Encoding visually with marks and channels:
- analyze idiom structure
  - as combination of marks and channels

Channels:
- Position on common scale
- Position on logarithmic scale
- Length (1D size)
- Width (2D size)
- Depth (3D size)
- Color
- Color saturation
- Color luminance
- Curvature
- Area (2D size)
- Volume (3D size)

Identity Channels: Categorical Attributes
- Position on common scale
- Position on logarithmic scale
- Length (1D size)
- Width (2D size)
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- Area (2D size)
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Expressiveness principle:
- match channel and data characteristics
- effectiveness principle
- encode most important attributes with highest ranked channels

Accuracy: Fundamental Theory

Accuracy: Vis experiments

Separability vs. Integrity

Grouping
- containment
- connection

How to encode: Arrange position and region

How to encode: Arrange space, map channels

Idioms: dot chart, line chart
- one key, one value
  - dots
- 2+quantities
  - marks
  - dot plot
  - connection marks between them
  - channels
  - aligned heights to express qualitative
  - separated and ordered by key: short bars (horizontal)

- task
  - find trend
  - connection marks emphasize ordering of items along key (may help explicitly showing relationships between other keys and the rest)

Idioms: glyphmaps
- rectilinear good for linear vs nonlinear trends
- radial good for cyclic patterns
### Coordinate views: Design choice interaction

- **Data**
  - All
  - Subset
  - None

- **Display**
  - Same
  - Multiform

- **Navigation**
  - Linked highlighting

- **Encoding**
  - Same
  - Different

- **Facet**
  - Coordinate
  - Multiple
  - Side By Side Views
  - Share Encoding: Same/Different
  - Share Data: All/Subset/None
  - Share Navigation

- **Map**
  - Coordinate
  - Multiple
  - Side By Side Views

- **Filter**
  - Embed

### How to handle complexity: 3 more strategies

- **Manipulate**
  - Facet
  - Reduce

- **Change**
  - Select

- **Partition**
  - Superimpose

- **Juxtapose**
  - Embed

### Why not animation?

- Disparate frames and regular association difficult
  - vs contiguous frames
  - vs small region
  - vs coherent motion of group

- Safe special case
  - Animated transitions

### Partition into views

- **How to divide data between views**
  - map
  - association between items using spatial proximity
  - major implications for what patterns are visible
  - split according to attributes

- **Design choices**
  - how many splits
  - split by state into regions
  - vs coherent motion of group within region
  - order in which attributes used to split
  - how many views

### Categorical color: Discriminability constraints

- 3 channels
  - identity for categorical
  - hue: magnitude for ordered
  - saturation: perceptually nonlinear

- RGB poor for encoding
- HSL better, but beware

### Ordered color: Rainbow is poor default

- Problems
  - perceptually unordered
  - perceptually nonlinear

- Benefits
  - few hues for large-scale structures
  - multiple hues with monotonically increasing luminance for fine-grained
  - augmented rainbow good for categorical ok for binned

- Costs: display area, 2 views side by side each have only half the area of one view

### Facet

- Juxtapose
- Partition
- Superimpose
- Embed

- Linked highlighting
- Filter
- Aggregate
- Embed

### Idiom: Animated transitions

- Smooth transition from one state to another
- Support for item tracking when amount of change is limited

- Example: multilevel matrix views

- Scope of what is shown narrows down
- Middle block stretches to fill space, additional structure appears within
- Other blocks squash down to increasingly aggregated representations

### Idiom: Small multiples

- Encoding: same
- Data: none shared
- Navigation: shared

- Different attributes for node colors
- Same network layout

- Overview-detail

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### Idiom: Linked highlighting

- See how regions contiguous in one view are distributed within another
  - Powerful and pervasive interaction idioms

- Encoding different
  - Multiform
  - Data shared

### System: EDV

- Bird’s-eye maps

- Encoding same

- Data: subset shared

- Navigation: shared

- Abridged linking

- Differences

- Viewport

- Overview-detail

### System: Cerebral

- Encoding same

- Data: none shared

- Navigation: shared

- Different attributes for node colors

- Same network layout

- Overview-detail

- Simple bar chart with grouped bars

- vs coherent motion of group within region

- Order in which attributes used to split

- How many views

### Partitioning: List alignment

- Single bar chart with grouped bars

- Split by state into regions

- Simple glyph within each region showing all ages

- Compare many within state, hard across ages

- Small multiple charts

- Split by age into regions

- Compare many within age, harder across states

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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

How to handle complexity: 3 more strategies
More Information
• this talk
http://www.cyclus.de/~meyerbhs/hi-viz/slides
• book page (including tutorial lecture slides)
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