Interaction

– multiple views in 3 modes
   – overview
   – detail view for selected single-image (full-right)
   – thumbnail view on selected single-image (left-right)
– data sources
– linked highlighting
– selection tools
– focused region
– zooming
– shifting range or size
– detail view on selected spatial extent

Case study: novice user

– speed: 10 min to find contiguous part of parameter space that yields high-quality results

Case study: expert user

– quality: higher quality result from considering over 3K images

Presentation topic choices

– presentation topic choices due next Friday (Oct 25) at 5pm
  – post your choice to discussion thread on Canvas 1 or 2 topic choices
  – all of us have more than one person with same choice
  – timing let me know if a specific day is bad for you ("even day")

– from this set Nov 5, 12, 19, Dec 4
  – I’ll assign days soon
  – I’ll assign papers (from this year’s VIS conf) at least 1 week before your presentation

– more on presentation expectations next time (Oct 29)

Ch 10: Manipulate

Data

– data: samples & output
  – CellProfiler full pipeline has 150-200 params
  – 10-20 modules w/ 5-20 params each
– derived data: table
  – rows are unique combos of sampled parameter values
  – columns = user-selected parameters
– derived data: hierarchical clustering
  – root of tree visualizes reference image w/ input parameters
  – found-good vs bad
– strategy
  – offline batch processing to compute, then interactive exploration of output

Overview

– cluster hierarchy of sampled params
– primary navigation control
  – user selects areas, linked highlighting in refinement view
  – visual encoding spatial position: rectilinear node-link view
– data: samples & output
– derived data: table
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Paper: Paramorama

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Paper: Paramorama
Idiom: Re-encode  
**System:** Tableau

Idiom: Change parameters  
• widgets and controls  
  – sliders, buttons, radio buttons, checkboxes, drop-down/comboboxes  
  – links  
    – clear affordances, self-documenting (with labels)  
  – components  
    – uses screen space  
  – design choices  
    – separated vs interlocked  
    – controls & curves

Idiom: Change alignment  
**System:** LineUp

Shiny example  
• APGI genome browser  
  – tooling: R/Shiny  
  – interactivity  
  – tooltip detail on demand on hover  
  – expand/contract chromosomes  
  – expand/contract control panes

Idiom: Animated transitions  
• smooth interpolation from one state to another  
  – alternative to jump cuts, supports item tracking  
  – best case for animation  
  – staging to reduce cognitive load  
  – example: animated transitions in statistical data graphics

Idiom: Animated transitions - tree detail  
• animated transition  
  – network drilldown/zoom

Idiom: Animated transition - bar detail  
• example: hierarchical bar chart  
  – add detail during transition to new level of detail

Interaction technology  
• what do you design for?  
  – mouse & keyboard on desktop  
  – touch interaction on mobile  
  – small screens, no hover, just tap  
  – gestures from video/sensor  
  – argumentic reality vs move bombast  
  – eye tracking

Selection  
• selection basic operation for most interaction  
  – design choices  
  – how many selection types?  
  – interaction modalities  
    – click/hover (one/two click) vs hover (lightweight but not available on most touchscreens)  
    – multiple click types (shift/click, option-click, ...)  
    – proximity beyond click/hover (touching vs nearby to distant)  
    – application semantics  
    – adding vs selecting set vs replacing selection  
    – easy selection too?  
    – on touch vs selecting+click on background  
    – primary vs secondary (e.g. sources/target nodes in network)  
    – group membership (additive items, item groups)

Idiom: Change order/arrangement  
• what: simple table  
  – how data-driven reordering by selecting column  
  – why: find extreme values, trends

Idiom: Reorder  
**System:** DataStripes

Idiom: Idiom: Animated transitions
• smooth transition from one state to another  
  – alternative to jump cuts, supports item tracking  
  – best case for animation  
  – staging to reduce cognitive load

Idiom: Change over time  
• change any of the other choices  
  – encoding itself  
  – parameters  
    – arrange: map, manipulate  
    – aggregation level, what is filtered...  
    – interaction entails change

Idiom: Idiom: Change parameters
• what: simple table  
  – how data-driven reordering by selecting column  
  – why: find extreme values, trends

Idiom: Idiom: Reorder
• what table with many attributes  
  – how: data-driven reordering by selecting column  
  – why: find correlations between attributes

Idiom: Idiom: Embed
Manipulate
Change View Over Time
Select
Navigate
Item Reduction
Zoom
Pan/Translate
Constrained
Geometric or Semantic
Attribute Reduction
Slice
Cut
Project

Navigate: Changing viewpoint/visibility
- change viewpoint
- changes which items are visible within view
- camera metaphor
- pan/translate/scroll
- move up/down/zoom

Navigate: Unconstrained vs constrained
- unconstrained navigation
- easy to implement for designer
- hard to control for user
- easy to overwhelm/underwhelm
- constrained navigation
- typically uses animated transitions
- trajectory automatically computed based on selection
- just click: selection ends up framed nicely in final viewport

Idiom: Animated transition + constrained navigation
- example: multilevel matrix views
- transition into containing mark causes aspect ratio (shape) change
- add detail during transition
- movie: http://www.win.tue.nl/vsl/home/fvham/matrix/Zoomin.avi
- movie: http://www.win.tue.nl/vsl/home/fvham/matrix/Pan.avi

Idiom: Scrollytelling
- how: navigate page by scrolling (panning down)
- pros:
  - familiar & intuitive, from standard web browsing
  - linear (only up & down) vs possible overhead of click-based interface choices
- cost:
  - full-screen mode may lack affordances
  - scroll/jumping: no direct access
  - unexpected behaviour
  - continuous control for discrete maps

Idiom: Highlighting
- interaction benefits
  - interaction pros
  - major advantage of computer-based vs paper-based visualization
  - people seem to be better at noticing changes
  - animated transitions provide excellent support
- interaction limitations
  - interaction has a time cost
  - sometimes minor, sometimes significant
  - degenerates to overview! may not interact as planned by designer
  - NYTimes logs show ~90% don't interact beyond scrollytelling - Aisch, 2016

Interaction benefits
- interaction pros
  - major advantage of computer-based vs paper-based visualization
  - flexible, powerful, intuitive
  - exploratory data analysis: change as you go during analysis process
  - direct input selecting offers different visual encoding support offers tasks
  - animated transitions provide excellent support
  - empirical evidence that animated transitions help people stay oriented

Interaction limitations
- interaction has a time cost
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- NYTimes logs show ~90% don't interact beyond scrollytelling - Aisch, 2016
### Linked views
- unidirectional vs bidirectional linking

### Linked views: Multidirectional linking

- Share Encoding: Same/Different
  - same highlighting
- Share Data: All/Subset/None
  - data: all shared
  - data: subset shared
- Share Navigation

### Video: Visual Analysis of Historical Hotel Visitation Patterns

- Video: [YouTube](https://www.youtube.com/watch?v=86p7brwuz2g)

### Complex linked multiform views

- System: Pathfinder

### Why not animation?
- disparate frames and regions: comparison difficult
- vs contiguous frames
- vs small region
- vs coherent motion of group

### Why not animation?
- System: EDV

### Why not animation?
- System: Improvise

### Why not animation?
- System: StratomeX

### Why not animation?
- System: Pathfinder

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**Linked views**

- **Overview-detail views**
  - System: Google Maps
  - encoding: same
  - data: subset shared
  - navigation: shared
    - unidirectional linking
    - differences
    - viewpoint
    - (page)
  - special case: birds-eye map

- **Overview-detail navigation**
  - System: Pathfinder

- **Overview-detail views**
  - System: Cerebral

- **Overview-detail views**
  - System: StratomeX

- **Overview-detail views**
  - System: Pathfinder

### Linked Highlighting
- System: Linked highlighting
  - connected views: side by side views
  - linked to other encodings
Partition into views
- how to divide data between views
- split into regions by attributes
- encodes association between items
- uses spatial proximity
- order of splits has major implications
- for what patterns are visible
- no strict dividing line
- view big/detailed
- color: region in which usually encoded data is shown on the display
- glyph: small/large
- object: with internal structure that arises from multiple marks

Partitioning: List alignment
- single bar chart with grouped bars
- split by state into regions
- compare glyph within each region showing all ages
- compare easy within state, hard across states

Partitioning: Recursive subdivision
- split by neighborhood
- then by type
- then time
- years as rows
- months as columns
- color by price
- neighborhood patterns
- where it's expensive
- where you pay much more for detached type

System: HIVE
- switch order of splits
- type then neighborhood
- switch color
- by price variation
- type patterns
- within specific type, which neighborhood inconsistent

Superimpose layers
- layer: set of objects spread out over region
- each set is visually distinguishable group
- entire: whole view
- design choices
- how many layers, how to distinguish?
- encode with different, non-overlapping channels
- two layers achievable, three with careful design
- small static set, or dynamic from many possible?

Static visual layering
- foreground layer: roads
- hue, size distinguishing main from minor
- high luminance contrast from background
- background layer: regions
- desaturated colors for water, parks, land areas
- user can selectively focus attention
- "get it right in black and white"
- check luminance contrast with greyscale view

Dynamic visual layering
- interactive based on selection
- one-hop neighbour highlighting demos: click vs hover (lightweight)

Reading for next time
- VAD Ch 13: Reduce
- VAD Ch 14: Embed
- VAD Ch 15: Case Studies
- Paper: Topological Fisheye Views for Visualizing Large Graphs
  - paper type: algorithm

Superimposing limits
- few layers, but many lines
- up to a few dozen
- too many lines
- superimpose vs juxtapose: empirical study
- superimposed for local, multiple for global
- tasks
- local maximum, global slope, discrimination
- same screen space for all multiples vs single superimposed

Idiom: Trellis plots
- superimpose within same frame
- color code by year
- partitioning
- split by site, rows are wheat varieties
- main-effects ordering
- derive value of median for group, use to order
- order rows within view by median
- order views themselves by site median

Getting it right in black and white. Stone. 2010.

Partitioning into Side-by-Side Views
- how to divide data between views
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