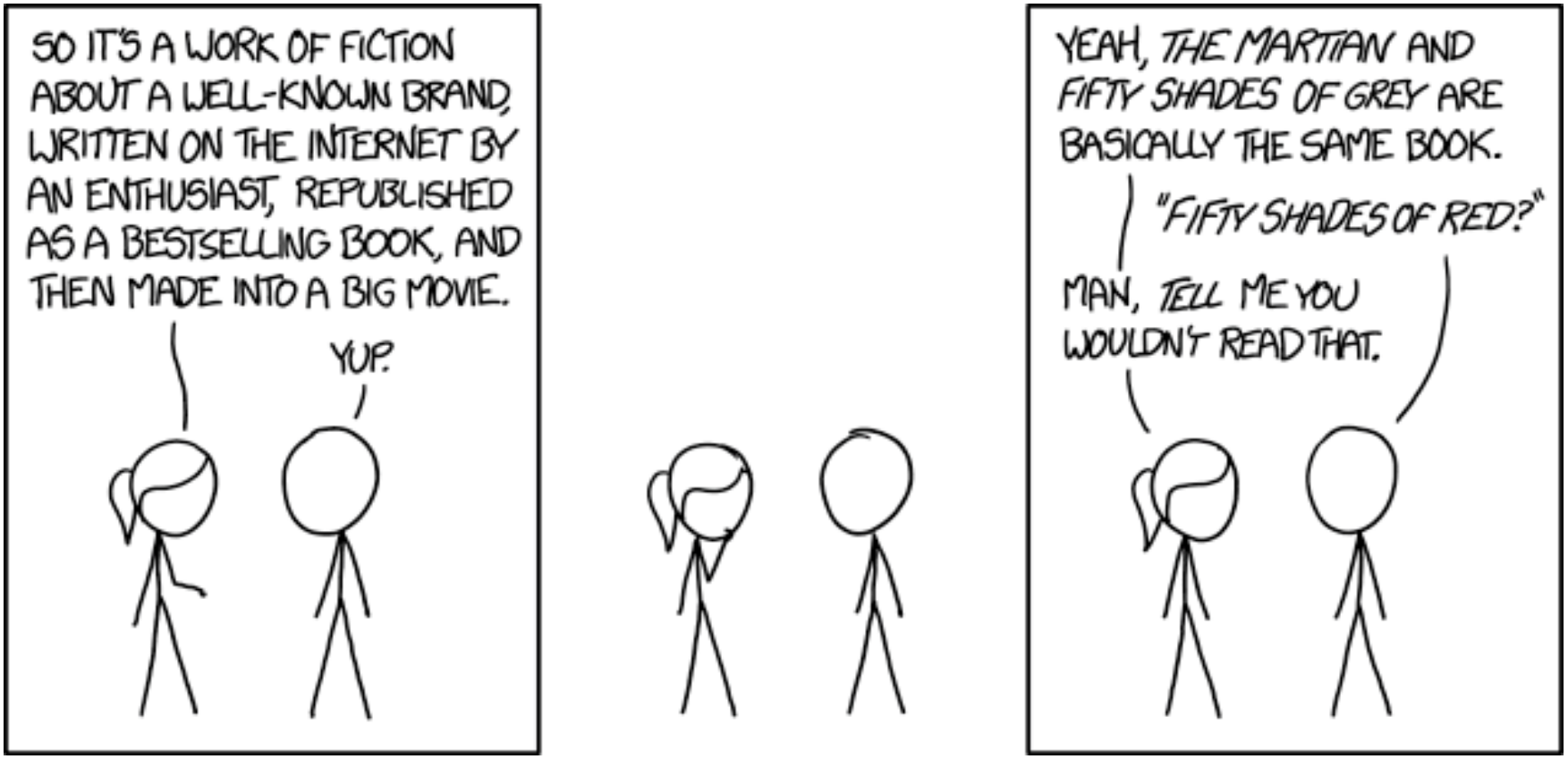
Similarity, equality, or dissimilarity

"Two or more instances of a phenomenon may be compared if and only if there exists some variable, say V, common to each instance."

– Morris Zelditch, Sociologist

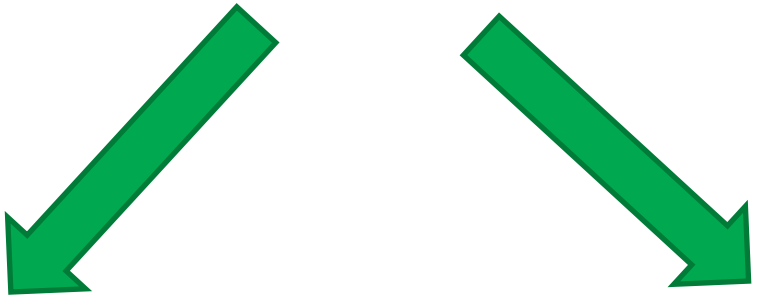
-> So, we need a common aspect, characteristic, variable, or relation by which to establish similarity, equality, or dissimilarity.

Choosing the "right V"…



[XKCD 1585]

The process of considering



Given a joint characteristic V, find similar data items according to V and/or dissimilar outliers.

Comparison
"Item Seeking"

Given multiple data items, find a joint characteristic V by which they are similar.

Relation Seeking

see [Andrienko & Andienko 2006] and [Tominski et al. 2012]

Comparison is…

(2) similarity, equality, or dissimilarity…

Relation / Aspect (V)

Relation Seeking

(1) the process of considering

"Item Seeking"

(3) between two or more items.

Cardinality!

TUTORIAL OUTLINE

Image source: https://www.grammarly.com/blog/how-to-write-outline/

Planned Tutorial Agenda

Introduction (you're listening to it right now)
14:20-14:35 (≈ 15 minutes)

1. **The Comparison Problem**
   14:35-15:10 (≈ 45 minutes)

1. The Comparison Problem

Data Characteristics

	Quantitative Data		Qualitative Data	
	Continuous	Discrete	Ordinal	Categorical
Interpolate	✓			
Difference	✓	✓		
Sort	✓	✓	✓	
Match	✓	✓	✓	✓

Task Characteristics

WHY to compare?

WHAT to compare?

HOW to compare?

Comparison Types

1-to-1 comparison

1-to-many comparison

many-to-many comparison

Planned Tutorial Agenda

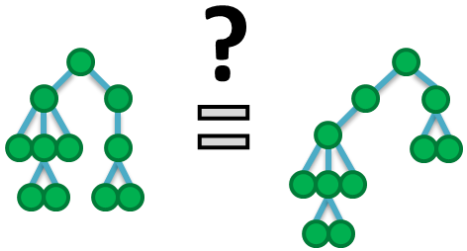
Introduction (you're listening to it right now)
14:20-14:35 (≈ 15 minutes)

1. **The Comparison Problem**
   14:35-15:10 (≈ 45 minutes)
2. **Algorithmic Comparison**
   15:10-16:00 (≈ 50 minutes)

2. Algorithmic Comparison

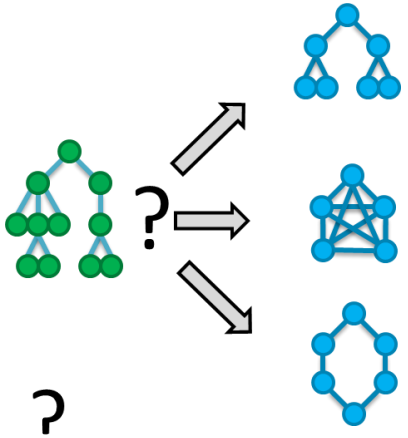
1-to-1 Comparison

-> Matching



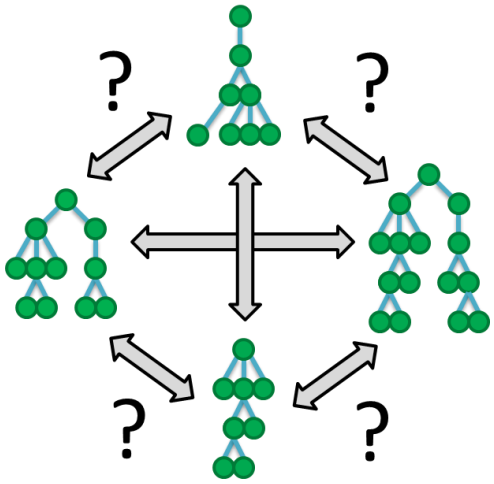
1-to-many Comparison

-> Classification



many-to-many Comparison

-> Clustering



Planned Tutorial Agenda

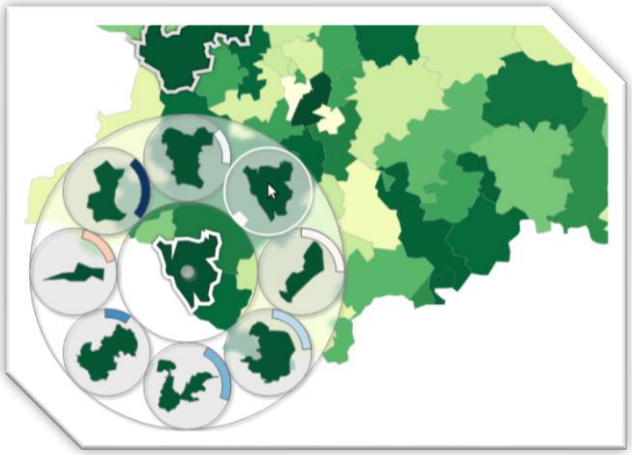
Introduction (you're listening to it right now)
14:20-14:35 (≈ 15 minutes)

1. **The Comparison Problem**
   14:35-15:10 (≈ 45 minutes)
2. **Algorithmic Comparison**
   15:10-16:00 (≈ 50 minutes)

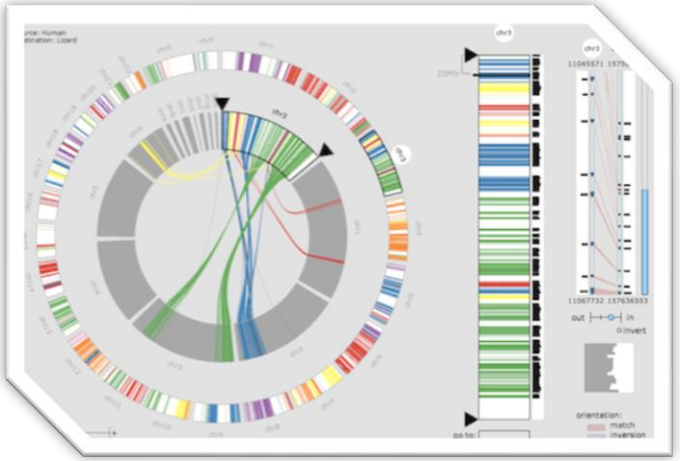
16:00-16:20 coffee break

3. **Visual Design and Interaction**
   16:20-17:10 (≈ 50 minutes)

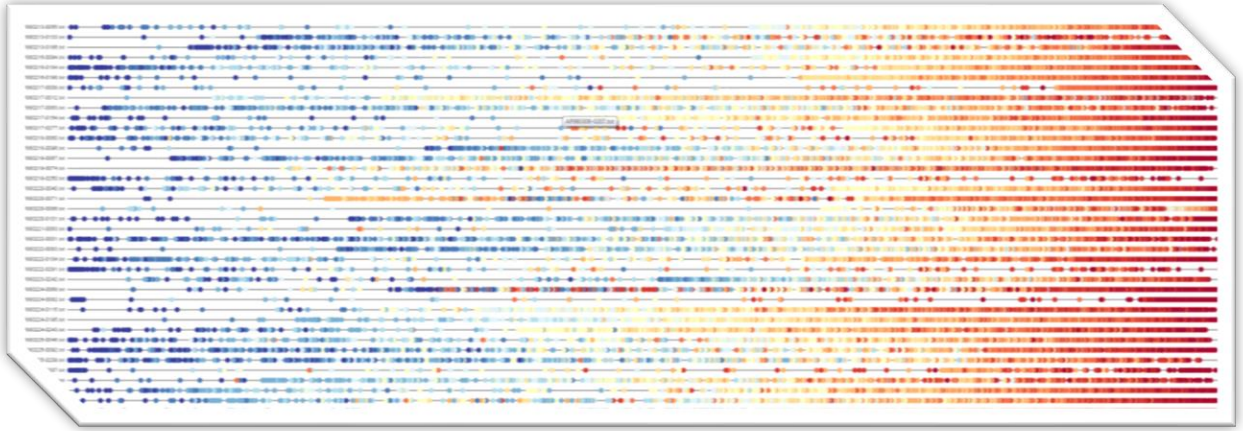
3. Visual Design & Interaction



CompaRing [Tominski 2016]



MizBee [Meyer et al. 2009]



Buddy Plots [Alexander & Gleicher 2016]

Planned Tutorial Agenda

Introduction (you're listening to it right now)
14:20-14:35 (≈ 15 minutes)

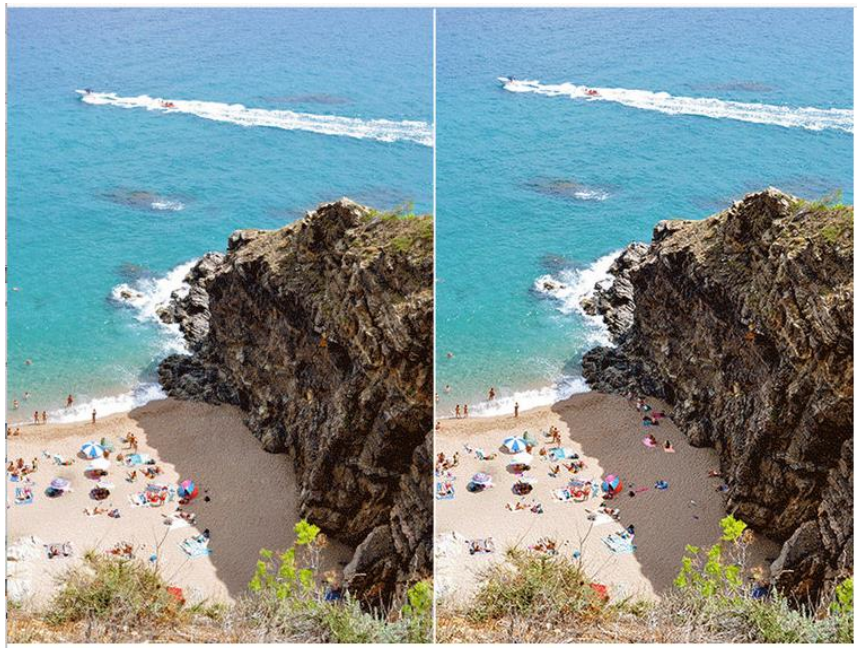
1. **The Comparison Problem**
   14:35-15:10 (≈ 45 minutes)
2. **Algorithmic Comparison**
   15:10-16:00 (≈ 50 minutes)

16:00-16:20 coffee break

3. **Visual Design and Interaction**
   16:20-17:10 (≈ 50 minutes)
4. **Perception and Cognition**
   17:10-17:40 (≈ 30 minutes)

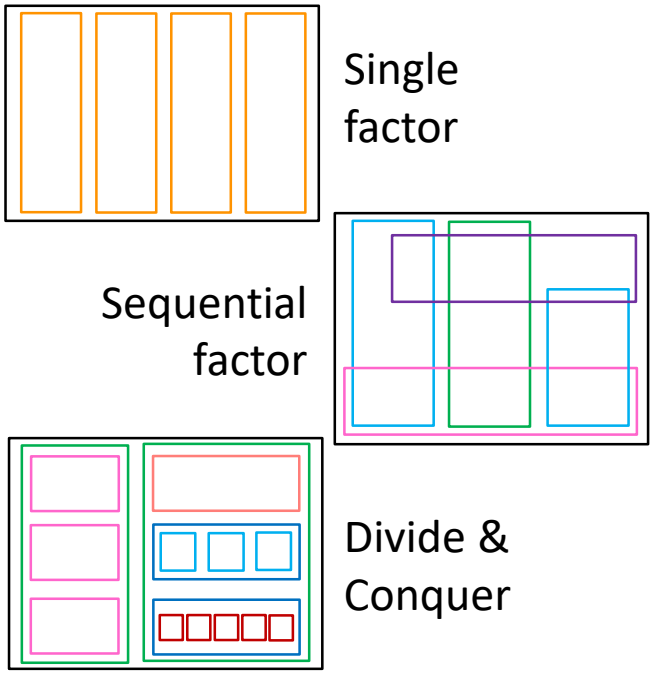
4. Perception and Cognition

Visual Attention



Change Blindness

Comparison Strategies



Planned Tutorial Agenda

Introduction (you're listening to it right now)
14:20-14:35 (≈ 15 minutes)

1. **The Comparison Problem**
   14:35-15:15 (≈ 40 minutes)
2. **Algorithmic Comparison**
   15:15-16:00 (≈ 45 minutes)

16:00-16:20 coffee break

3. **Visual Design and Interaction**
   16:20-17:10 (≈ 50 minutes)
4. **Perception and Cognition**
   17:10-17:40 (≈ 30 minutes)
5. **Summary and Q&A**
   17:40-18:00 (≈ 20 minutes)

Materials:

- Slides
- Videos
- Literature

http://www.gris.tu-darmstadt.de/vis2018/