Nudging People Into Log-Scale Thinking

Tamara Munzner
Department of Computer Science
University of British Columbia

Hackers Conference
9 Nov 2024

http://www.cs.ubc.ca/~tmm/talks.html#hackers24

@tamara@vis.social

Why did we want to nudge people into log-scale thinking?

- museum exhibit about deep time
- deep time: very long periods of time of geological processes
  - or other long timescales: evolutionary/biological, astronomical...
- museum exhibits: informal science education
  - a few seconds to engage, a few minutes if you're lucky
  - not trapped in a classroom, they can and will wander away
- collaboration
  - visualization researchers, geoscience education researchers, museum curators

2

From goals to project requirements

- goal: support museum visitors in improving their proportional learning skills by facilitating comparisons between historical events on exponentially increasing time scales
  - unpack into five project requirements
- **Staff facing**
  - **R-Deploy**: find/build collaborations that lead to deployment
  - **R-Curate**: enable non-technical museum staff to curate datasets
- **Visitor facing**
  - **R-Engage**: engage visitors through enjoyment or interest
  - **R-Inspire**: inspire curiosity to foster positive relationships with science
  - **R-Compare**: support task of **comparing varied-magnitude time periods**

3

What Have Others Done?

4

Trail of Time: Multi-hour walk

- interpretive trail in Grand Canyon
- 1 meter represents 1 million years
- visceral experience unfolds over hours & kilometers

https://tot.unm.edu/

5

Powers of Ten: Ten-minute animation

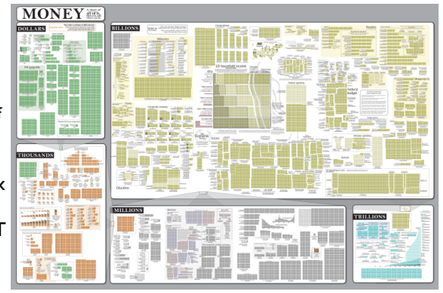
- animation zooms from human out to galactic in to subatomic scales
- visceral sense of time passing over the minutes
- animation costs: duration, plus high memory load

https://youtu.be/0fKBhvDjuy0

6

XKCD Money: Concrete scales

- compare sizes of familiar things
  - 1 Starbucks latte per day for a year
  - box office revenue of Titanic
  - one fighter jet
- unitization: each box is $1, or $1K, or $1M, or $1B, or $1T
- must zoom to read



https://xkcd.com/980/huge

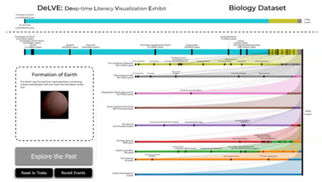
7

What Did We Do?

8

DeLVE Look and Feel Video

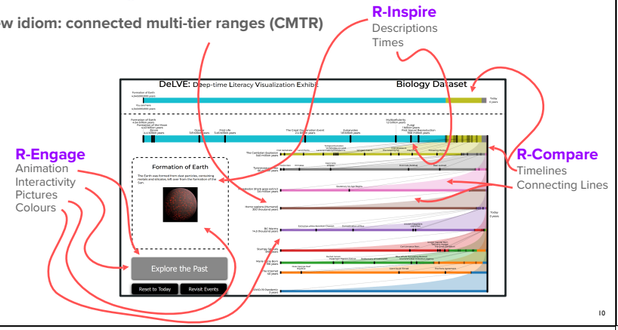
Mara Solen, Nigar Sultana, Laura Lukes, Tamara Munzner



9

Visual encoding: Connected Multi-Tier Ranges

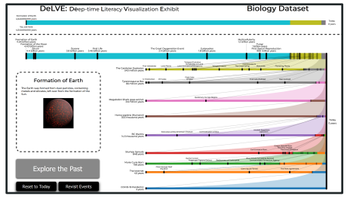
New idiom: connected multi-tier ranges (CMTR)



10

Visual encoding: Connected Multi-Tier Ranges

- concrete scales
  - start with familiar
- side by side views
  - all ranges stay visible, after builds
  - within range: linear
  - follow log shaped relation curves to see relative length of times on exponentially increasing scales
- animation for transitions only
  - animation for everything would hit limits of human visual memory



11

Data abstraction

- not the common visualization use cases where datasets known in advance
  - exploratory data analysis
  - communication / presentation
- instead, nudging towards understanding of abstract concept
  - museum curators specify in spreadsheet tied to their particular museum's collection
  - what properties should curated datasets have?
- abstraction: values & ranges
  - monotonic: ordered from smallest to largest
  - contiguous: neighbouring ranges share edges
  - disjoint: individual ranges do not overlap

12

DeLVE Into Earth's Past:

A Visualization-Based Exhibit Deployed Across Multiple Museum Contexts

joint work with:
Mara Solen, Nigar Sultana, Laura Lukes

paper page:
https://www.cs.ubc.ca/group/infovis/pubs/2024/delve/

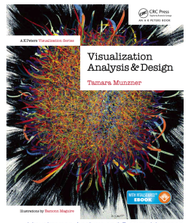
live demo:
https://deeptime.cs.ubc.ca/

DeLVE into Earth's Past: A Visualization-Based Exhibit Deployed Across Multiple Museum Contexts
Solen, Sultana, Lukes, and Munzner. IEEE TVCG to appear (Proc. IEEE VIS 2024).

13

More stuff

- this talk
  http://www.cs.ubc.ca/~tmm/talks.html#hackers24
- book
  http://www.cs.ubc.ca/~tmm/vadbook
- full courses, papers, videos, software, talks
  http://www.cs.ubc.ca/group/infovis
  http://www.cs.ubc.ca/~tmm



Visualization Analysis and Design. Munzner.
CRC Press, AK Peters Visualization Series, 2014.

@tamara@vis.social

14