**Lectures 1&2: Manipulate & Interact**

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**DSCI 532: Data Visualization 1**  
Lectures 1&2: 20 & 22 March 2017

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**What's when**

- 8 lectures in 4 weeks  
  - Mon & Wed, 11am-12:30pm (80 min), Mar 20 - Apr 12, ORCH 3058  
- 4 labs  
  - Mon, 2-4pm, Mar 20 - Apr 12, ESB 1042  
  - start work Mon 2pm, due next Mon 9am, 12.5% each  
- 2 quizzes/Week 3 (Mon Apr 3) & week 5 (Thu Apr 20)  
  - 2-2:30pm, 25% each  
- my (optional) office hrs are in ICICS/CS X661  
  - Mon-Fri 3:30-4:30pm, Mar 20 - Apr 10  
  - or by appointment

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**How to handle complexity: 1 previous strategy + 3 more**

- **Idiom: Change encoding**  
  - widgets and controls  
    - sliders, buttons, radio buttons, checkboxes, dropdowns/combos  
    - pros:  
      - clear affordances, self-documenting (with labels)  
      - easy to compare  
    - cons:  
      - drop menu space  
      - design choices:  
        - separated vs interleaved  
        - controls & canvas

- **Idiom: Change parameters**  
  - table with many attributes; derived rankings based on weights  
  - how reorder by interactively changing weights

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**Reading**

- same as before  
  - core foundational material covered in lectures  
  - textbook as backup to lectures  
    - library has multiple ebook copies for free  
    - see [http://ubcbooks.ubc.ca/rentalbook/](http://ubcbooks.ubc.ca/rentalbook/)

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**Topics**

- Lectures 1&2  
  - Manipulate/View, Select, Facet  
- Lectures 5&6  
  - Face into Multiple Views  
  - Justapose, Partition, Layer  
- Lectures 7&8  
  - Reduce Items & Attributes  
  - Filter, Aggregate, Embed  
- Lectures 11&12  
  - Usability/Validation & Case Studies

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**Labs**

- make visualizations as self-documenting as possible  
  - meaningful & useful titles, labels, legends  
  - axes and pens/alternatives should have labels  
  - axes should have good min/max boundary tick marks  
  - everything that's plotted should have a legend  
  - axes and panes/subwindows should have labels  
  - avoid scientific notation in most cases

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**How?**

- encoding itself  
- parameters  
- arrange: rearrange, reorder  
- (aggregation level, what is filtered…)

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**System: Tableau**

- **Idiom: Change encoding**  
  - sliders, buttons, radio buttons, checkboxes, dropdowns/combos

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**System: LineUp**

- **Idiom: Change order/arrangement**  
  - what: simple table  
  - how: data-driven reordering  
  - why: find extreme values, trends

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[Sortable Bar Chart](https://bl.ocks.org/mbostock/3885705)

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Map
Color
Motion
Size, Angle, Curvature, ...
Hue Saturation Lumiance
Shape
Direction, Rate, Frequency, ...
from categorical and ordered attributes

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[LineUp: Visual Analysis of Multi-Attribute Rankings](http://www.scs.ubc.ca/lineup/)

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[Tableau](http://tableausoftware.com)

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[Map Color Motion Size, Angle, Curvature Hue Saturation Lumiance Shape Direction, Rate, Frequency from categorical and ordered attributes](https://xkcd.com/833/)

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Idiom: Change encoding

- widgets and controls
  - sliders, buttons, radio buttons, checkboxes, dropdowns/combos
  - pros
    - clear affordances, self-documenting (with labels)
  - cons
    - uses screen space
  - design choices
    - separated vs interleaved
    - controls & canvas

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Idiom: Change parameters

- table with many attributes; derived rankings based on weights
- how reorder by interactively changing weights

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Idiom: Change order/arrangement

- what: simple table
- how: data-driven reordering
- why: find extreme values, trends
Navigate: Unconstrained vs constrained
• unconstrained navigation
  – easy to implement for designer
  – hard to control for user
  – hovering doesn’t work
• constrained navigation
  – typically uses animated transitions
  – trajectory automatically computed based on selection
  – just click selection ends up framed nicely in final viewport

Select: basic operation for most interaction
• select
  – how many selection types?
  – interaction modality
  – clicking (hard)/hovering (light) vs touchscreen
  – multiple click types
  – proximity of click/hovering vs distance
• application semantics
  – adding vs selecting vs replacing selection
  – use selection for what
  – we suggest as nothing selected if click on background

Tooltips
• what do you design for?
  – hover or click
  – can provide useful additional detail on demand
  – popup information for selection
  – hover or click
  – can provide useful additional detail on demand
  – a rollover or tooltip, assume nobody will see it. If it’s important, make it explicit. 
  – Gregor Aisch, NYTimes

Interaction technology
• what do you design for?
  – mouse & keyboard on desktop?
  – for larger screens, hover, multiple clicks
  – touch interaction on mobile?
  – small screens, no hover, just tap
  – gestures from video / sensors?
  – ergonomic vs reality vs movie broadcast
  – eye tracking?

Navigate: Changing viewpoint/visibility
• change viewpoint
  – changes which items are visible within view
• camera metaphor
  – pan/translate/scroll
  – mouse & keyboard on desktop?
  – typically uses animated transitions

Scrolling: Scrollytelling
• how: navigate page by scrolling (panning down)
• pros:
  – familiar & intuitive, from standard web browsing
  – linear (only up & down) vs possible overload of click-based interface choices
• cons:
  – full-screen mode may lack affordances
  – scrolling/panning, no direct access
  – unexpected behaviour
  – continuous control for discrete steps

Animated transition + constrained navigation
• example: geographic map
  – simple zoom only viewpoint changes
  – add detail during transition to new level of detail

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

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

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

Highlighting
• highlight change visual encoding for selection targets
  – change item color
  – but hides existing color coding
  – add outline mark
  – change shape (ex: from solid to dashed line for link mark)
  – unusual channels: motion
    – motion usually avoid for single view
    – with multiple views, could push to draw attention to other views

Idiom: Animated transition + constrained navigation
• example: incidence plot
  – add detail during transition into containing mark
  – smooth transition from one state to another
  – alternative to jump cuts, supports item tracking
  – best case for animation
  – staging to reduce cognitive load

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

Rule of thumb: Responsiveness is required
• visual feedback: three rough categories
  – 0.1 seconds: perceptual processing
  – 1 second: immediate response
  – 1 second: noticeable reaction
  – 10 seconds: context
  – bounded response after dialog box - mental model of heavyweight operation (file load)
  – scalability considerations
  – highlight selection without complete redraw of view (graphics frontier buffer)

Scrollytelling examples
• how: navigate page by scrolling (panning down)
• pros:
  – familiar & intuitive, from standard web browsing
  – linear (only up & down) vs possible overload of click-based interface choices
• cons:
  – full-screen mode may lack affordances
  – scrolling/panning, no direct access
  – unexpected behaviour
  – continuous control for discrete steps

Data visualization and the news - Gregor Aisch (37 min)
https://www.bloomberg.com/graphics/
how-the-us-and-opec-drive-oil-prices.html?_r=1
vimeo.com/182590214
Interaction limitations

- Interaction has a time cost
  - sometimes minor, sometimes significant
  - degenerates to human-powered search in worst case
- Remembering previous state imposes cognitive load
  - risk of thumb-eye overlap memory
- Controls may take screen real estate
  - or invisible functionality may be difficult to discover (lack of affordances)
- Users may not interact as planned by designer
  - NY Times logo show ~90% don’t interact beyond scrollytelling - Aisch, 2016
- Interaction benefits
  - Major advantage of computer-based vs paper-based visualization
  - Fluid task switching: different visual encodings support different tasks
  - Animated transitions provide excellent support
  - Empirical evidence that animated transitions help people stay oriented

Further reading