• comments marks out for 3/Tasks and 4/Validation,
  – lect 2 avg 86, min 73, max 94
  – lect 3 avg 85, min 78, max 98
  – lect 4 avg 88, min 84, max 100
Now

• first, work in small groups
  – exercise: decoding marks and channels
  – 45 min, +/- 15 min
    • status checkins at 30 min, 45 min, (60 min)

• then readings discussion
**VAD Ch 5: Marks and Channels**

**Channels:** Expressiveness Types and Effectiveness Ranks

- **Magnitude Channels:** *Ordered Attributes*
  - Position on common scale
  - Position on unaligned scale
  - Length (1D size)
  - Tilt/angle
  - Area (2D size)
  - Depth (3D position)
  - Color luminance
  - Color saturation
  - Curvature
  - Volume (3D size)

- **Identity Channels:** *Categorical Attributes*
  - Spatial region
  - Color hue
  - Motion
  - Shape

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[VAD Fig 5.1]
Encoding visually

• analyze idiom structure
Definitions: Marks and channels

• marks
  – geometric primitives

• channels
  – control appearance of marks
Encoding visually with marks and channels

• analyze idiom structure
  – as combination of marks and channels

1: vertical position
mark: line

2: vertical position
horizontal position
mark: point

3: vertical position
horizontal position
color hue
mark: point

4: vertical position
horizontal position
color hue
size (area)
mark: point
Channels

Position on common scale
Position on unaligned scale
Length (1D size)
Tilt/angle
Area (2D size)
Depth (3D position)
Color luminance
Color saturation
Curvature
Volume (3D size)
Spatial region
Color hue
Motion
Shape

Same
Channels: Rankings

**Magnitude Channels: Ordered Attributes**
- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)

**Identity Channels: Categorical Attributes**
- Spatial region
- Color hue
- Motion
- Shape

- **effectiveness principle**
  - encode most important attributes with highest ranked channels
- **expressiveness principle**
  - match channel and data characteristics
Grouping

- containment
- connection

Marks as Links

- Containment
- Connection

Identity Channels: Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape

Proximity
- same spatial region

Similarity
- same values as other categorical channels
Accuracy: Fundamental Theory

Steven’s Psychophysical Power Law: $S = I^N$
Accuracy: Vis experiments

Cleveland & McGill’s Results

Crowdsourced Results

Positions

Angles

Circular areas

Rectangular areas (aligned or in a treemap)

Log Error

[1.0, 1.5, 2.0, 2.5, 3.0]


Discriminability: How many usable steps?

- must be sufficient for number of attribute levels to show
  - linewidth: few bins

[mappa.mundi.net/maps/maps_014/telegeography.html]
Separability vs. Integrality

- **Position**
  - Hue (Color)
  - 2 groups each
  - Fully separable

- **Size**
  - Hue (Color)
  - 2 groups each
  - Some interference

- **Width**
  - + Height
  - 3 groups total: integral area
  - Some/significant interference

- **Red**
  - + Green
  - 4 groups total: integral hue
  - Major interference
Further reading: Articles


- **Crowdsourcing Graphical Perception: Using Mechanical Turk to Assess Visualization Design.** Jeffrey Heer and Michael Bostock. Proc. CHI 2010


Further reading: Books

  – Chap 5: Marks and Channels


• Information Visualization: Perception for Design, 3rd edition. Ware.

• How Maps Work: Representation, Visualization, and Design. Alan M.


• Psychophysics: Introduction to its Perceptual, Neural, and Social Prospects.
Next Time

• to read
  – VAD Ch. 6: Rules of Thumb
  – paper: Artery Viz (type: design study / evaluation)

• reminder: office hrs after class today