No unjustified 3D: Danger of depth

- we don't really live in 3D: we see in 2.05D
  - acquire more info on image plane quickly from eye movements
  - acquire more info for depth slower, from head/body motion

Occlusion hides information

- occlusion
- interaction complexity

Perspective distortion loses information

- perspective distortion
  - interferes with all size channel encodings
  - power of the plane is lost!

No unjustified 3D example: Time-series data

- extruded curves: detailed comparisons impossible

Why not animation?

- disparate frames and regions comparison difficult
  - vs contiguous frames
  - vs small region
  - vs coherent motion of group

Eyes beat memory example: Cerebral

- small multiples: one graph instance per experimental condition
  - some spatial layout
  - color differently by condition

Why not animation?

- disparate frames and regions comparison difficult
  - vs contiguous frames
  - vs small region
  - vs coherent motion of group

- change blindness
  - even major changes difficult to notice if mental buffer wiped

- special case
  - animated transitions
Resolution beats immersion

Overview first, zoom and filter, details on demand

• Influential mantra from Shneiderman


  • overview = summary

  • microcosm of full vis design problem

  • nuances

  — beyond just two levels: multi-scale structure

  — difficult when scale huge: give up on overview and browse local neighborhoods?


  • Algorithm

  • Domain situation

  — You misunderstood their needs

  — You're showing them the wrong thing

  — Visual encoding/interaction idiom

  — The way you show it doesn't work

  — Algorithm

  — Your code is too slow

  — Data/task abstraction

  — It's not the right data to visualize

  — The data is already abstracted

  — It's not the right abstraction to display

  — Algorithm

  • Further reading


  • Chap 6: Rules of Thumb


  • Design Studies: Lessons learned after 21 of them

  — Four Levels of Design

  — Analysis:  What, Why, How

  — Design: How to Do Design Studies

  —4 Levels of Design

  — 2 Levels of Validation

  — Nested Levels of Design and Validation

  — Further reading

  • Design Study Methodology: Reflections from the Trenches and from the Stacks

  • Domain situation

  — You misunderstood their needs

  — You're showing them the wrong thing

  — Visual encoding/interaction idiom

  — The way you show it doesn't work

  — Algorithm

  — Your code is too slow

  — Data/task abstraction

  — It's not the right data to visualize

  — The data is already abstracted

  — It's not the right abstraction to display

  — Algorithm

  • First, focus on functionality

  — start with focus on functionality

  — straightforward to improve aesthetics later on, as refinement

  — if no expertise-in-house, find good graphic designer to work with

  — dangerous to start with aesthetics

  — usually impossible to add function retroactively

  — Final presentation, work, projects, future work

  — Pitfall Example: Premature Publishing

  • metaphor: horse race vs. music debut

  • Pitfall Example: Premature Publishing
Cancer Research
• collaboration with analysts at BC Genome Sciences Center
  – studying genetic basis of leukemia
• two big questions
  – what to show
    • data abstraction
    • challenge: enormous range of scales in the data
  – how to show
    • visual encoding idiom

Dominant paradigm: genome browsers
• strengths: flexible and powerful
  – horizontal tracks: user data
  – shared coordinate system: genome coordinates (bp)
• problems
  – tiny features of interest spread out across large extent
  – must zoom far in to inspect
  – high cognitive load for interaction
  – must already know where to look
  – no need for pan and zoom

Data: Filtering to relevant biological levels and scales
• Sequence Variant Definition
  – Sequence variants
    • Difference between reference and given genome
  – Discovery:
    • harmful variants
    • new candidate genes

Features of interest small even in variant-specific view
• pruning: reduce, filter, aggregate, embed
  • pruning
  – remove irrelevant information
  – focus on pertinent details

Abstractions
• Idioms
  – Visualization Analysis Framework
  – Idiom Design Choices, Part 2

Guidelines and Examples
• Map Color
  – for genome browsers

Filter out whole genome, keep genes
• Exon regions small

Visualization Analysis Framework
Session 1 10:00am-11:15am
– Introduction: Definitions
– Analysis: What, Why, How
– Marks and Channels

Idiom Design Choices
– Arrange Tables
– Arrange Spatial Docs
– Arrange Networks and Trees
– Map Color

Session 2 11:00am-12:15pm
– Guidelines and Examples
– Rules of Thumb
– Validation

Further reading
  – Chap 4: Analysis: Four Levels for Validation
  – Visualization Analysis Framework
  – Data: Filtering to relevant biological levels and scales
  – Design Study Methodology: Reflections from the Trenches and from the Stacks.

Outline
• Visualization Analysis Framework
  – Introduction: Definitions
  – Analysis: What, Why, How
  – Marks and Channels
• Idiom Design Choices, Part 2
  – Arrange Tables
  – Arrange Spatial Docs
  – Arrange Networks and Trees
  – Map Color
• Idiom Design Choices
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  – Validation

Further reading
  – Chap 4: Analysis: Four Levels for Validation
  – Visualization Analysis Framework
  – Data: Filtering to relevant biological levels and scales
  – Design Study Methodology: Reflections from the Trenches and from the Stacks.

Variant View: Visualizing Sequence Variants in their Gene Context.
http://www.cs.ubc.ca/~tmm/talks.html#minicourse14

Data abstraction: highly filtered scope of transcript coordinates
• strengths: flexible and powerful
  – horizontal tracks: user data
  – shared coordinate system: genome coordinates (bp)
• problems
  – tiny features of interest spread out across large extent
  – must zoom far in to inspect
  – high cognitive load for interaction
  – must already know where to look

Filter out non-exon regions
• Exon regions small

Presentation Example: Example 1

Variant View: Visualizing Sequence Variants in their Gene Context.
http://www.cs.ubc.ca/~tmm/talks.html#minicourse14
In contrast, low scoring genes...  

No collocation of variants

Mostly unaffected protein regions

**Methods**

- **Phase 1: Winnow and Cast**
  - 3 months
  - **embedded within GSC for all stages**
  - **winnow stage**
    - considered and ruled out many potential collaborators
  - **cast stage**
    - **gatekeeper (PI)**
    - two front-line analysts (postdocs)

- **Phase 2: Core Design**
  - 5 months
  - **main task abstraction**
    - discover gene
  - **semi-structured interviews**
    - every week for 1 hr
  - **iterative refinement**
    - 8 data sketches deployed

- **Phase 3: Two More Tasks**
  - 1 month
  - **two new analysts**
    - connected by enthusiastic gatekeeper
  - **new task abstractions**
    - compare patients
    - debug pipeline
  - **minimal changes**

- **Phase 4: Reflect and write**
  - 3 months
  - **abstraction innovation**
    - data abstraction: highly filtered transcript coordinates (vs genome coordinates)
  - **guidelines**
    - specialise first, generalise later
  - **high-level considerations**
  - **what to visually encode directly vs what to support through interaction**
  - **when (and how) to eliminate navigation**

**Outline**

- **Visualization Analysis Framework**
  - Session 1 9:30-10:45am
    - Introduction: Definitions
    - Analysis: What, Why, How
    - Marks and Channels

- **Idiom Design Choices, Part 2**
  - Session 3 11:00am-12:15pm
    - Manipulate: Change, Select, Navigate
    - Focus: Juxtapose, Partition, Superimpose
    - Reduce: Filter, Aggregate, Embed

- **Idiom Design Choices**
  - Session 2 11:00am-12:15pm
    - Arrange Tables
    - Arrange Spatial Data
    - Arrange Networks and Trees
    - Map Color

- **Guidelines and Examples**
  - Session 4 1:15pm-2:45pm
    - Rules of Thumb
    - Validation
    - BioVis Analysis Example

**More Information**

- book
- this tutorial
- papers, videos, software, talks, courses
- conferences
  - VIS, VAST, InfoVis, SciVis
  - 2014 Paris, Nov 9-14
  - EuroVis
  - 2014 Swannee, Jun 9-13
  - BioVis
  - 2014 Boston, Jul 11-12 (w/ ISMB)
  - VizBi
  - 2015 Boston, March 25-27

[http://www.cs.ubc.ca/~tmm/talks.html#minicourse14](http://www.cs.ubc.ca/~tmm/talks.html#minicourse14)