InfoVis: a semiotic perspective

based on

Semiology of Graphics
by J. Bertin
Infovis is composed of

- **Representation**
  a mapping from raw data to a visible representation

- **Presentation**
  organizing this visible representation into the space available

- **Interaction**
  changing what is immediately viewable
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- **Representation**
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Representation

• a representation is
  • a formal system or mapping by which the information can be specified (D. Marr)
• for example: the number thirty-four
  decimal: 34,
  binary: 100010,
  roman: XXXIV
• different representations reveal different aspects
  decimal: counting & information about powers of 10,
  binary: counting & information about powers of 2,
  roman: counting, adding
Representations

• Good representations
  - capture essential elements of the event / world
  - deliberately leave out / mute the irrelevant
  - appropriate for the person and their interpretation
  - appropriate for the task, enhancing judgment ability

• How many buffalo?

Adapted from S. Greenberg
Representation

• Solving a problem simply means representing it so as to make the solution transparent … *(Simon, 1981)*

• Good representations
  - allow people to *find* relevant information
    - information may be present but hard to find
  - allow people to *compute* desired conclusions
    - computations may be difficult or “for free” depending on representations

Adapted from S. Greenberg
Bertin’s disclaimer

- he considers
  - printable, on white paper,
  - visible at a glance
  - reading distance of book or atlas
  - normal and constant lighting
  - readily available graphic means
Where does one start?

• with marks!
  – for us, pixels?
• Visual Variables: how can we vary marks?
  – by where we place them
  – by how we place them (Bertin calls this ‘implantation’)
  – by their visual characteristics (Bertin calls these retinal variables)
Visual Variables

Slides by: Sheelagh Carpendale
Visual Variables

- **position**
  - changes in the x, y, (z) location

- **size**
  - change in length, area, repetition

- **shape**
  - infinite number of shapes

- **value**
  - changes from light to dark

- **orientation**
  - changes in alignment

- **colour**
  - changes in hue at a given value

- **texture**
  - variation in pattern

- **motion**
Visual Variables

Characteristics of visual variables can be

• **selective**
  is a change in this variable enough to allow us to select it from a group?

• **associative**
  is a change in this variable enough to allow us to perceive them as a group?

• **quantitative**
  is there a numerical reading obtainable from changes in this variable?

• **order**
  are changes in this variable perceived as ordered?

• **length**
  across how many changes in this variable are distinctions perceptible?
Visual Variable: Position

- selective
- associative
- quantitative
- order
- length
Visual Variable: Size

• selective

• associative

• quantitative

4 \times \square = \square ?

• order

• length
  - theoretically infinite but practically limited
  - association and selection \sim 5 and distinction \sim 20
W: Size
Size

- Categories of size,
  - height of a column,
  - area of a sign,
  - number of equal signs

AND ITS COUNTABLE VARIANTS
Size

points  lines  areas
Visual Variable: Shape

- selective
- associative
- quantitative
- order
- length
  - infinite
Shape

- Constant size variation in shape
- Quantity is read through the legend
Shape
Shape

points  lines  areas
Visual Variable: Value

- selectiveness
- association
- quantitative
- order
- length

- theoretically infinite but practically limited
- association and selection ~ < 7 and distinction ~ 10
Value

- Categories of value,
  - various degrees between black and white,
Value

points  lines  areas
Visual Variable: Value

- Ordered, and can not be re-ordered
Visual Variable: Value

- Is not quantitative
  (oil consumption in Europe base unit 1 million tons)
Visual Variable: Value

- Value intensity can be mis-read as density
  (population of Paris)
Visual Variable: Colour

- selective
- associative
- order (theoretically infinite but practically limited; association and selection ~ < 7 and distinction ~ 10)
- length
Colour

- Categories of colour,
  - changes in hue at equal value
Colour

points

lines

areas
Encoding

- Common advice says use a rainbow scale
  - Marcus, Murch, Healey
  - problems with rainbows
Visual Variable: Orientation

- selective
- associative
- quantitative
- order
- length
  - ~5 in 2D; ? in 3D
Orientation

• Categories of orientation,
  - variations is line or line-pattern ranging from the vertical to the horizontal
Orientation

points  lines  areas

Slides by: Sheelagh Carpendale
Visual Variable: Texture

- selective
- associative
- order
- length
  - theoretically infinite

Slides by: Sheelagh Carpendale
Texture

- Categories of texture,
  - changes in fineness or coarseness of the marks in an area
  - can be combined changes in characteristics
Texture

points  lines  areas
Textures
Visual Variables on a computer?

- **motion**
  - direction? speed? speed, frequency, onset, ‘personality’
- **transparency**
- **saturation**
  - colour as Bertin uses it largely refers to hue
- **flicker**
  - frequency, rhythm, appearance
- **depth**
  - occlusion, aerial perspective, binocular disparity
- **illumination**
Visual Variable: Motion

- Selective
  - motion is one of our most powerful attention grabbers

- associative
  - moving in unison groups objects effectively

- quantitative
  - subjective perception

- order

- length
  - distinguishable types of motion?
Motion