Visual Analytics with a Focus on Time

Invited Talk @ CNRS MAP 2015
Marseille, 21nd January 2015

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St. Poelten University of Applied Sciences, Institute of Creative\Media/Technologies

Why me?

7 years of research experience in Visual Analytics / Information Visualization with a Focus on Time

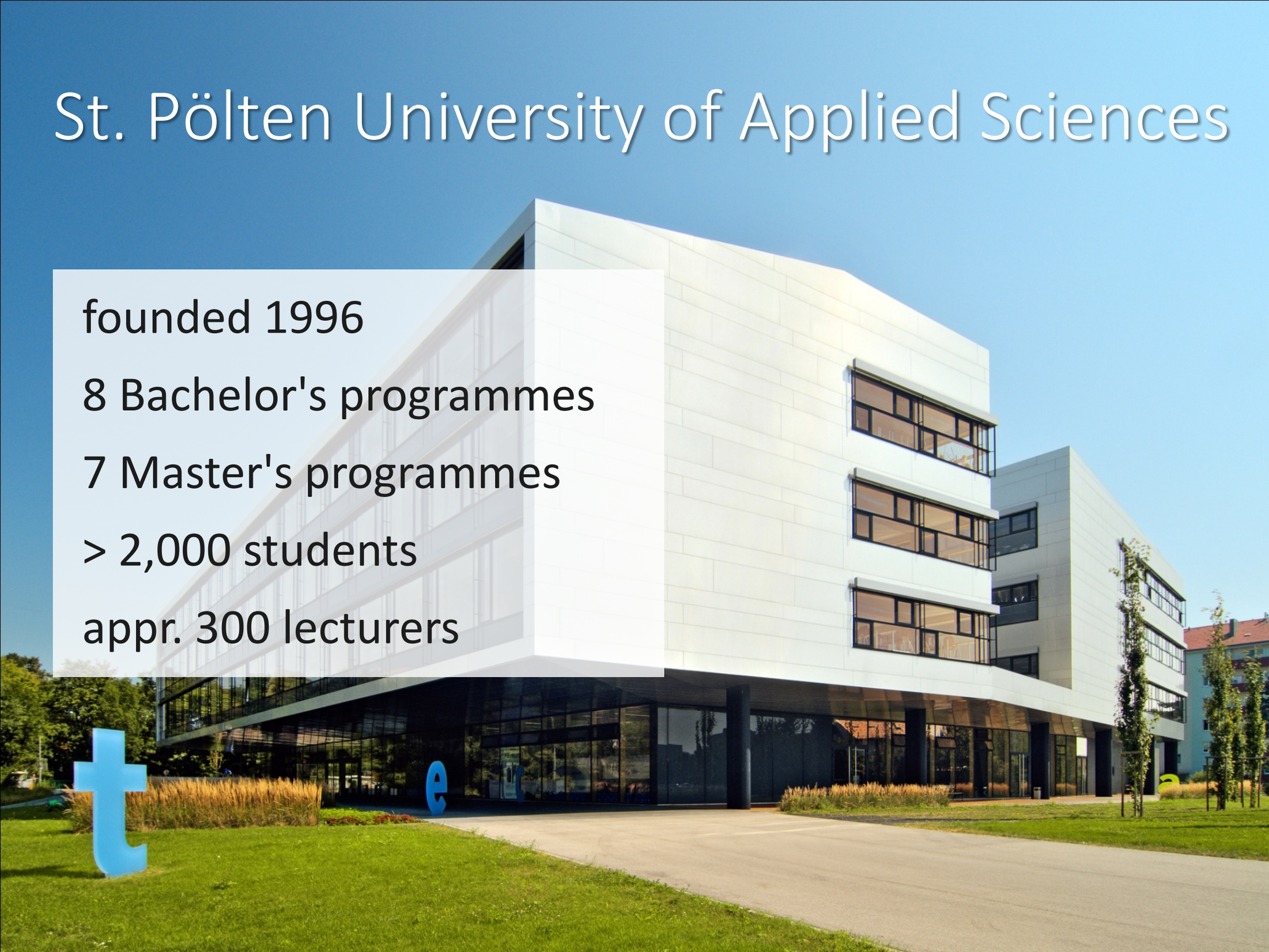
- Danube University Krems
- Vienna University of Technology
- St. Pölten University of Applied Sciences

7 peer-refereed journal articles, esp.

- TimeBench – a data model and open source software
- Survey on Electronic Health Records Visualization

interest in cultural heritage as application domain

St. Pölten University of Applied Sciences



founded 1996

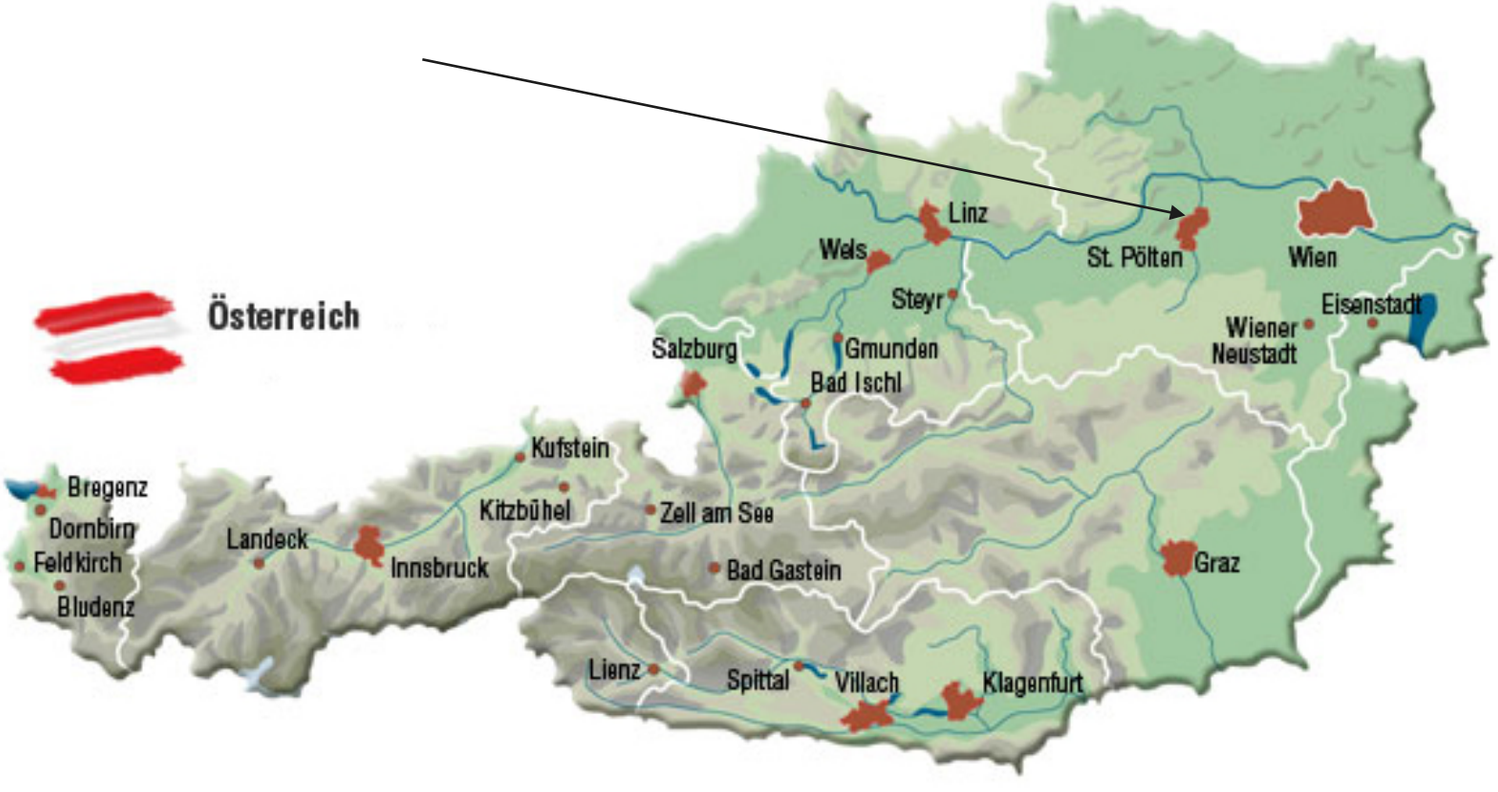
8 Bachelor's programmes

7 Master's programmes

> 2,000 students

appr. 300 lecturers

St. Pölten/Lower Austria



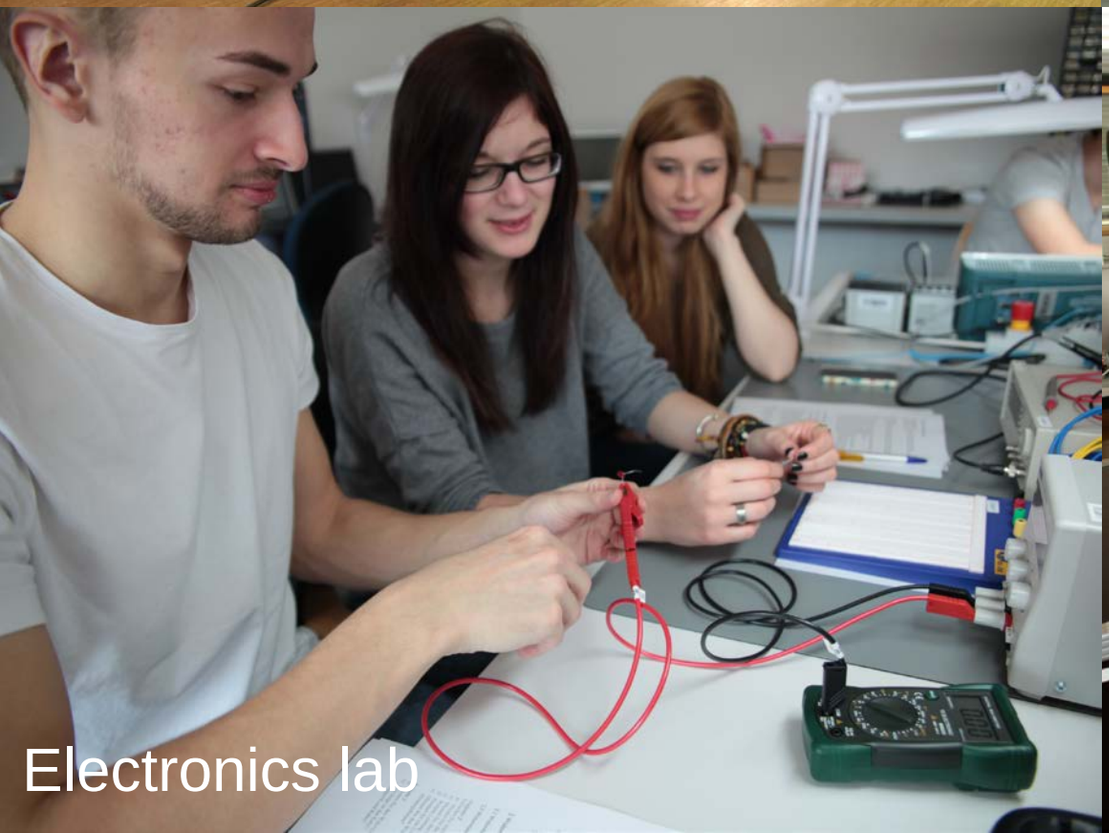
Distances:

Vienna 60 km (by train: 25 min.)

Marseilles 964 km, Paris 982 km


TV lab


Usability lab


Electronics lab

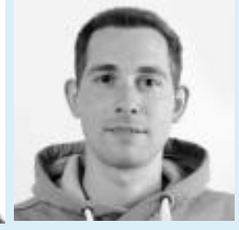

Audio lab

Media Computing Research Group

Game Design & Human Computer Interaction

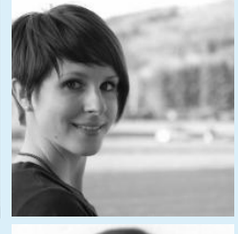
Peter Judmaier, Gernot Rottermanner, Bernhard Zeller





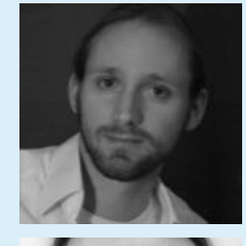
Information Visualization & Visual Analytics

Wolfgang Aigner, Christina Niederer, Alexander Rind,
Markus Wagner, Andrea Haberson


Multimedia Signal Processing & Retrieval

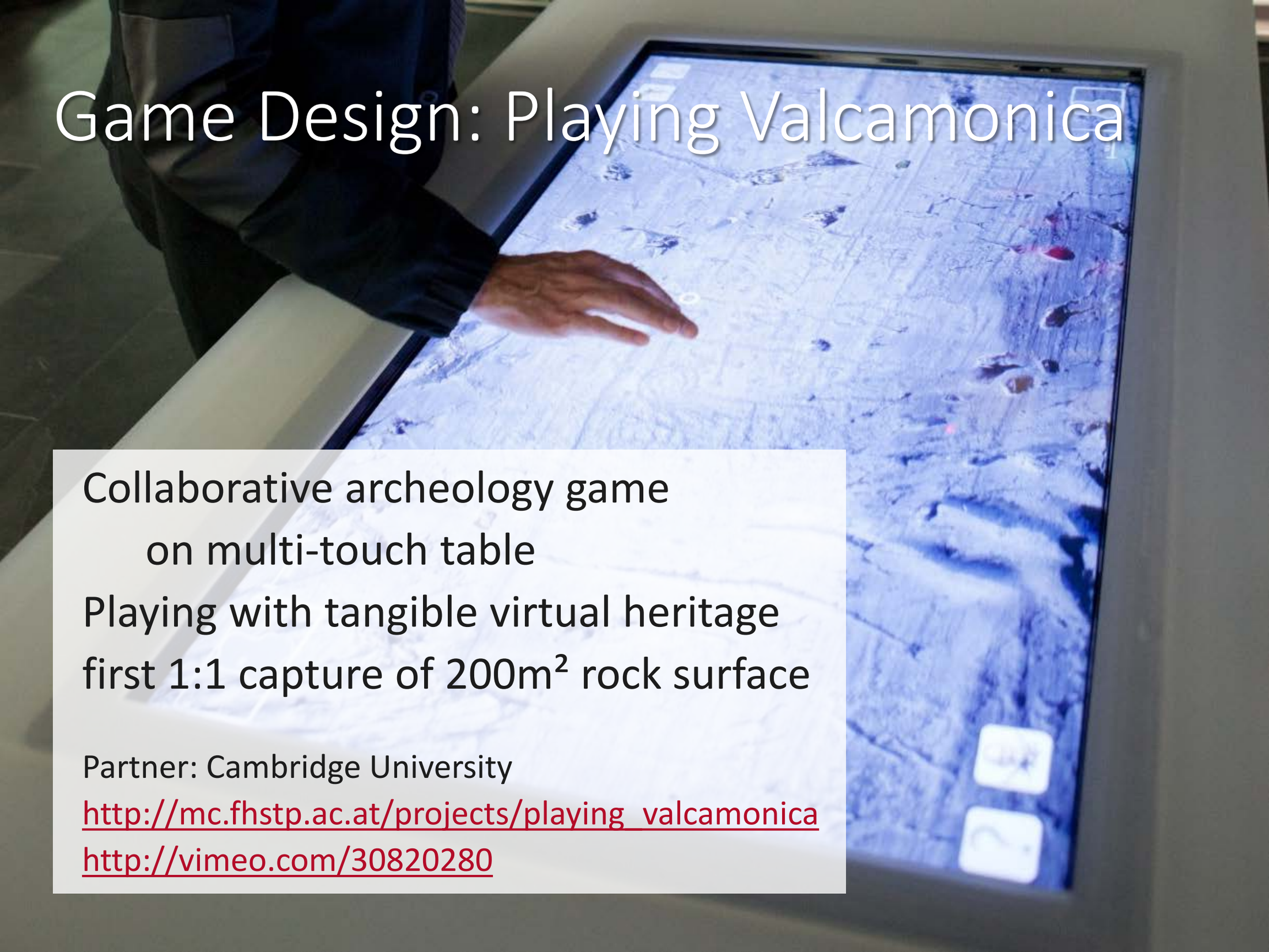
Markus Seidl, Matthias Zeppelzauer,
Ewald Wieser


http://mc.fhstp.ac.at/

Multi-touch HCI: The Revelation

Game Design: Playing Valcamonica



Collaborative archeology game
on multi-touch table

Playing with tangible virtual heritage

first 1:1 capture of 200m² rock surface

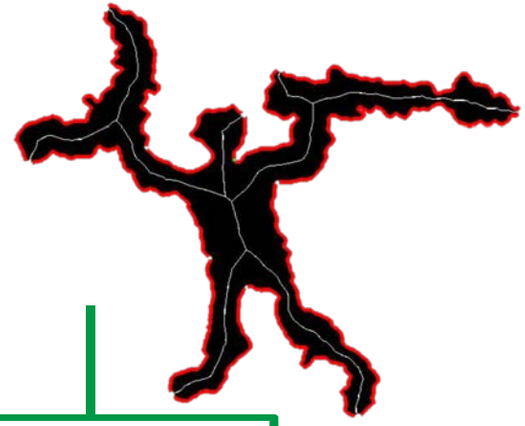
Partner: Cambridge University

http://mc.fhstp.ac.at/projects/playing_valcamonica

http://vimeo.com/30820280

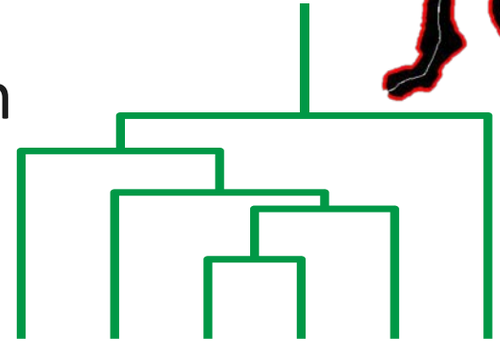
Media Processing: 3D-Pitoti

3D-Acquisition, Intelligent Processing, 3D Presentation of Rock Art



St. Pölten‘s Tasks:

- Petroglyph segmentation and classification
- Shape analysis, shape classification,
- Analysis of surface topology



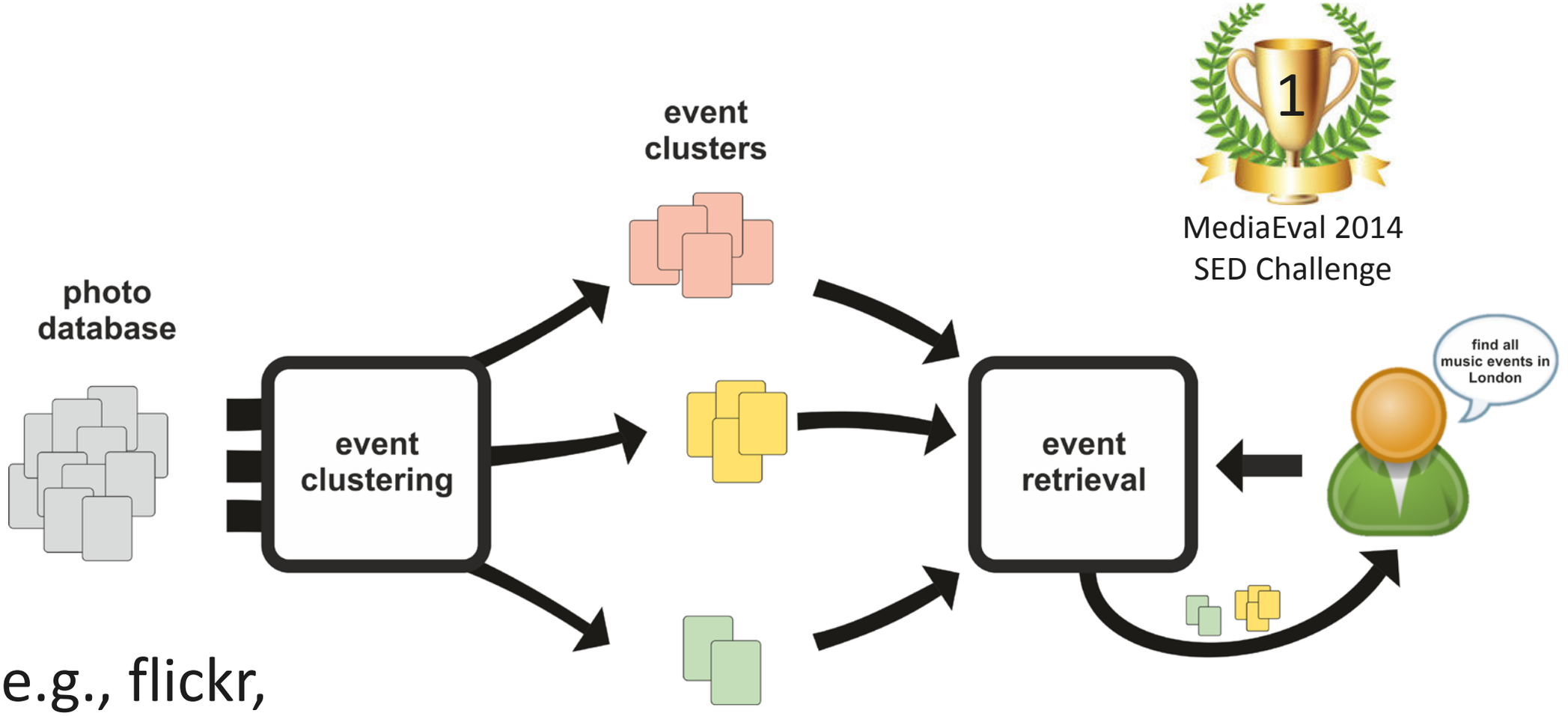
Partners: Univ. of Nottingham , Univ. of Cambridge, CCSP, Bauhaus Univ. Weimar, TU Graz, Actron3D

Funding: EU FP7

http://3d-pitoti.eu

[Seidl et al., 2014]

Media Retrieval: Social Event Detection



e.g., flickr,
instagram

e.g., football match,
concert, conference,
…, events by location

[Zaharieva et al., 2014]

Visual Analytics
with a Focus on Time

fh st.pölten

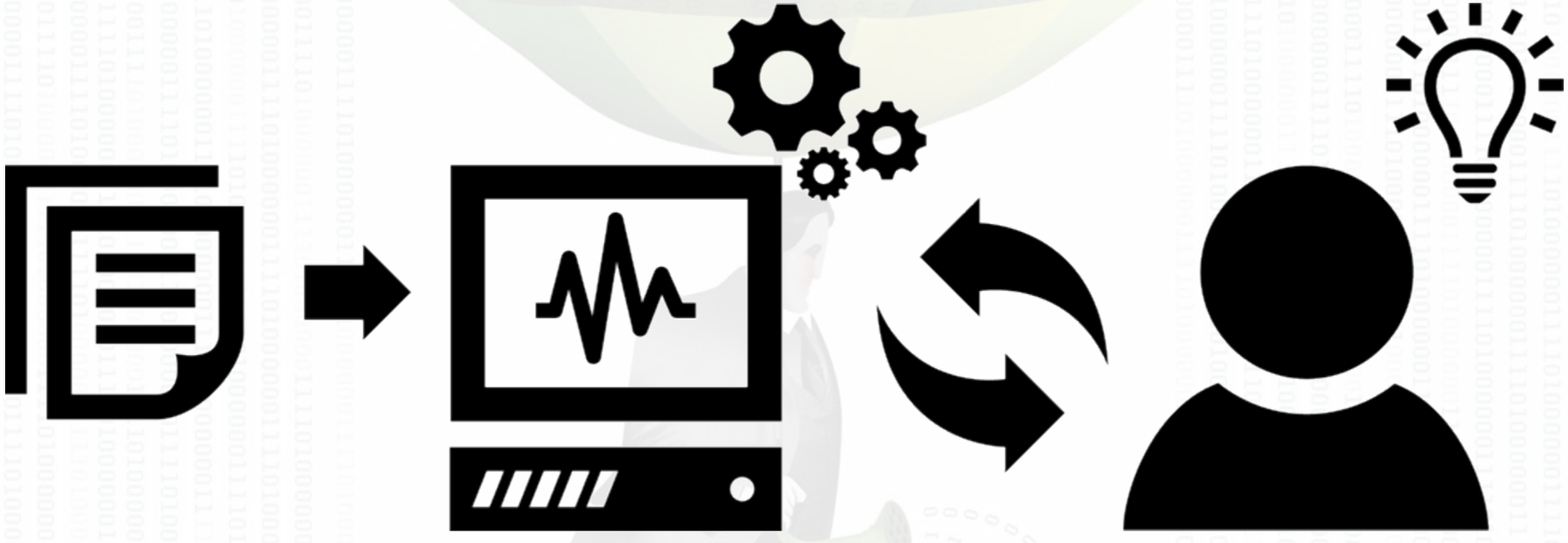
Electronic Health Records

Text Corpora & Narratives

Cultural Heritage

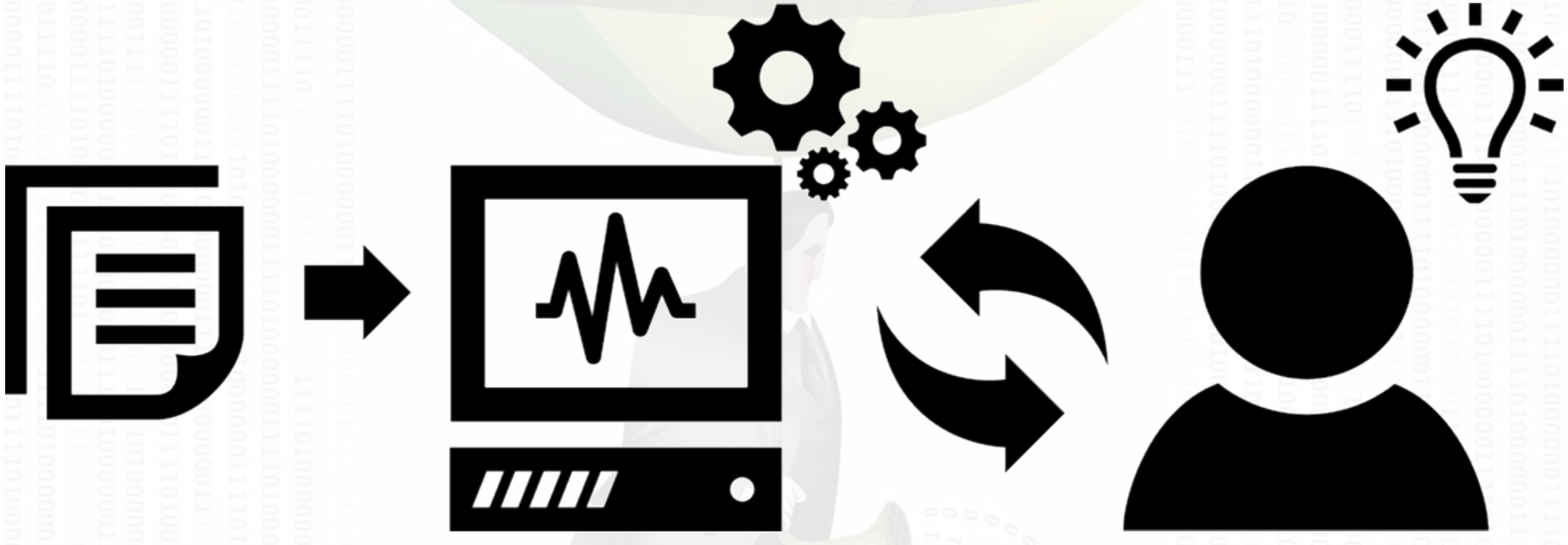
Business Transactions

Image: Brett Ryder (The Economist, 2010); Dudek & Blaise (2013)



"Visual Analytics is the science of analytical reasoning facilitated by interactive visual interfaces."

[Thomas & Cook, 2005]



"Visual Analytics is the method to perform **tasks involving data** using both **computer-based analysis systems** and **human judgment** facilitated by **direct interaction** with **visual representations of data**."

[Rind, ca. 2015]

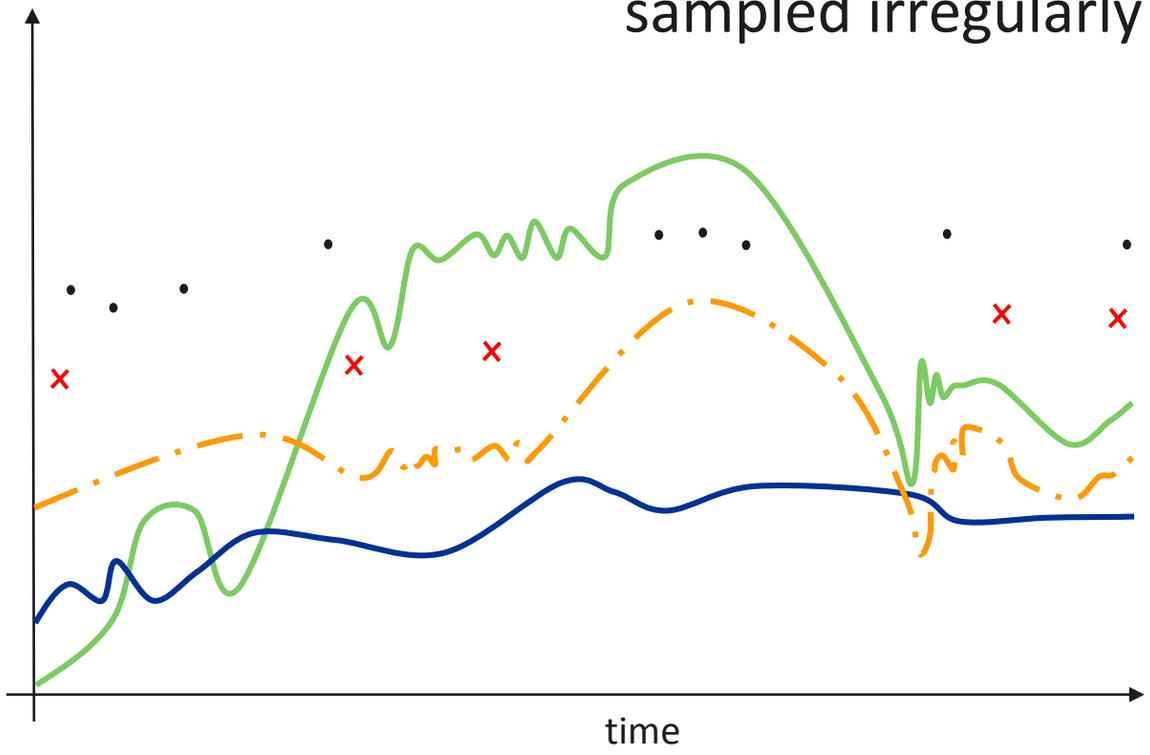
Challenges of Time-oriented Data

e.g., analyzing electronic health records

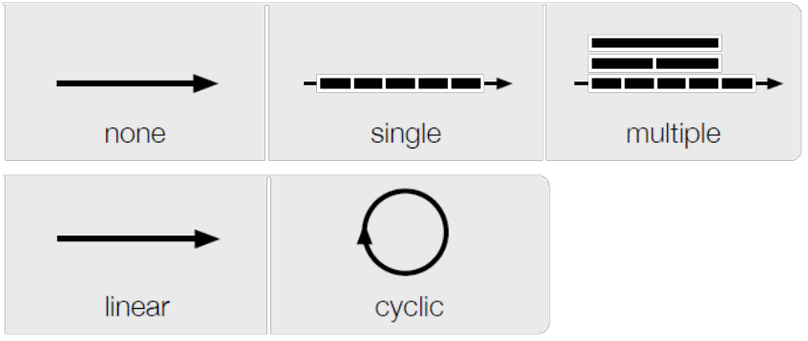
time-oriented

multivariate

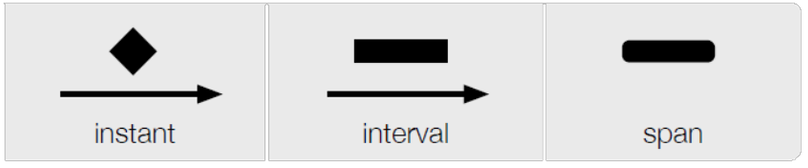
sampled irregularly



multiple granularities & cycles

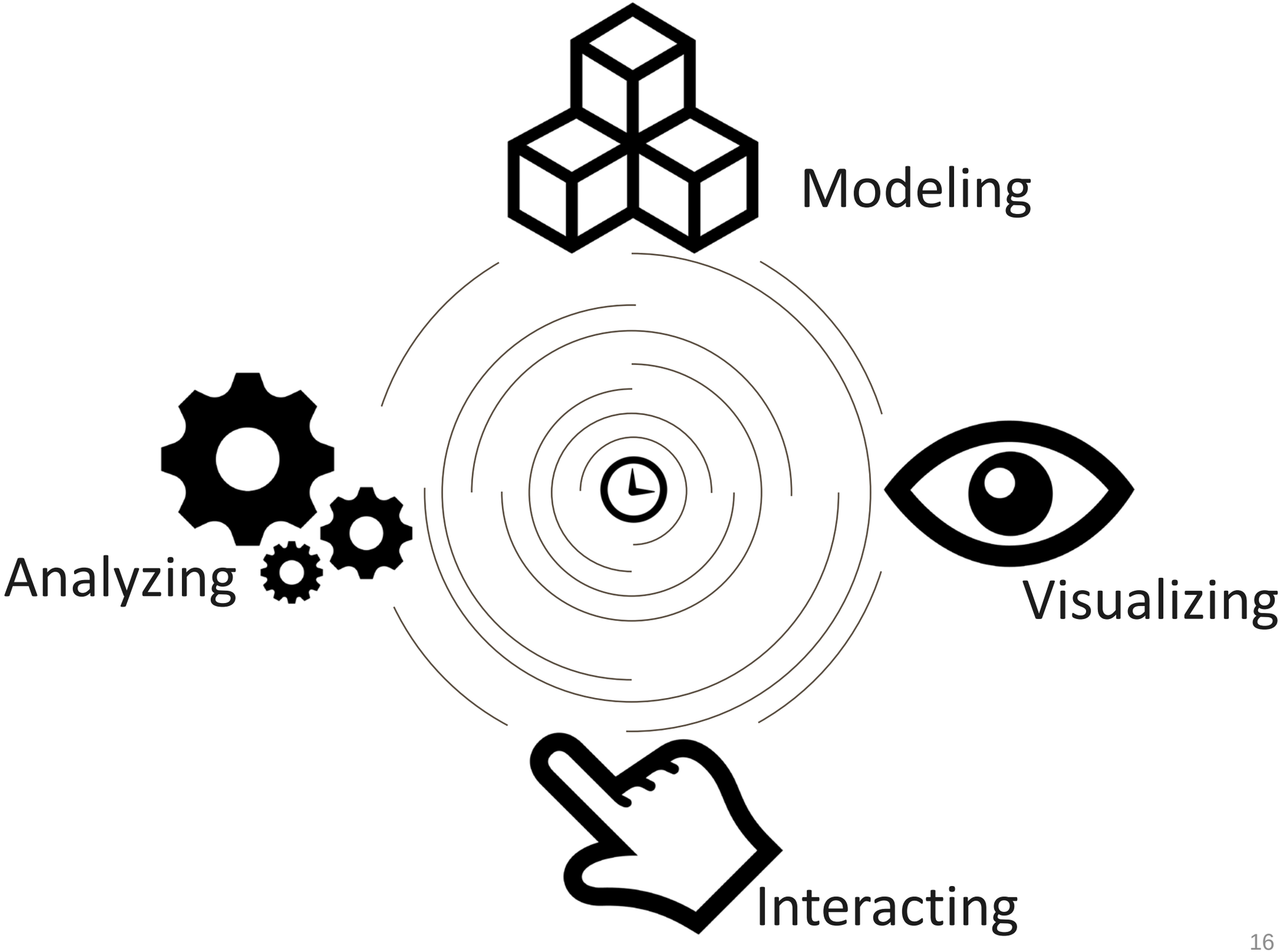


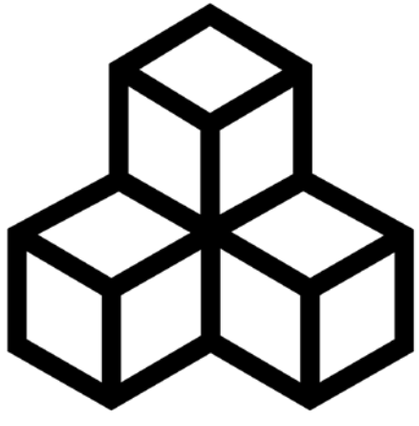
different time primitives



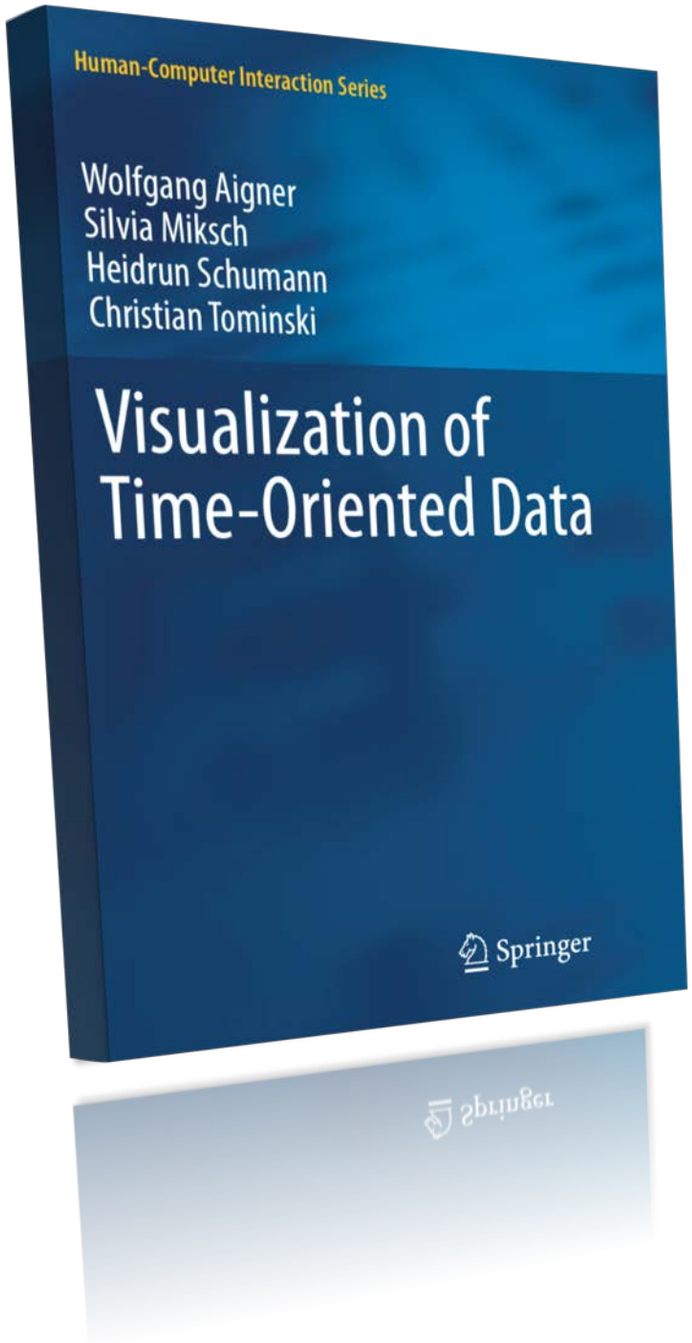
temporal indeterminacy

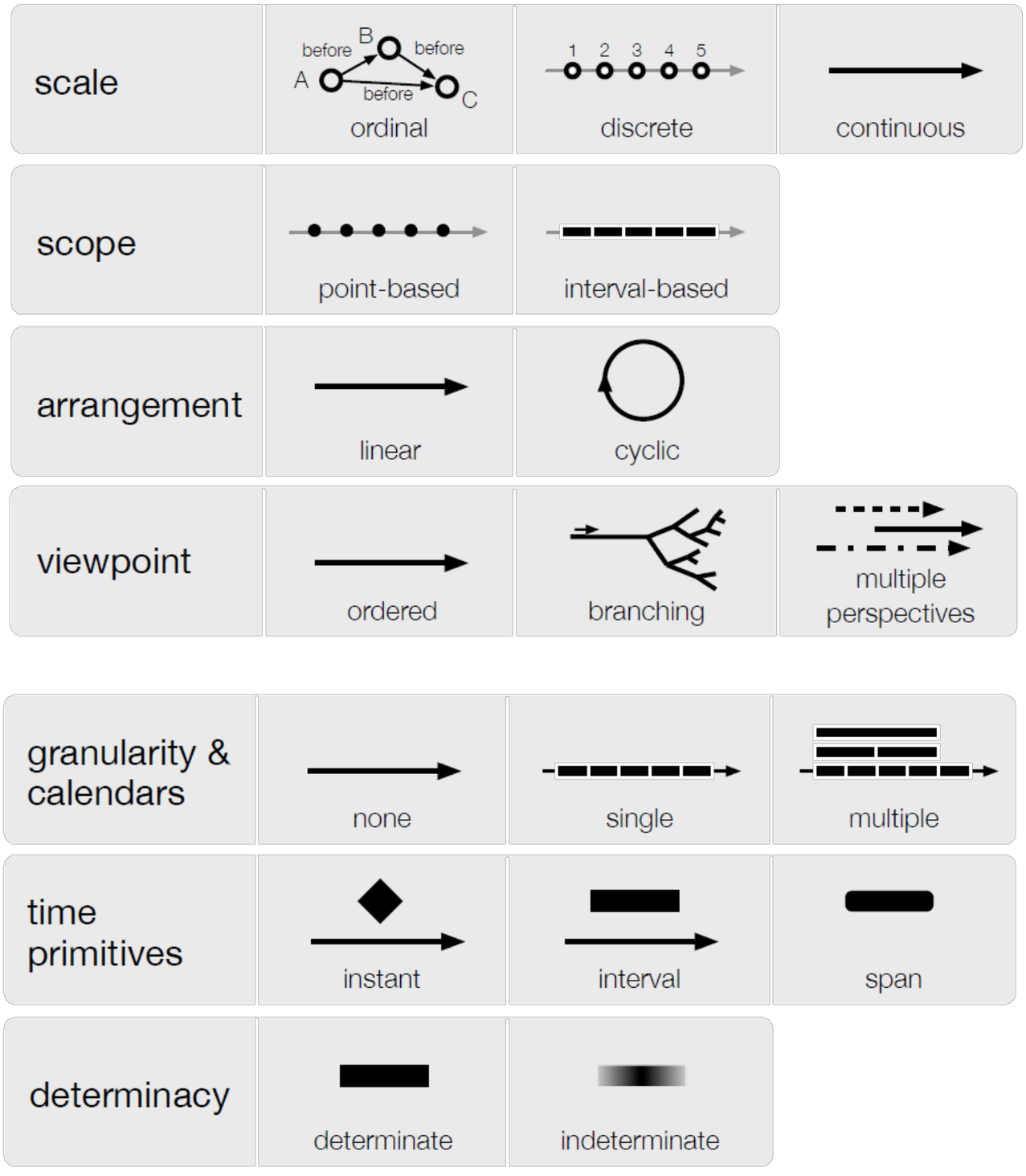
[Aigner et al., 2011]


Modeling
Analyzing
Visualizing
Interacting

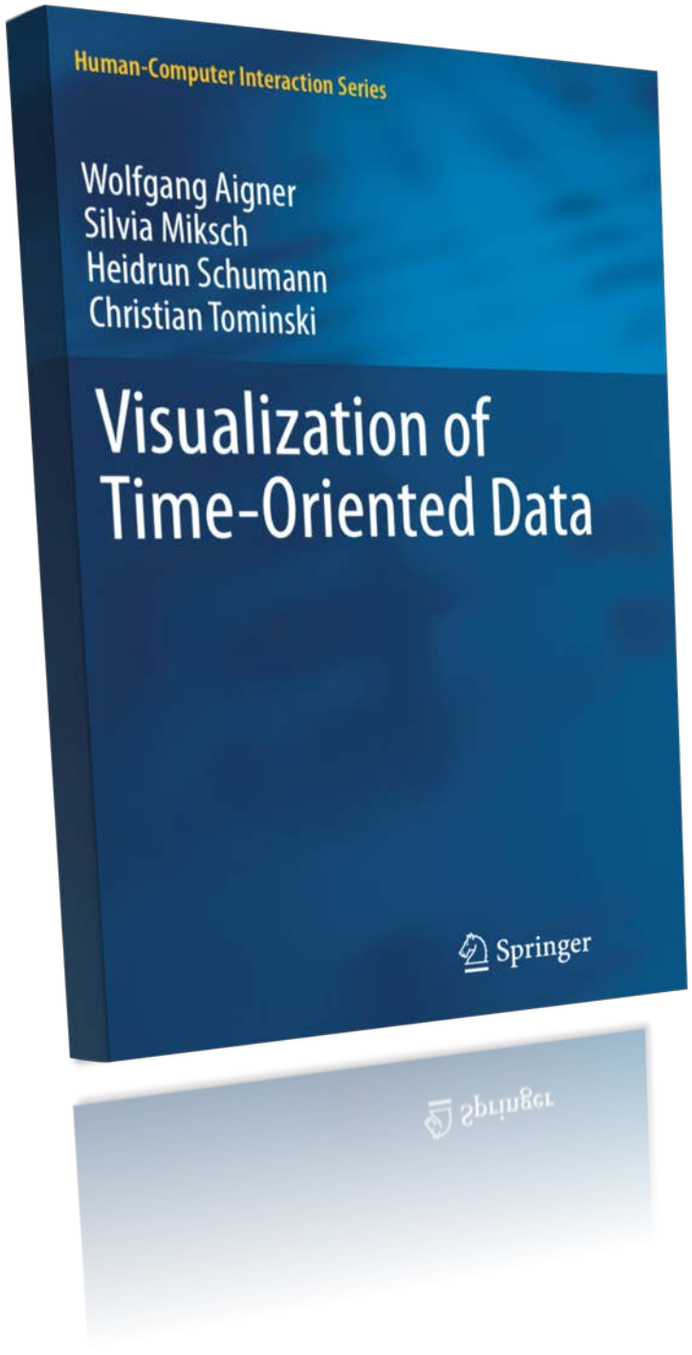


Modeling Time & Time-Oriented Data





[Aigner et al., 2011]

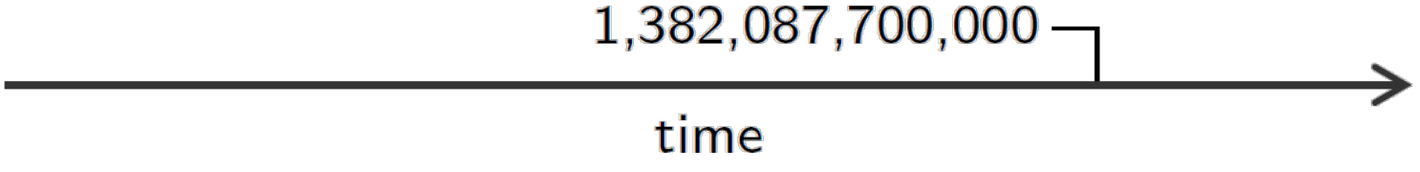


scale	3.14 3.27 4.88 quantitative	coconut banana apple qualitative
frame of reference	abstract	spatial
kind of data	events	states
number of variables	univariate	multivariate

internal time inherent in the data model	non-temporal	temporal
external time extrinsic to the data model	static	dynamic

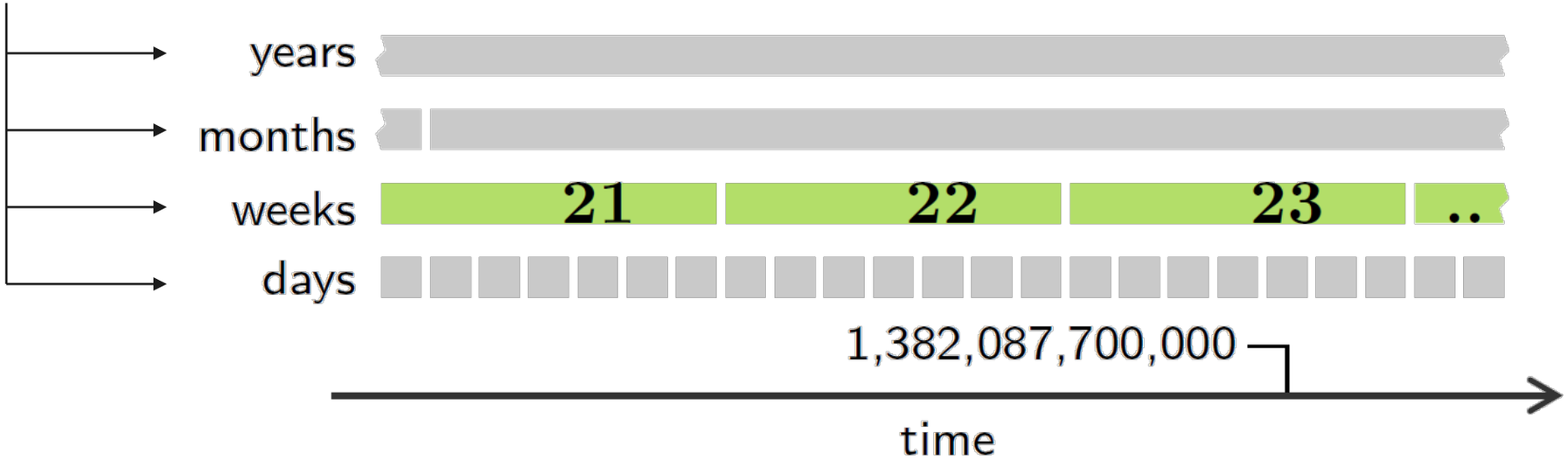
[Aigner et al., 2011]

Challenging Aspect: Multiple Granularities & Cycles



Challenging Aspect: Multiple Granularities & Cycles

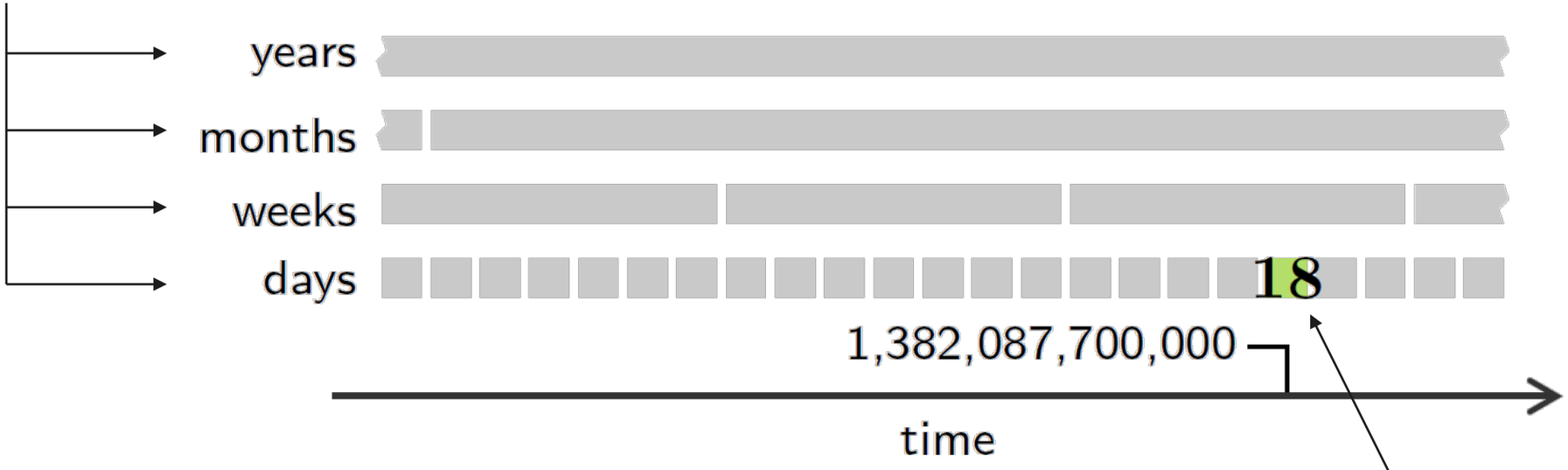
granularities … map time and integer numbers



[Bettini et al., 2000]

Calendar Operations for Granularities

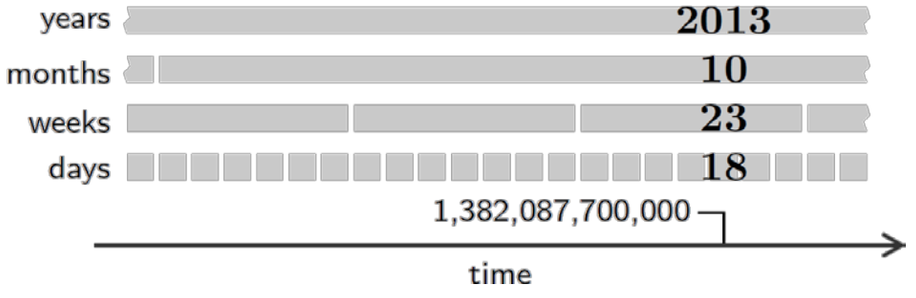
granularities … map time and integer numbers



granule … subset of time for a granularity and an identifier

[Bettini et al., 2000]

Calendar Operations based on Granularities



anchor data on any granularity

convert granules to another granularity

roll-up / drill down

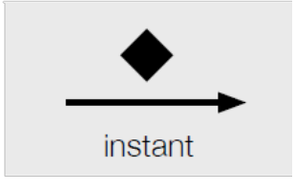
group granules by identifier

(e.g., every Wednesday in March)

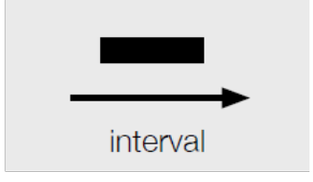
shifting granules by a given number

check qualitative temporal relations

Challenging Aspect: Different Time Primitives



1 time point

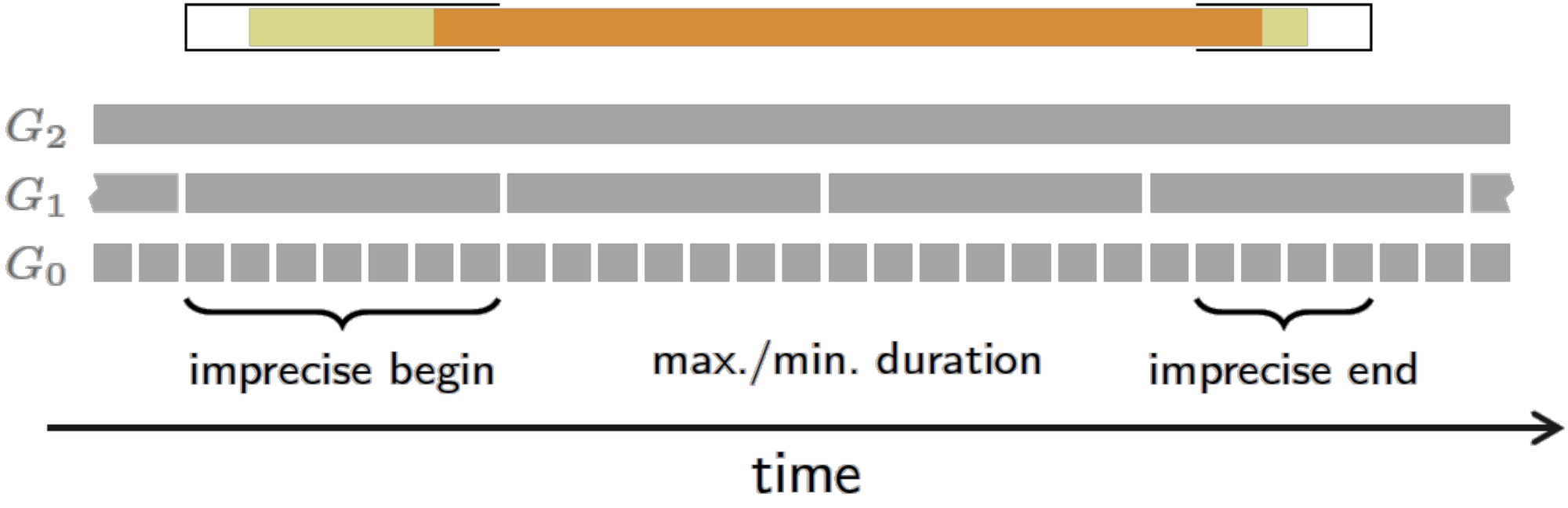


period between 2 time points

duration of a period (not anchored in time)

[Aigner et al., 2011]

Challenging Aspect: Temporal Indeterminacy

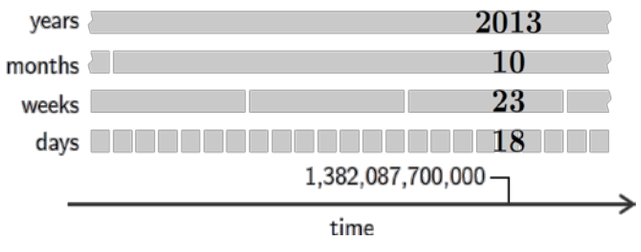


[Aigner et al., 2005]

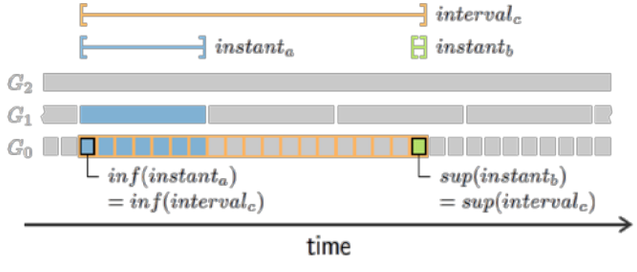
TimeBench.org

A Software Library for Visual Analytics of Time-Oriented Data

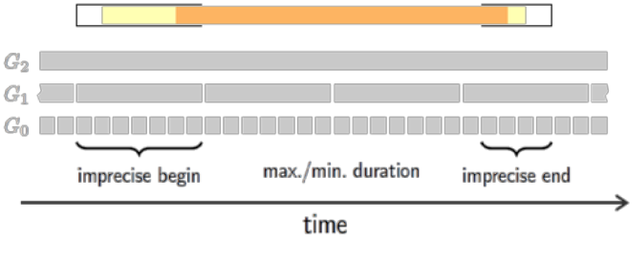
multiple granularities & cycles

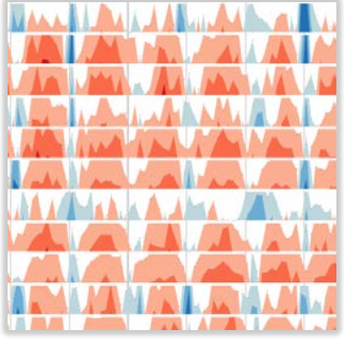


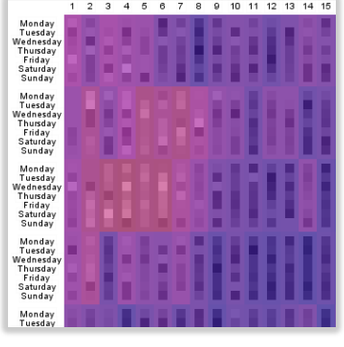
different time primitives

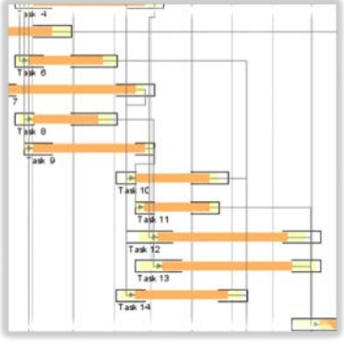


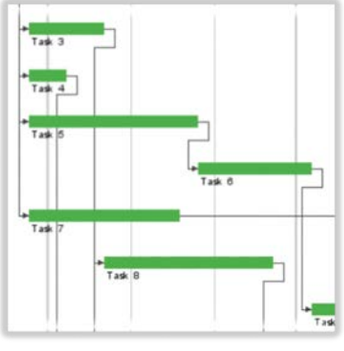
temporal indeterminacy

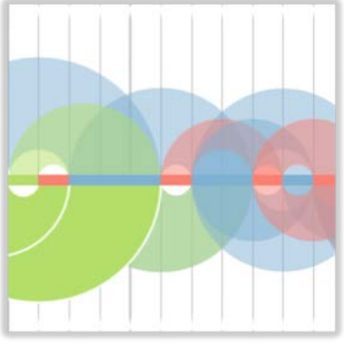


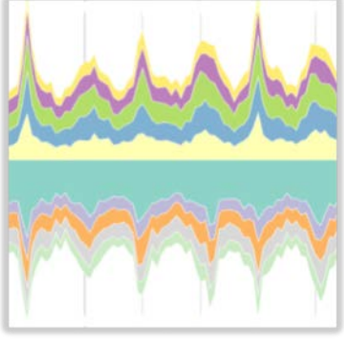








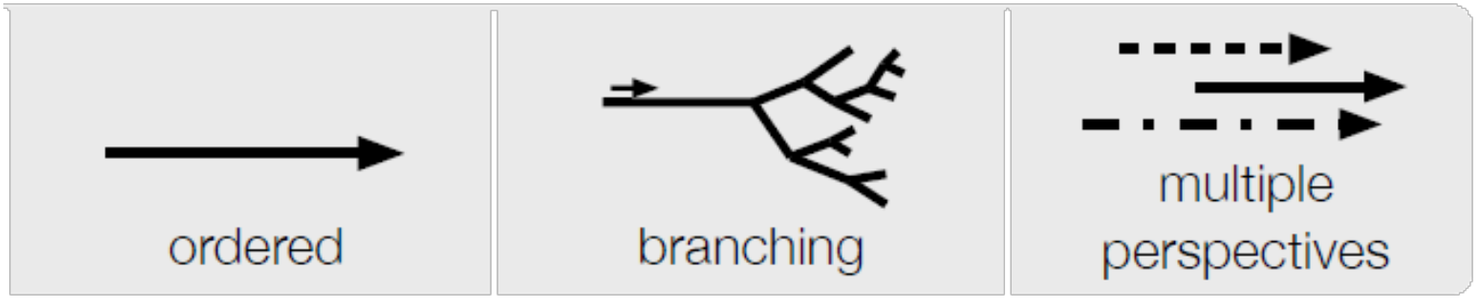




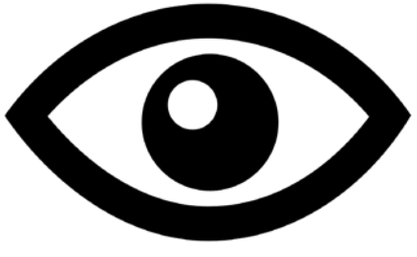
Rind, Lammarsch, Aigner, Alsallakh, Miksch:

TimeBench: A Data Model and Software Library for Visual Analytics of Time-Oriented Data – VAST/*TVCG, 2013*

Challenging Aspect: Viewpoints



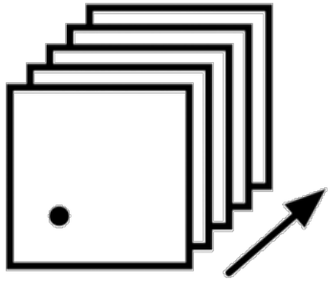
[Aigner et al., 2011]



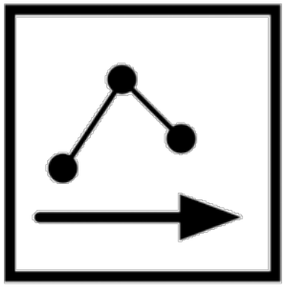
Visualizing Time-Oriented Data

Visualizing time

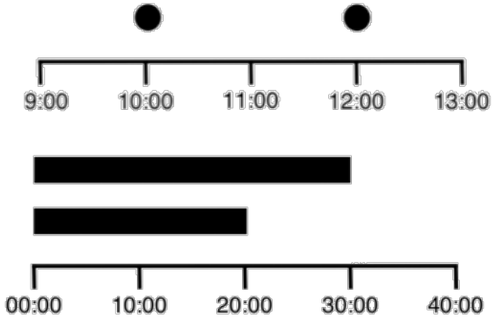
Dynamic:
Time → Time (Animation)

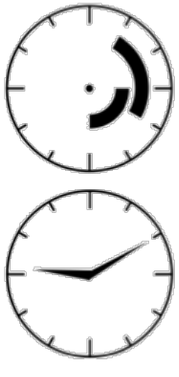


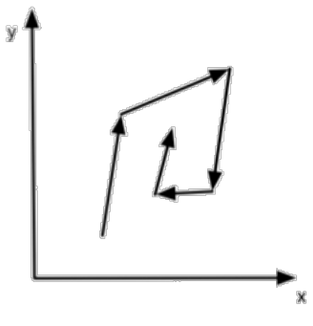
Static:
Time → Space

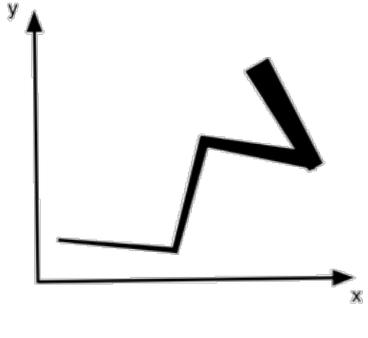


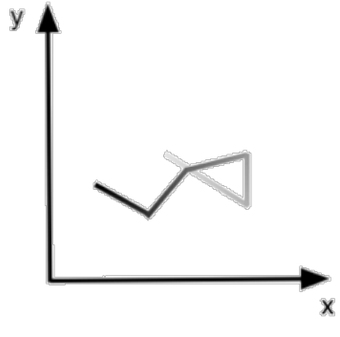
Visual variables:
position, length, angle, slope, connection, thickness, ...



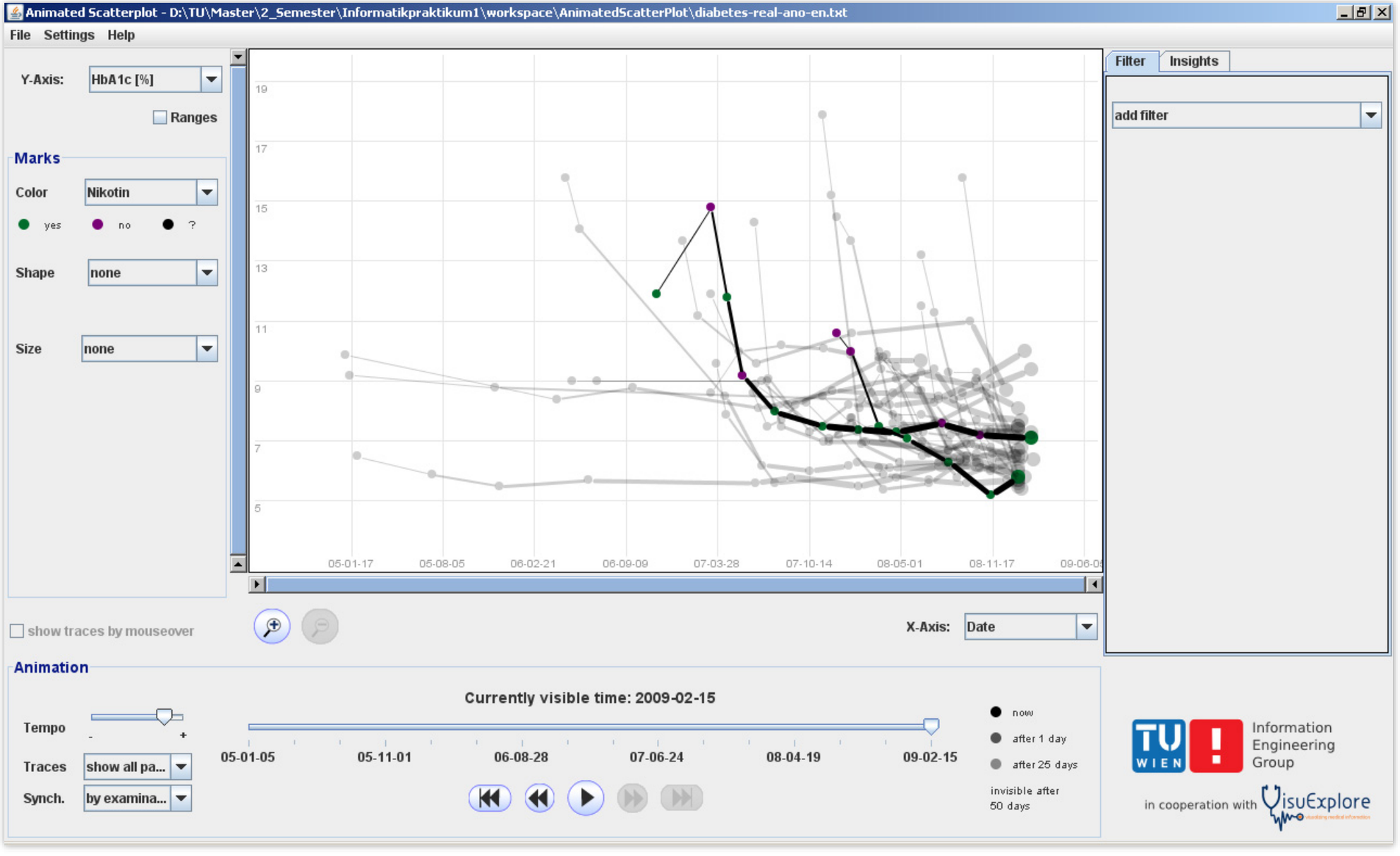








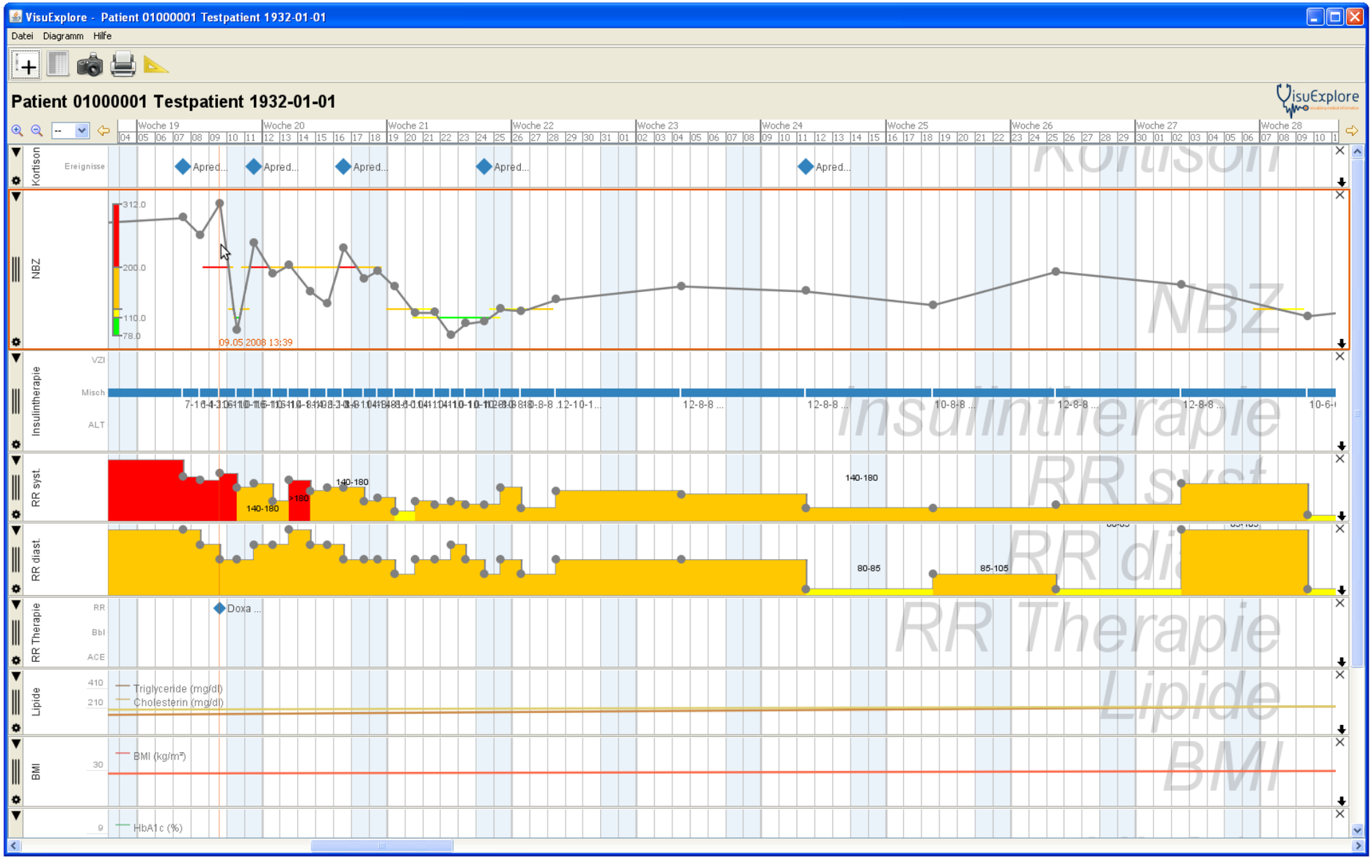
TimeRider



Rind, Aigner, Miksch, Wiltner, Pohl, Drexler, Neubauer, Suchy:

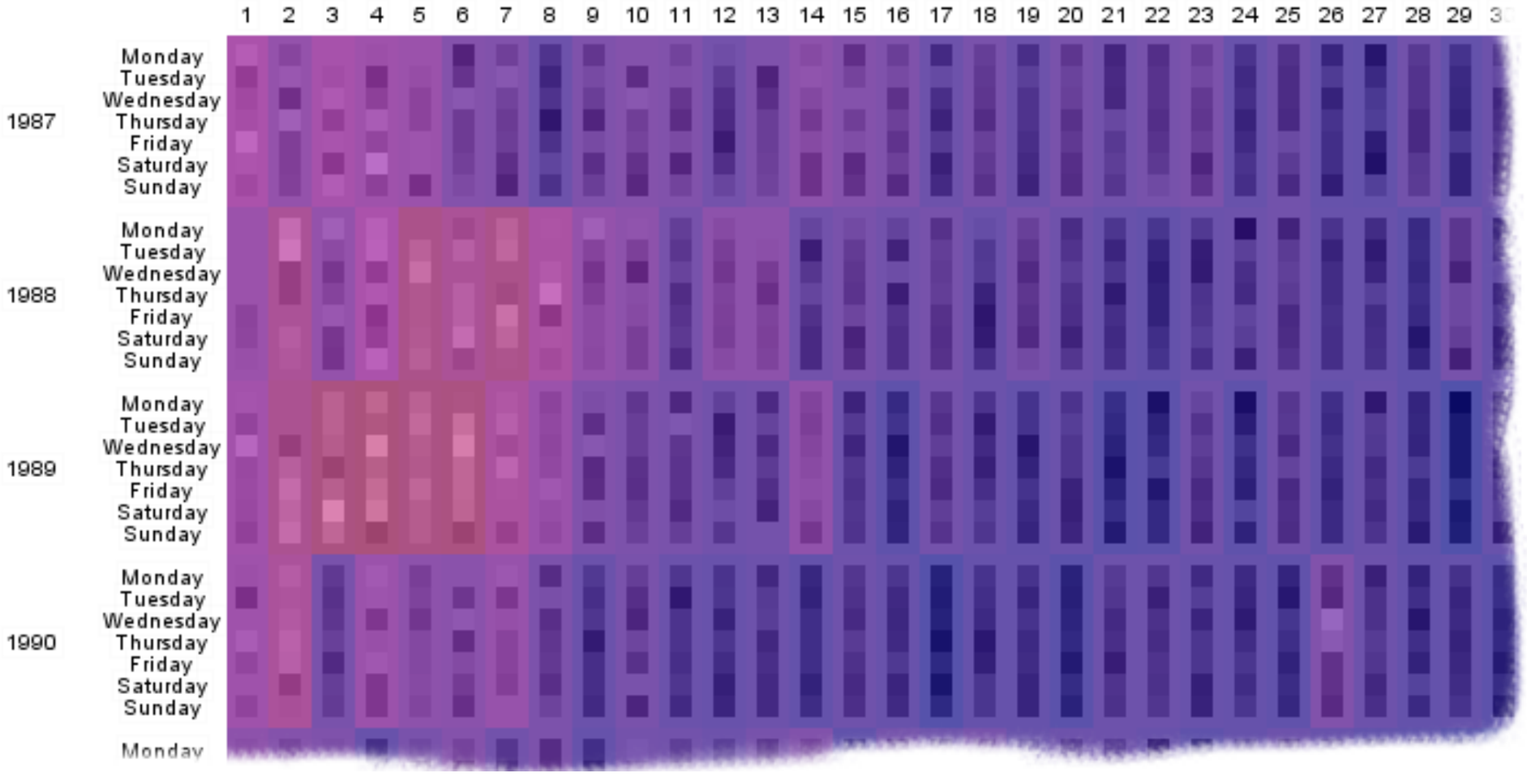
Visually Exploring Multivariate Trends in Patient Cohorts Using Animated Scatter Plots – *HCII, 2011*

VisuExplore



Rind, Aigner, Miksch, Wiltner, Pohl, Turic, Drexler:
Visual Exploration of Time-oriented Patient Data for Chronic Diseases: Design Study and Evaluation– *USAB, 2011*

GROOVE

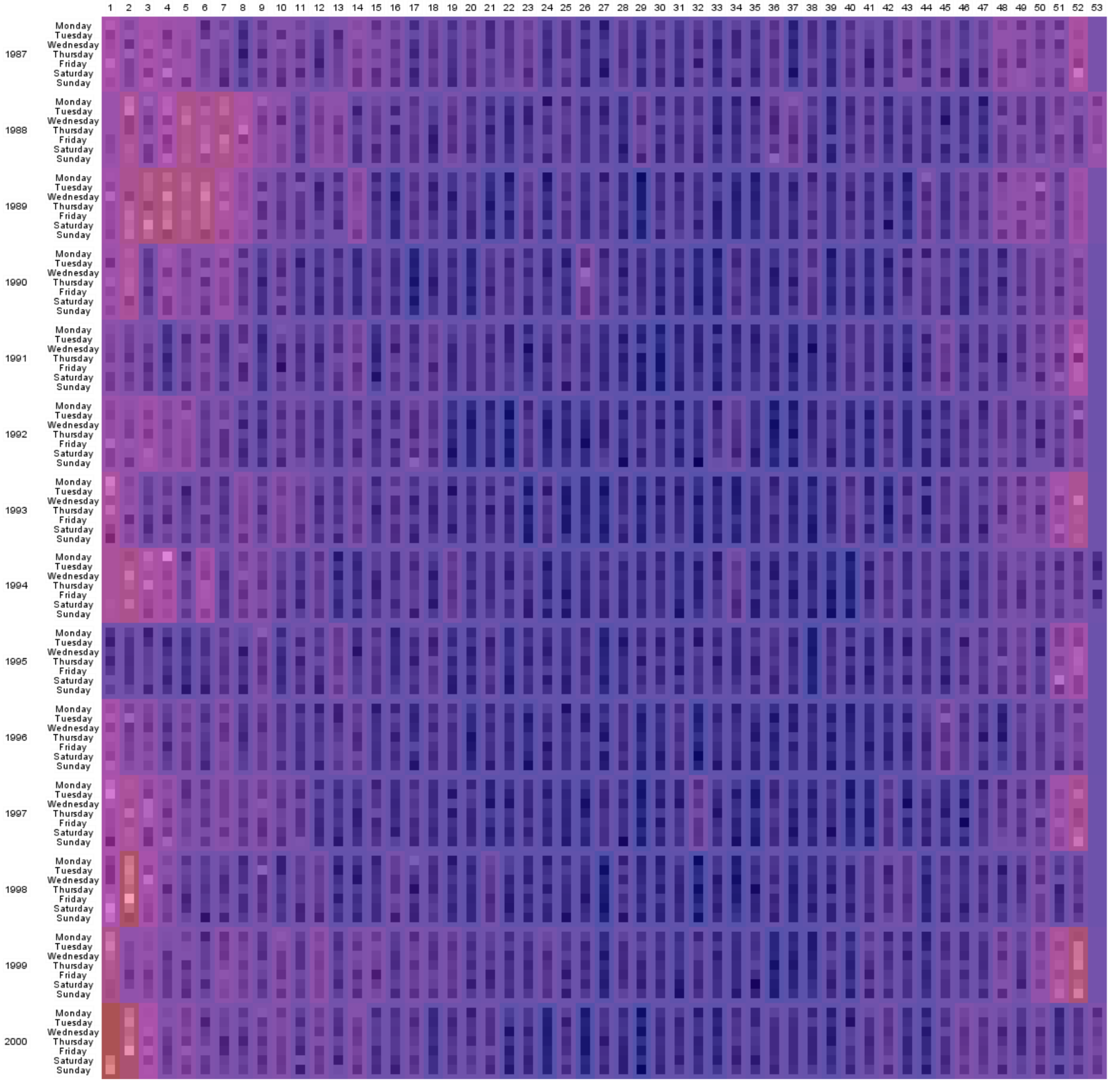


Lammarsch et al.:

Hierarchical Temporal Patterns and Interactive Aggregated Views for Pixel-Based Visualizations – *Proc. IV, 2005*

Rind, Lammarsch, Aigner, Alsallakh, Miksch:

TimeBench: A Data Model and Software Library for Visual Analytics of Time-Oriented Data – *TVCG, 2013*


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53
1987
1988
1989
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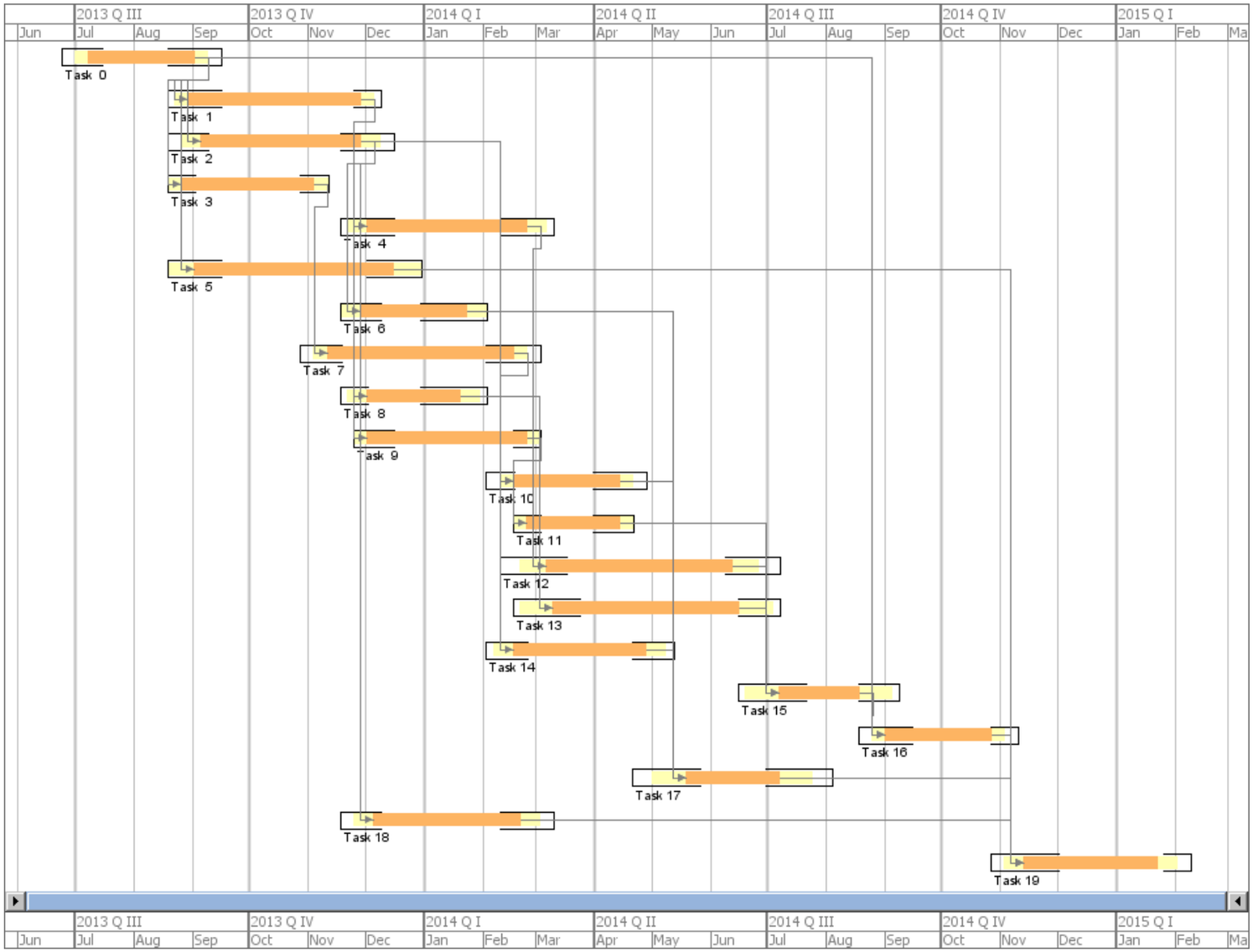
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

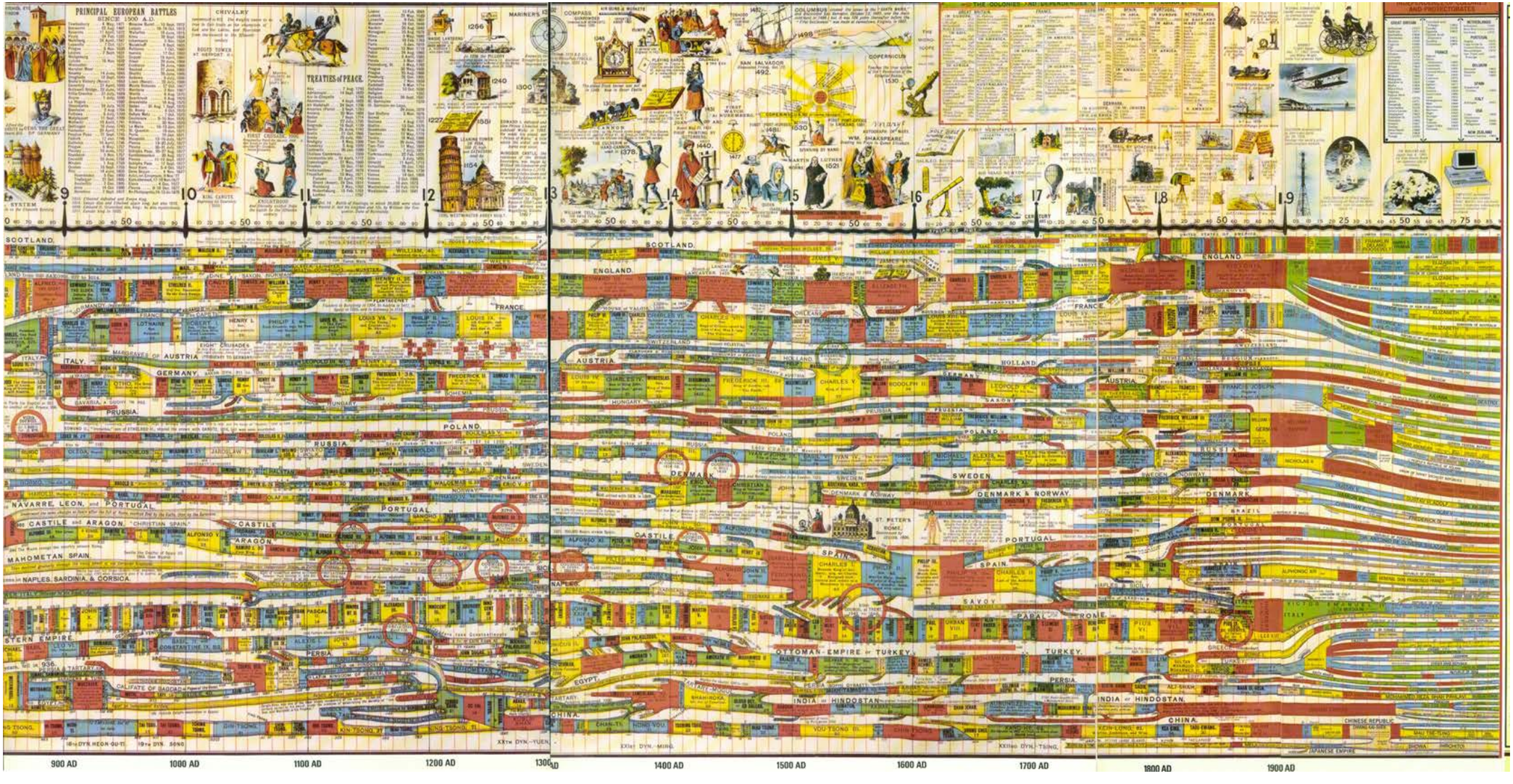
PlanningLines



Aigner et al.:
PlanningLines: novel glyphs for representing temporal uncertainties and their evaluation – *Proc. IV, 2005*
Rind, Lammarsch, Aigner, Alsallakh, Miksch:
TimeBench: A Data Model and Software Library for Visual Analytics of Time-Oriented Data – *TVCG, 2013*

Interacting with Time-Oriented Data

Example: Historical Timelines

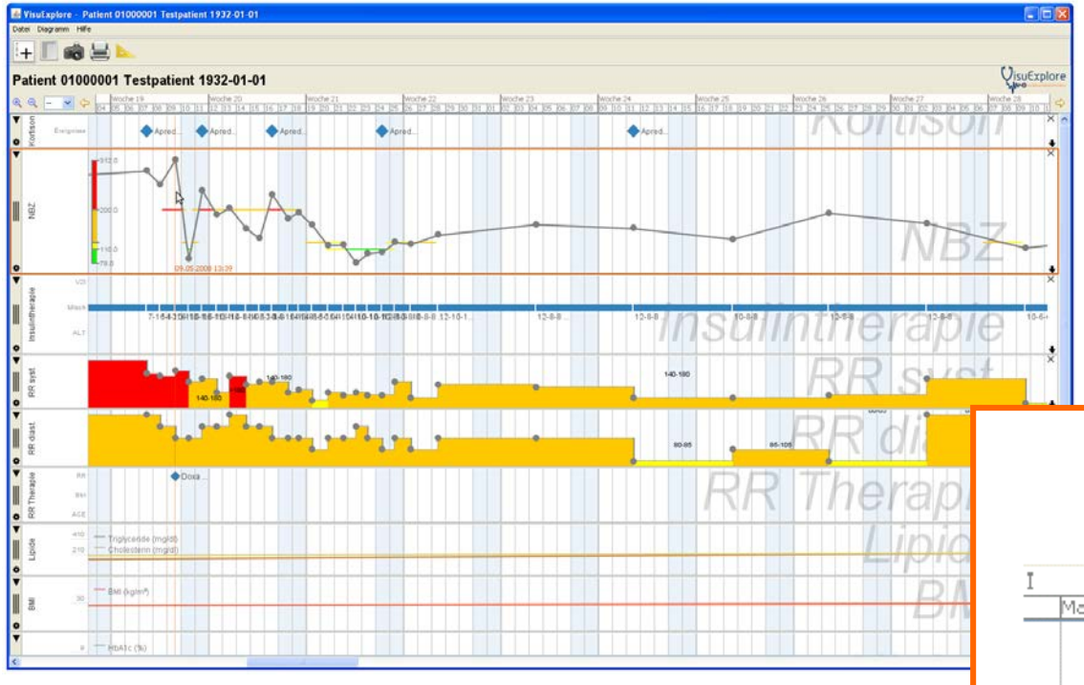


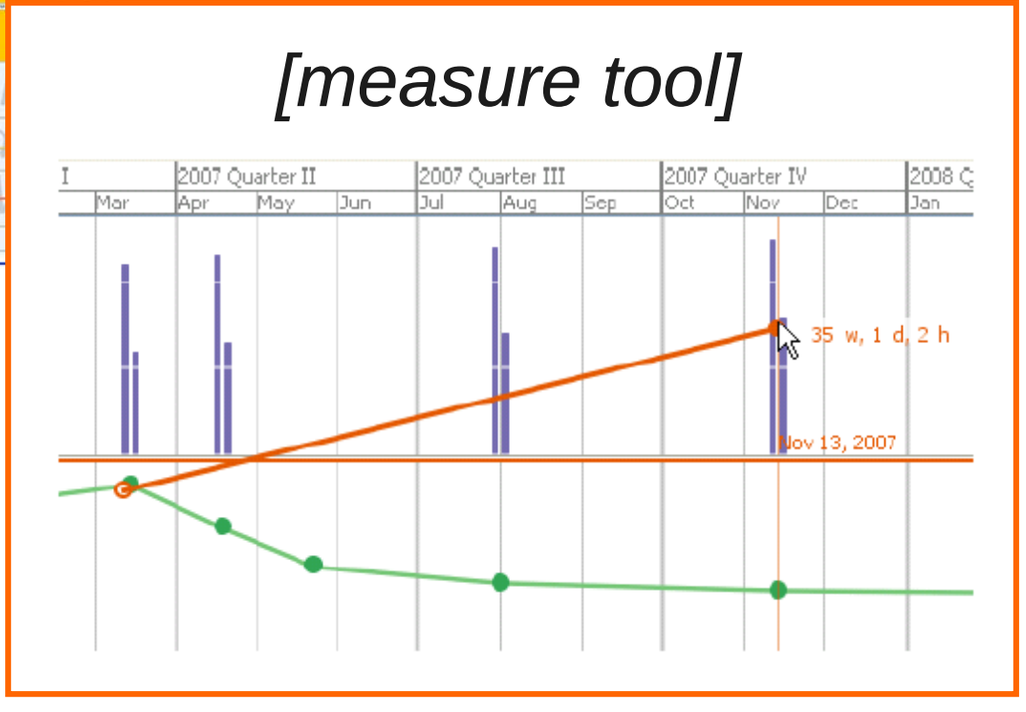
based on Deacon (1890)

Example: Historical Timelines

by Barbeu-Dubourg (1753)

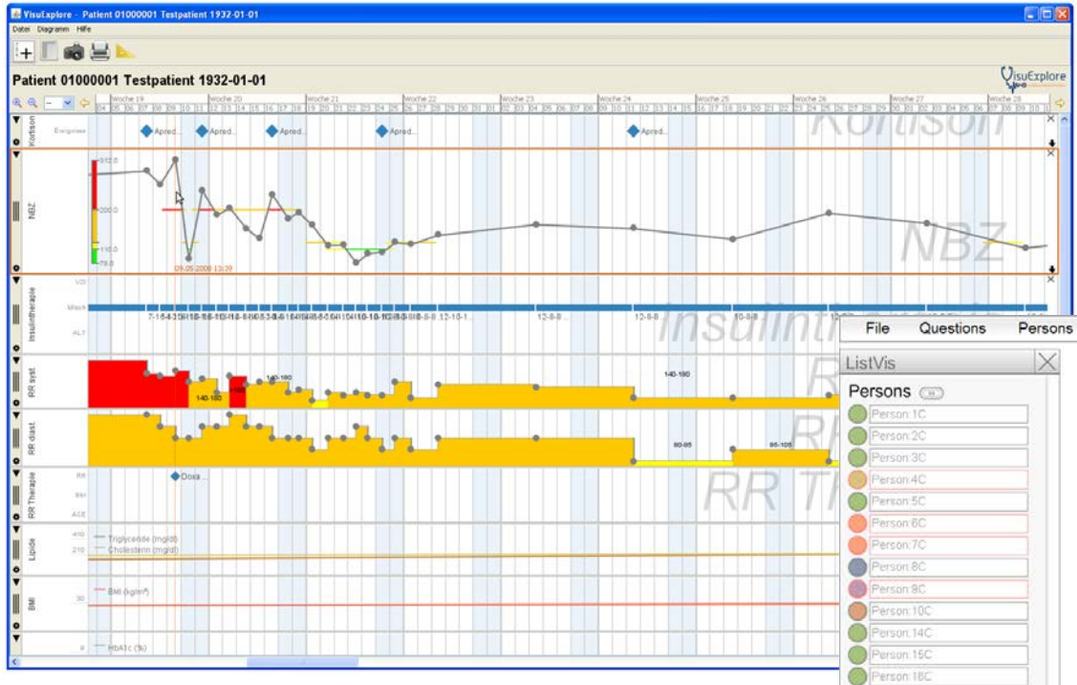
Example: Historical Timelines





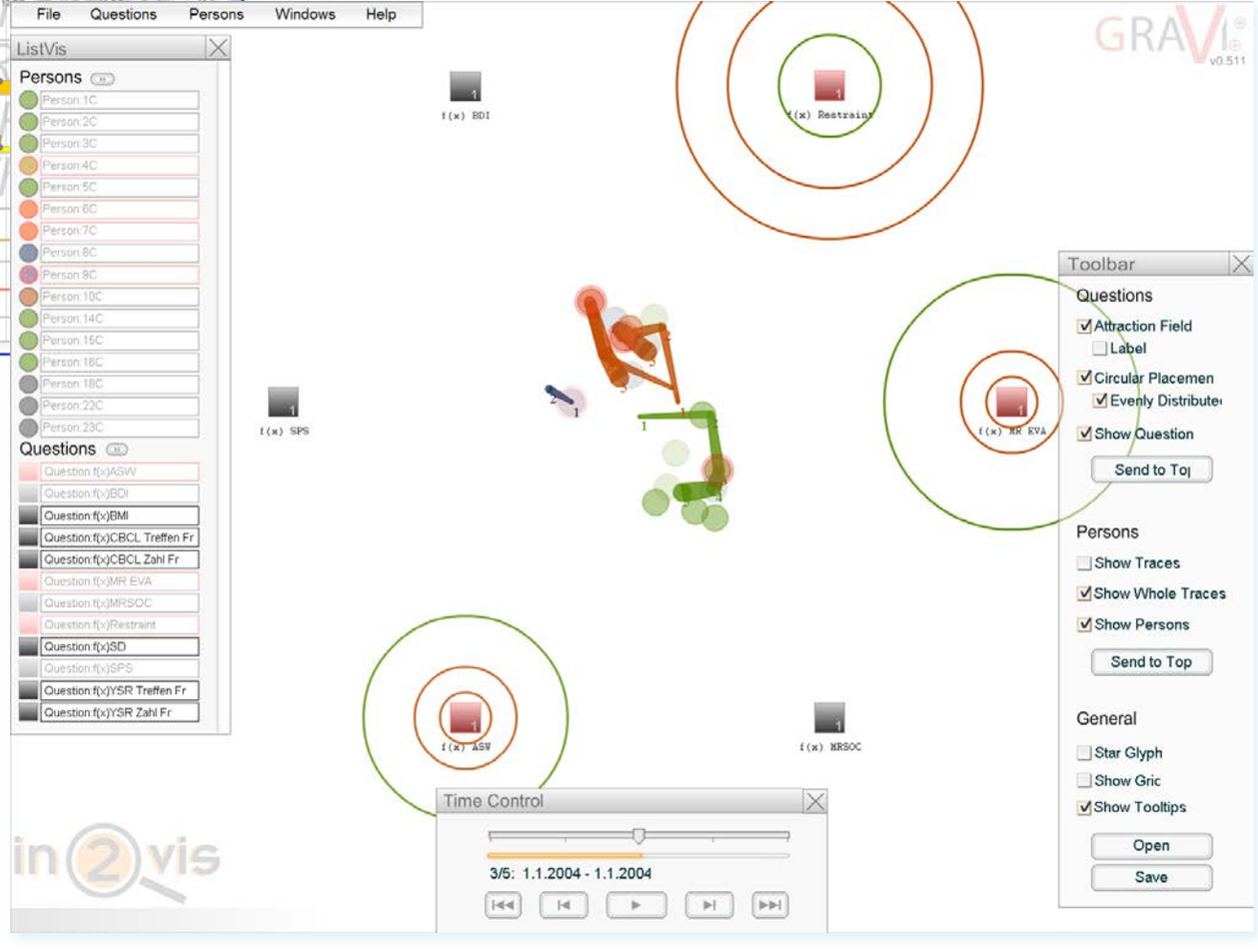
Rind, Aigner, Miksch, Wiltner, Pohl, Turic, Drexler:
Visual Exploration of Time-oriented Patient Data for Chronic Diseases: Design Study and Evaluation– *USAB, 2011*

VisuExplore vs. Gravi ++



[Rind et al., 2011]

[Hinum et al., 2005]



Pohl, Wiltner, Miksch, Aigner, Rind:
Analysing Interactivitz in Information Visualisation – *KI, 2012*

A Software Library for Visualization Evaluation

Reduces implementation effort for evaluation features

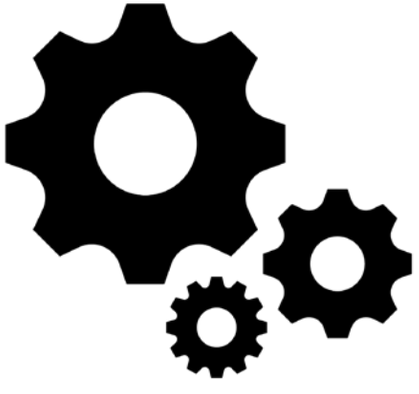
Consistent and reproducible execution of study protocols

Integrates well with existing visualization prototypes

Free and open source software (@GitHub)

supports: controlled experiments • interaction logging • laboratory questionnaires • heuristic evaluations • insight diaries

Aigner, Hoffmann, Rind:
EvalBench: Design and Implementation of a Software Library for Evaluation in Visualization - *CGF, 2013*



Automated Analysis of Time-Oriented Data

Temporal Data Mining

Example: Retail

A

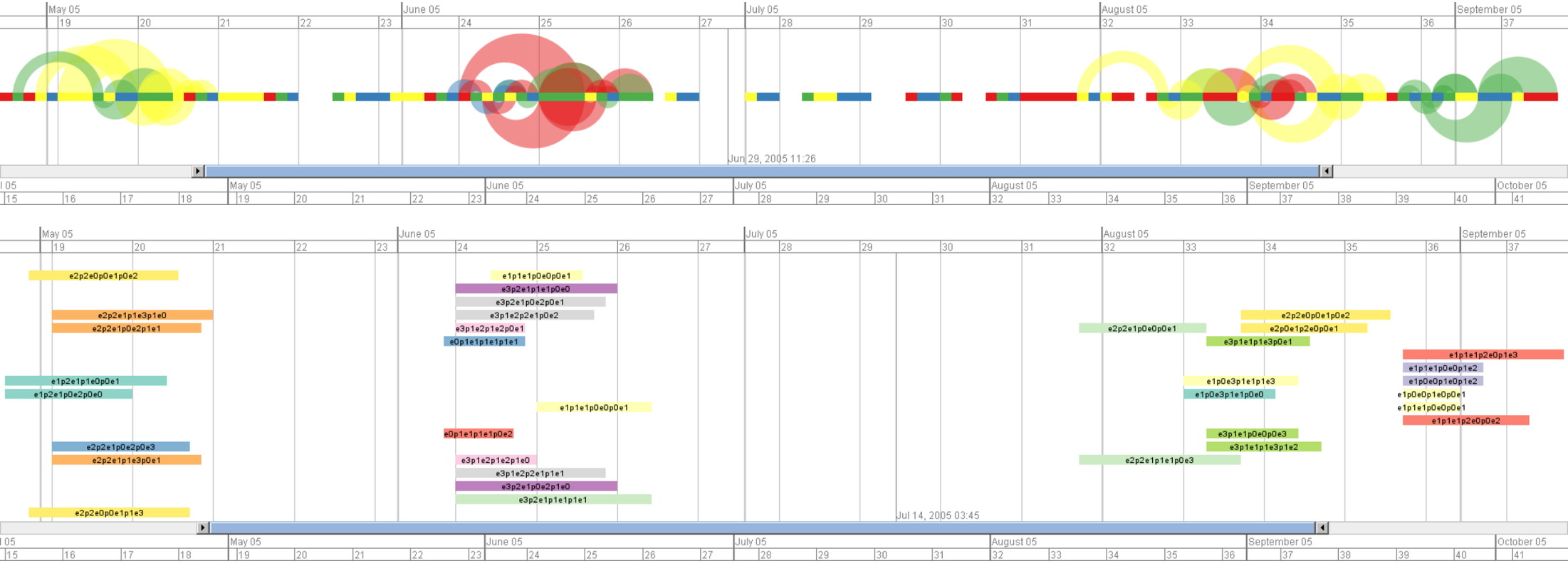
B

C

D

ABCD → A-*1day*-B-*5days*-C-*3months*-D

MuTIny & MEMuRY

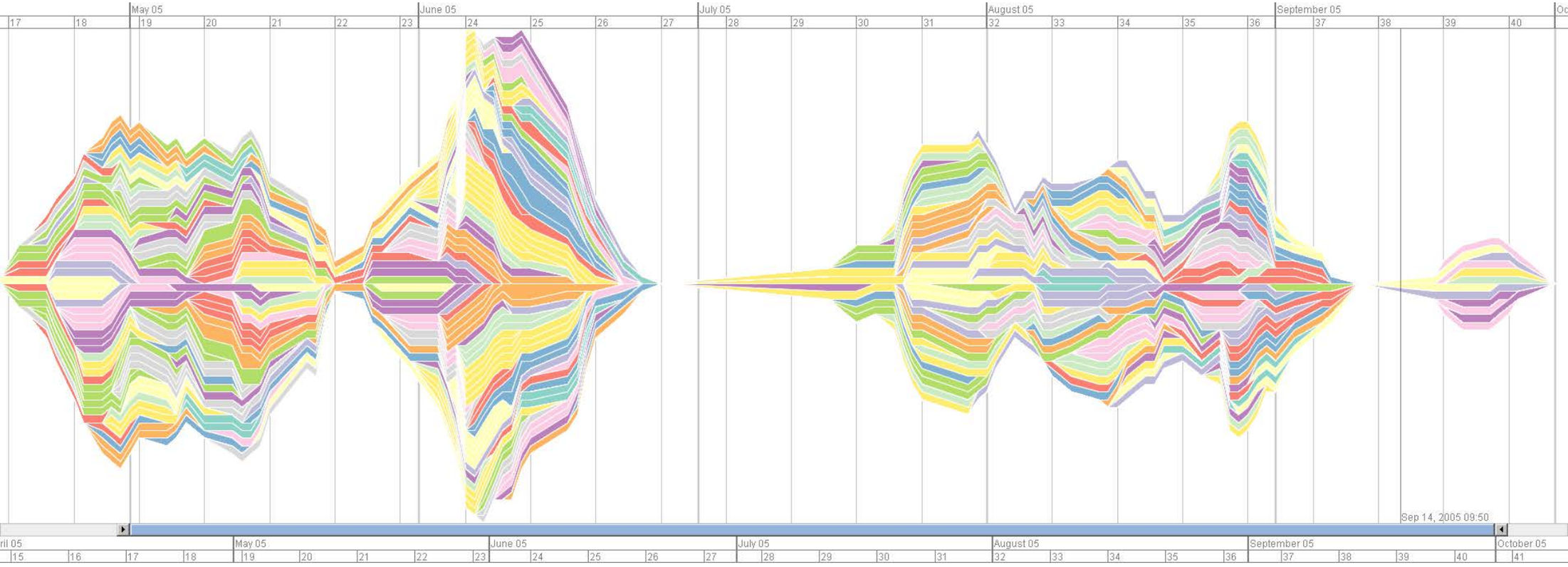


Lammarsch, Aigner, Bertone, Miksch, Rind:
Mind the Time: Unleashing Temporal Aspects in Pattern Discovery – *Computers & Graphics, 2014*

Bertone, Lammarsch, Turic, Aigner, Miksch, Gärtner:
MuTIny: A Multi-Time Interval Pattern Discovery Approach to Preserve the Temporal Information in Between - *ECDM, 2010*

Bertone, Lammarsch, Turic, Aigner, Miksch:
Does Jason Bourne need Visual Analytics to catch the Jackal? - *EuroVAST, 2010*

MuTIny & MEMuRY



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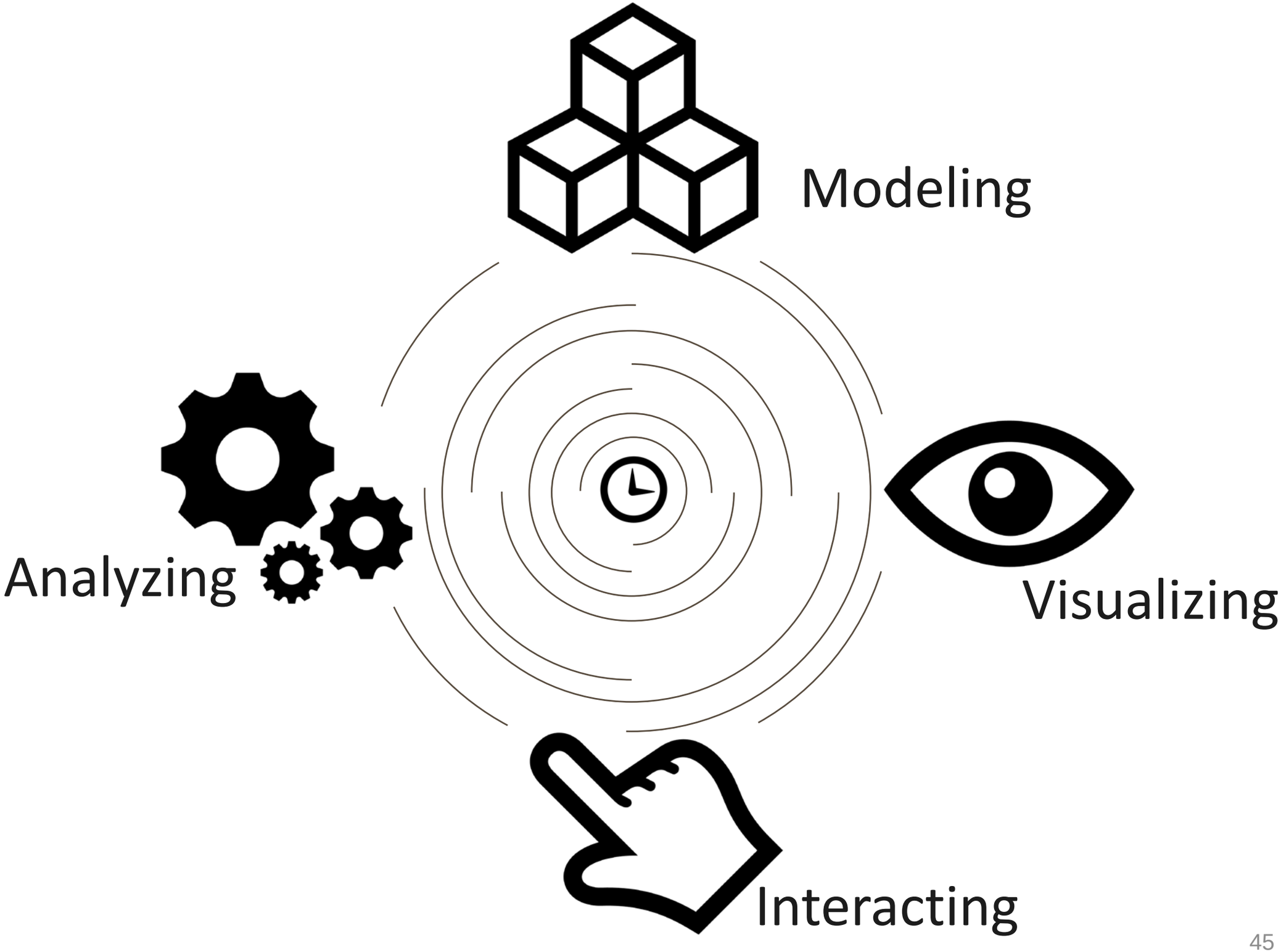

Modeling
Analyzing
Visualizing
Interacting

Future Challenges

Science of interaction

What is the role and value of interactivity for sensemaking with visualizations?

Knowledge-Assisted Visual Analytics

How can the Visual Analytics process benefit from externalized and shared knowledge of analysts?

Event Sequences in Software

How can we effectively analyze software behavior patterns, especially malicious behaviors?

Time in Humanities

How can we model time characteristics in narratives, plays, etc. such as multiple perspectives for visual analytics in humanities?

www.infovis-wiki.net

www.evalbench.org

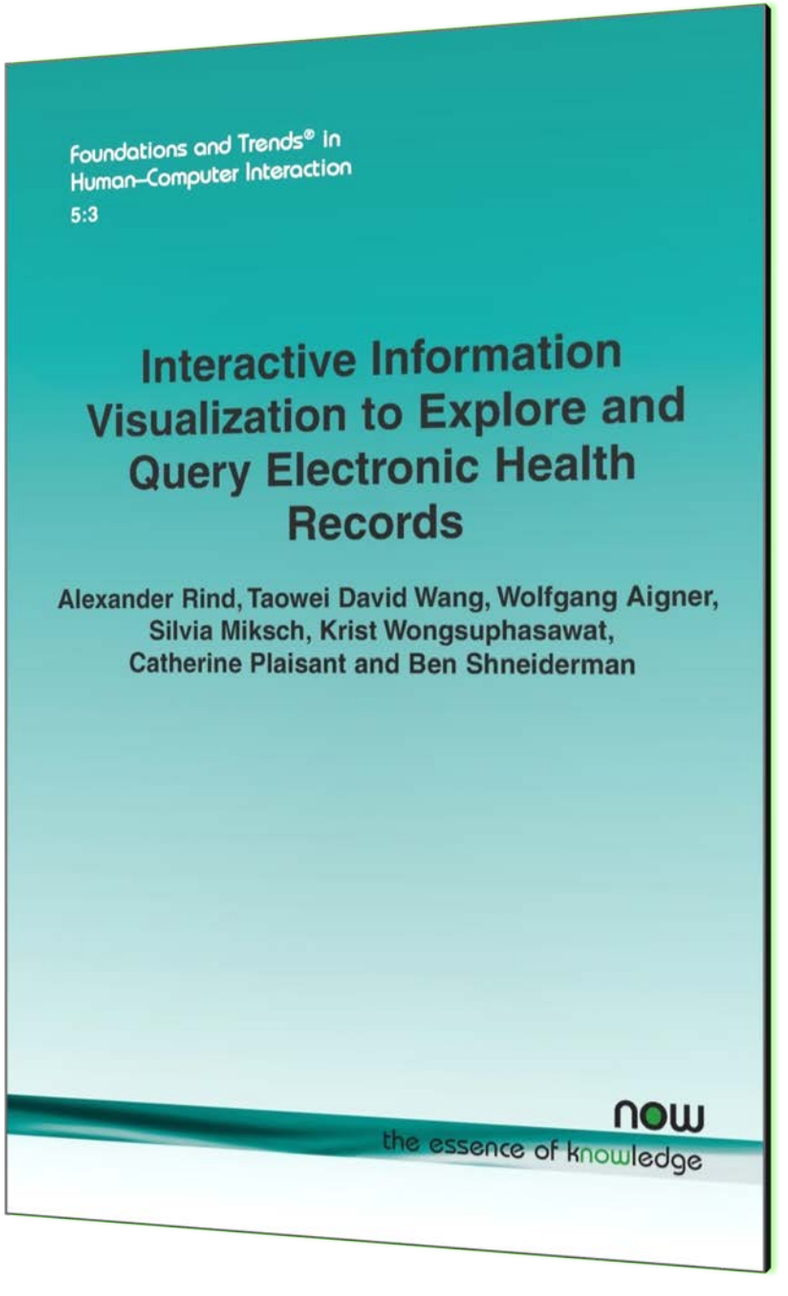
www.timebench.org

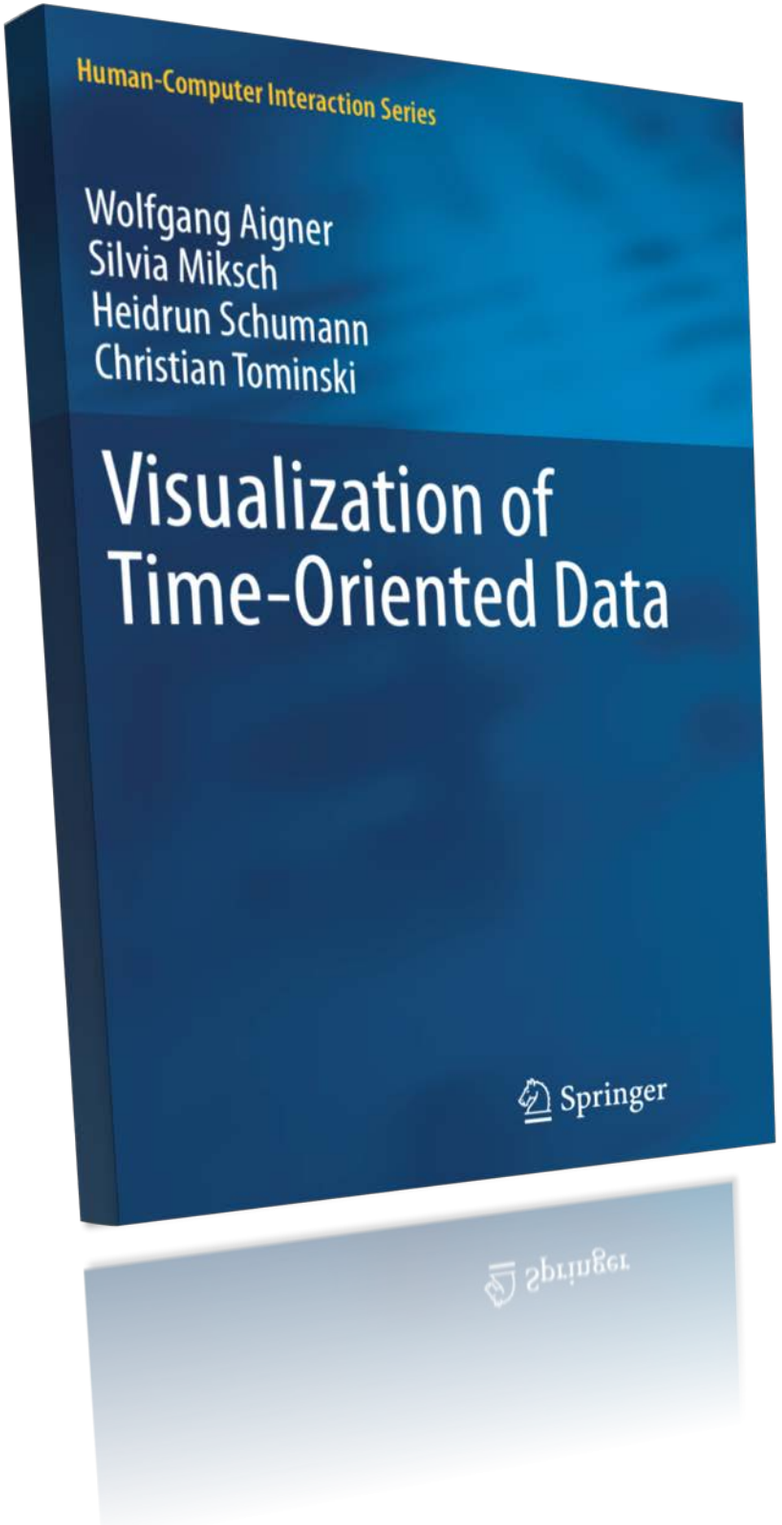
Alexander Rind • Taowei David Wang • Wolfgang Aigner • Silvia Miksch • Krist Wongsuphasawat • Catherine Plaisant • Ben Shneiderman

Interactive Information Visualization to Explore and Query Electronic Health Records

State of the Art Review

Foundations and Trends® in Human–Computer Interaction, 2013, 92 pages
doi: 10.1561/1100000039





Wolfgang Aigner • Silvia Miksch •
Heidrun Schumann •
Christian Tominski

Visualization of Time-Oriented Data

with a foreword by Ben Shneiderman

Springer

1st Edition., 2011, XVIII, 286 p. 221 illus., 198 in color.
Hardcover, ISBN 978-0-85729-078-6.

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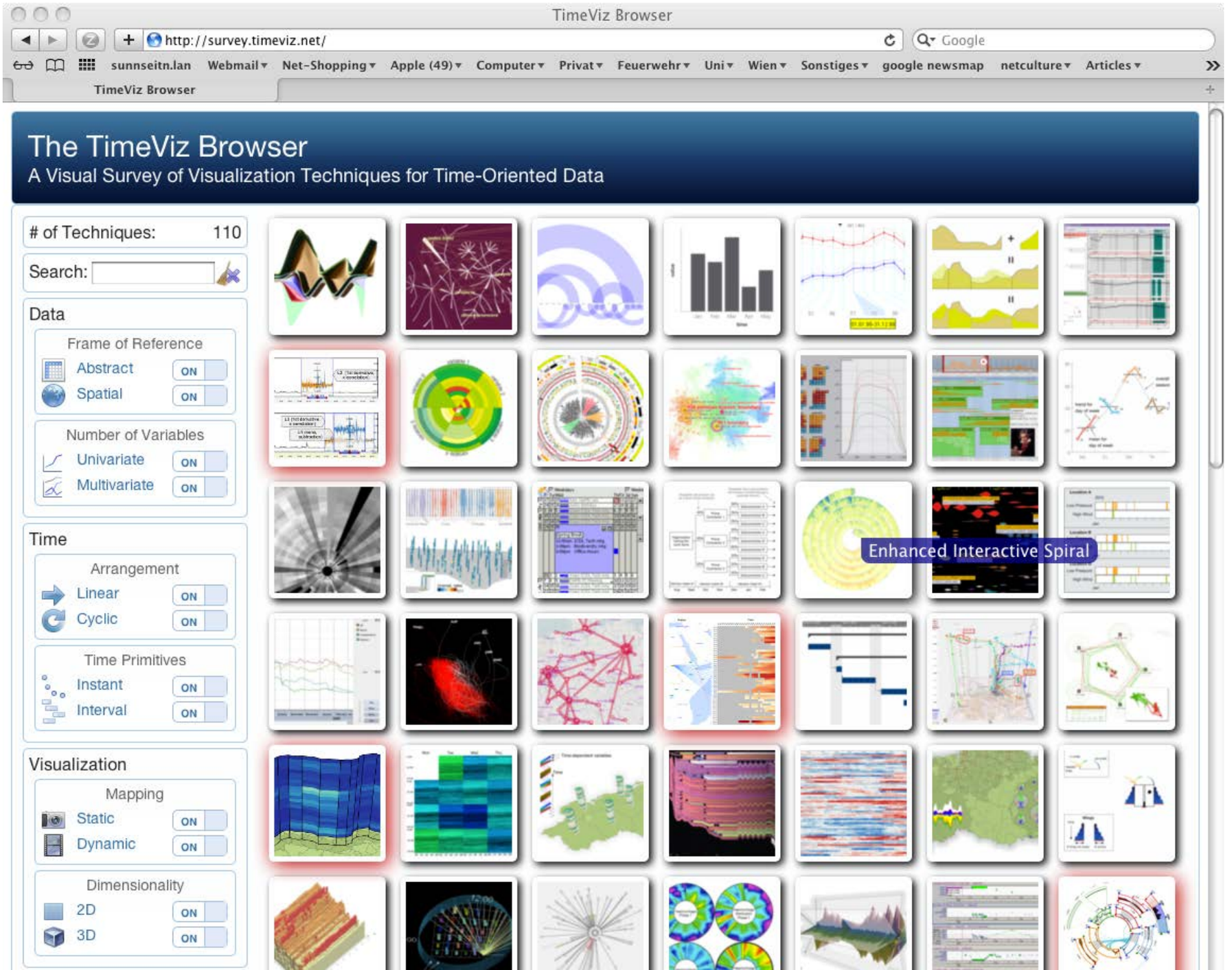
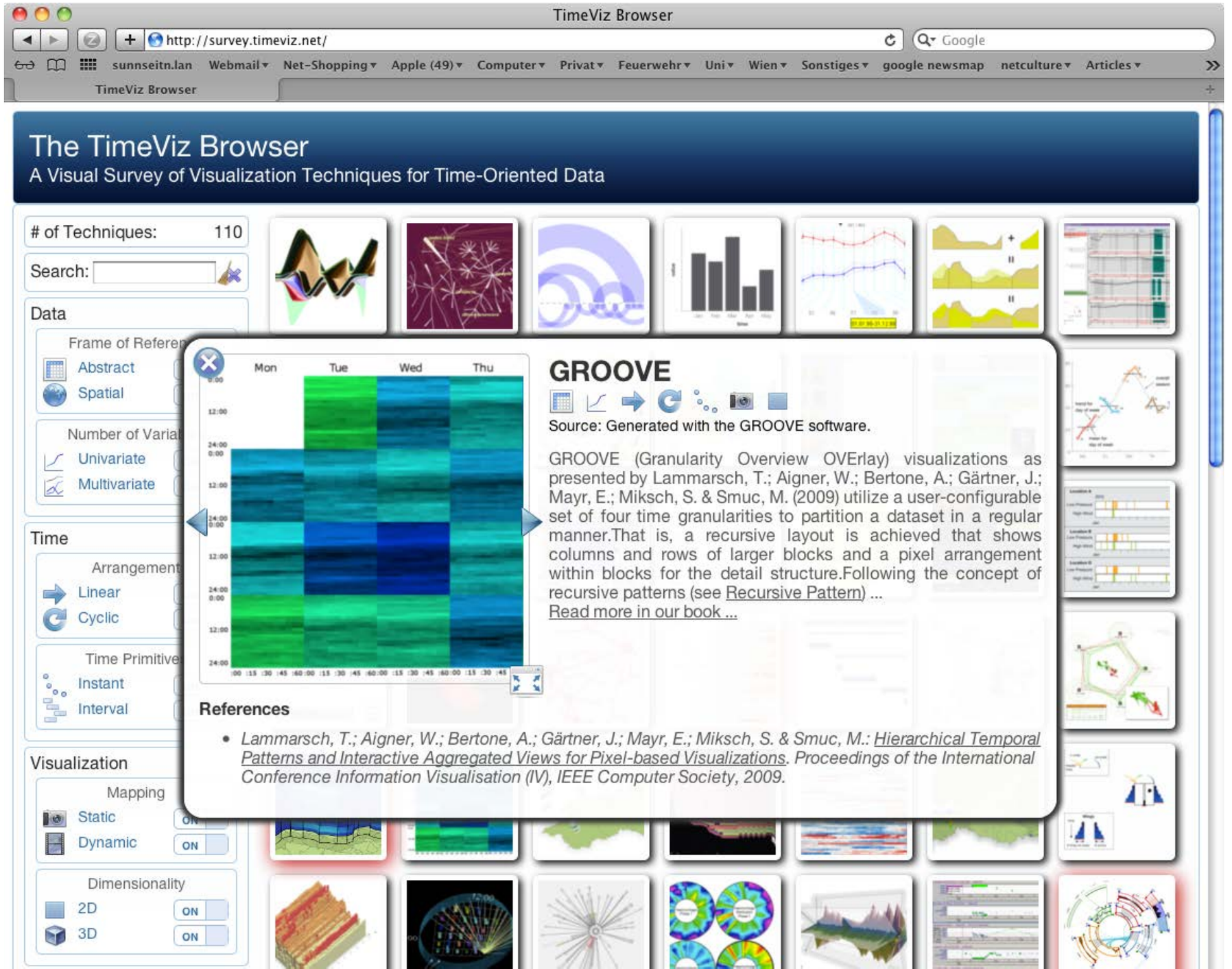
www.timeviz.net

survey.timeviz.net



survey.timeviz.net



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FFG FORSCHUNG WIRKT.
FWF Der Wissenschaftsfonds.
bmwfj Bundesministerium für Wirtschaft, Familie und Jugend
CENTRES OF EXPERTISE LAURA BASSI

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