# Information Visualization: Glyphs

CPSC 533 Topic Presentation

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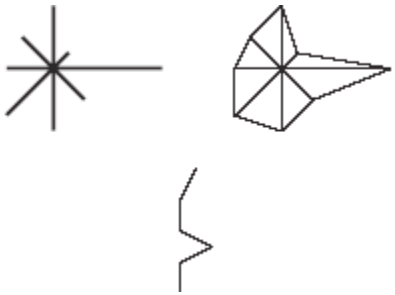
# Presentation Outline

- **Glyphs: Definition**
- Basics Of Encodings
- Glyph Discernability
- Placement As Encoding

# Glyphs: Definition

- Informally, what is a glyph?
  - A “thing”
  - A marker
- In some circles, is seen as a linguistic construct of sorts
  - But what does it represent?
  - What is its meaning?



(Ware, 2004)

# Glyphs: Definition

- InfoViz literature: we see that glyphs represent data
  - But how?
- “Thing” or “marker” implies a discrete nature
- Also referred to as “icons” (Ward)
  - ... Why?

# Glyphs: Definition

- What aspects of the data are expressed in a glyph?
  - Uninteresting unless non-trivial set of attributes
  - Multivariate data
- Thus, it encodes more than one dimension by its very nature
- How does it do it?
  - A “thing” that encodes “multiple attributes”
  - Is an entire viz system a glyph?
    - Do you really see it as a “thing”?

# Glyphs: Definition

- Clearly we're getting into fuzzy territory
  - (Unclear if this is a problem in the community)
  - Definition problem arose as I looked through papers
- So let's adapt definition from Ward ...

# Glyphs: Definition

- **A glyph is a single visual *perceptual entity* whose existence encodes a non-trivial number of dimensions of a given datapoint or set of datapoints**
  - **(note italics)**

# Glyphs: Definition

- **A glyph is a single visual *perceptual entity* whose existence encodes a non-trivial number of dimensions of a given datapoint or set of datapoints**
  - **Remember, much like “icons” ...**
  - **Glyphs abstract, encapsulate, yet exist as “one”**
  - **Does not discount aggregation**

# Presentation Outline

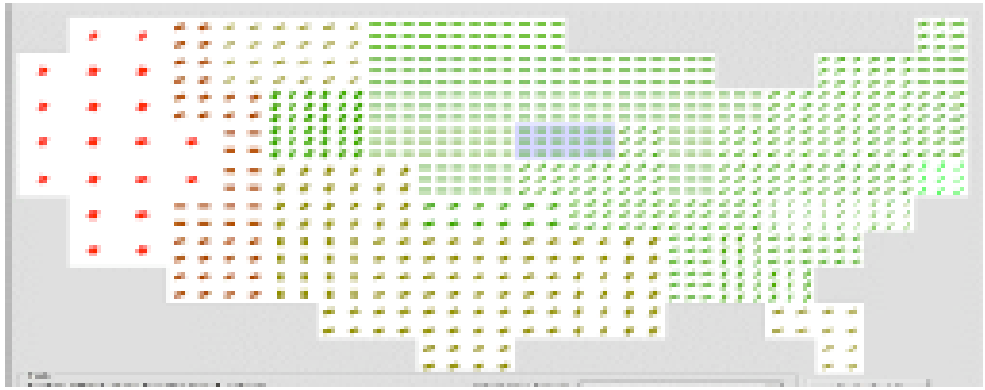
- Glyphs: Definition
- **Basics Of Encodings**
- Glyph Discernability
- Placement As Encoding

# Basics Of Encodings

- **So given our definition, what can we encode?**
- **How can we encode it?**
- **Some examples**

# Basics Of Encodings

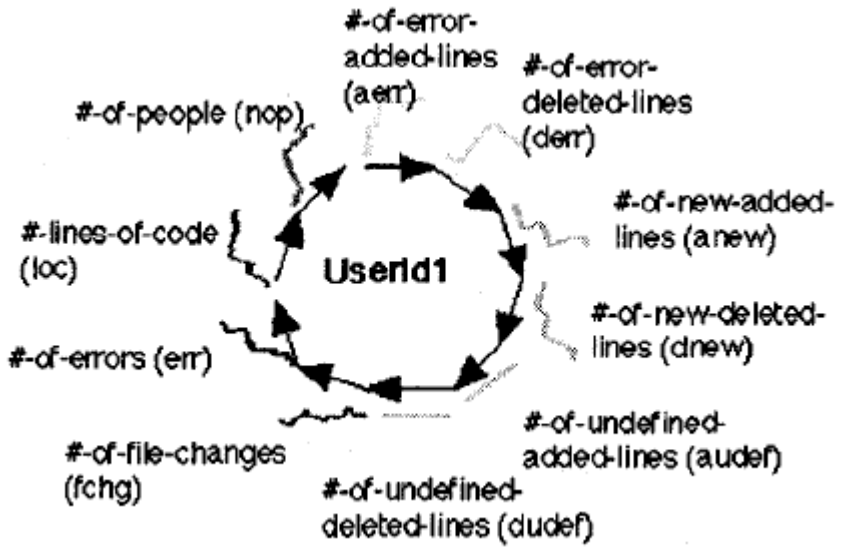
- **Data: *n-dimensional, captured in discrete format***
- ***Most familiar case: discretize the "continuous", aggregate***
- ***i.e. Map data***
- ***Individual glyphs aggregate data of several dimensions over a region***



(Yost & North, 2001)

# Basics Of Encodings

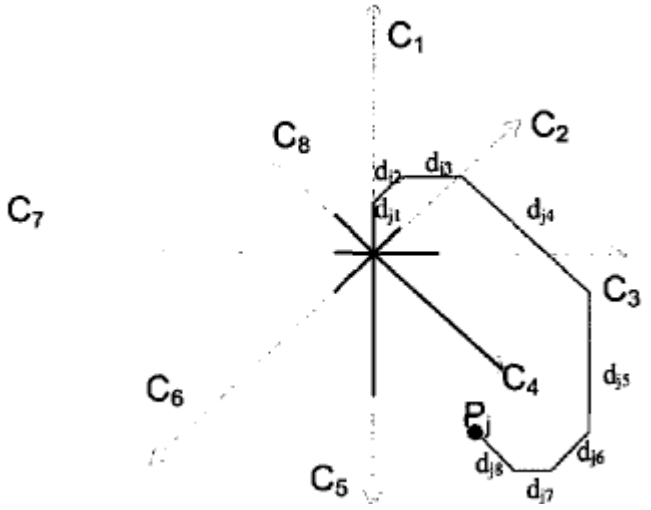
- ***More obscure example: Software visualization***
- ***TimeWheel: each item on the wheel is a trend graph depicting change over time***
- ***N dimensions, each aggregated over time***
- ***Abstracts away individual data points***




(Chua & Eick, 1997)

# Basics Of Encodings

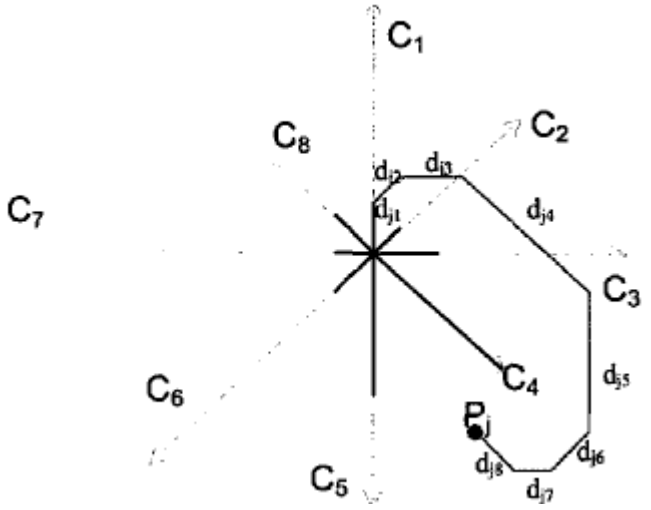
- ***Per-datapoint encodings***
- ***Encode each datapoint directly as a glyph***
- ***If the data set is big though, we like to see them in aggregate ..***
- ***Star Coordinates***




(Kandogan, 2001)

# Basics Of Encodings

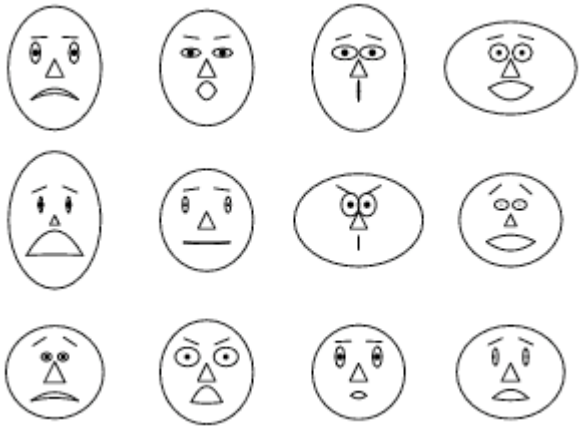
- ***Star Coordinates: much like conventional Cartesian systems***
- ***There are n "arms" that act as axes in the SC space***
- ***Location of glyph on 2-D SC space is simply vector sum of each arm for that datapoint***
- ***Ambiguity?***
- ***(more later)***




(Kandogan, 2001)

# Basics Of Encodings

- Another per-datapoint encoding:
- Chernoff faces
- Different attributes of faces represent diff dimensions
- Notion of icons, human interpretability



(MathWorld site)

# Presentation Outline

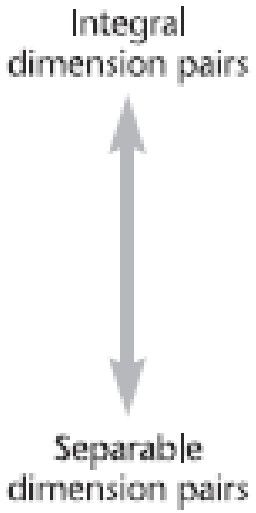
- Glyphs: Definition
- **Basics Of Encodings**
- **Glyph Discernability**
- Placement As Encoding

# Glyph Discernability

- How to make use of our visual params?
- The standard dimensional encodings
  - Space, shape, orientation
  - Color, luminance
  - Location
- It depends on the task though
  - What do we want to do with glyphs?
  - Compare within dimensions?  Across dimensions?
  - Within/across datapoints / datasets?

# Glyph Discernability

- Intra-glyph discernability
  - Within a glyph, compare and correlate dimensions
  - Ability to isolate a single dimension for analysis
    - Separable vs. integral visual parameters
  - Many of the standard ideas apply

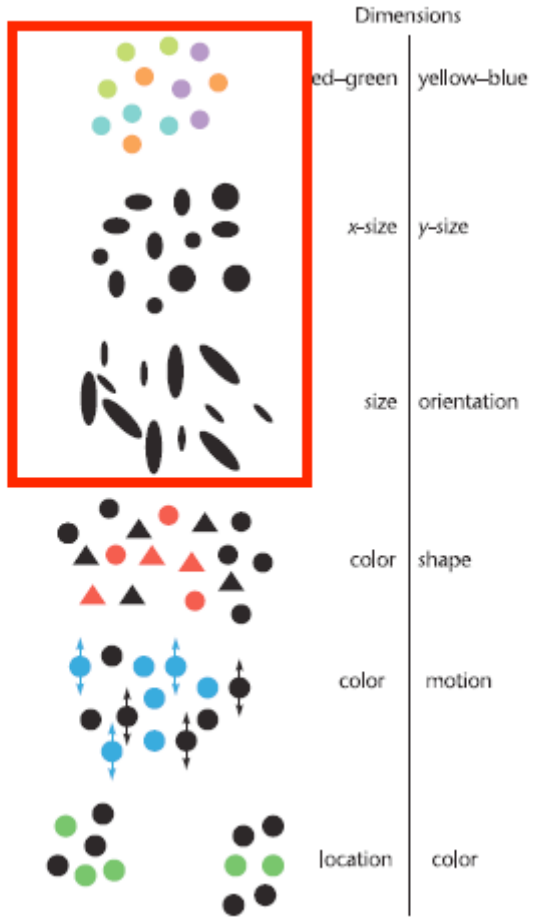



| | |
|---|---|
| red–green | yellow–blue |
| red–green | black–white |
| shape height | shape width |
| shape | size |
| color | size |
| direction of motion | shape |
| color | shape |
| color | direction of motion |
| *x,y* position | size, shape, or color |

(Ware, 2004)

# Glyph discernability

- Intra-glyph discernability
- Integral pairs are very hard to separate out
- Raises the question:
- **Is it worth it to overload?**
- **Can we re-use dimensions?**



# Glyph discernability

- **Glyphs have very particular nature in this regard**
- **Compare and contrast with “small multiples”**
- **Yost paper:**
  - **Compare overloaded encodings to multiple view encodings**

# Glyph discernability

- Tasks + views

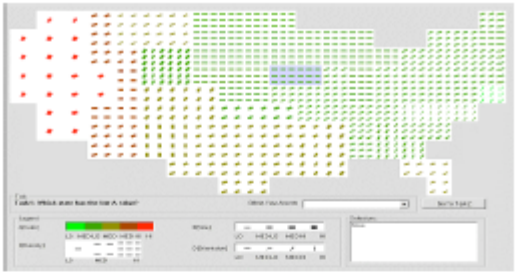


Figure 1. Integrated, 1 view. Data attributes mapped to color, size, density, and orientation.

Figure 2. Dual, 2 views. Color and size used in both.

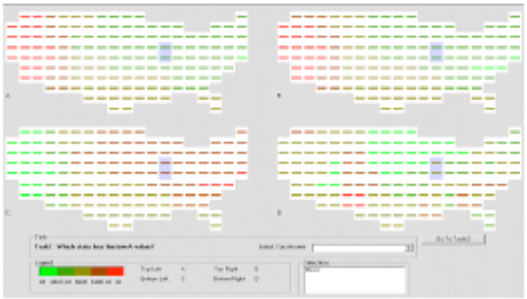


Figure 3. Multiple, 4 views. Color used in all four.

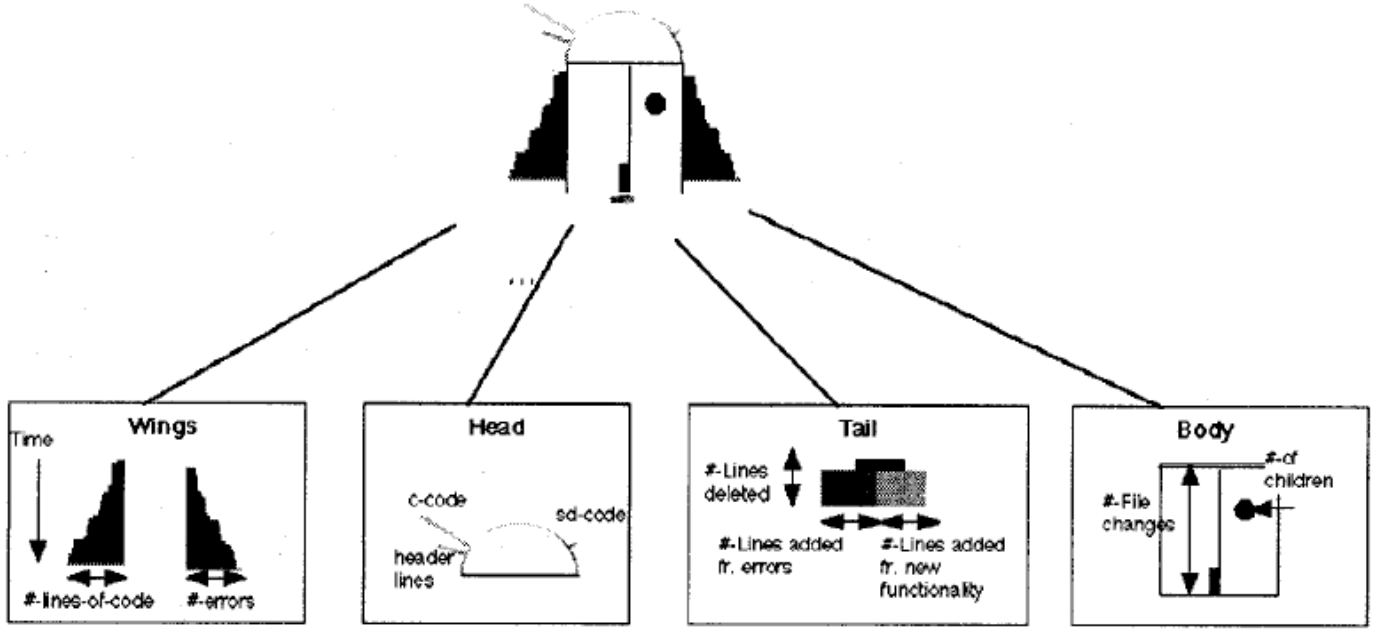
| | Most important attribute, Best visual encoding | Less important attribute, Not best visual encoding |
|---|---|---|
| **Detect:One attribute** | Which state has the lowest A value? | Which state has the highest D value? |
| **Detect: Two attributes** | Which state has the medium low A value and the low B value? | Which state has the medium low A value and the medium C value? |
| **Trend: One attribute** | What's the trend from West to East in terms of A value? | What's the trend from North to South in terms of D value? |
| **Trend: Two attributes** | What's the relationship between A and B? | What's the relationship between A and C? |

# Glyph discernability

- **Best practice appears to be:**
  - **Re-use and recycle!**
  - **Overloaded glyphs = integral dimension problem**
  - **The encoding of the glyph itself takes precedence**
  - **Relative judgements:**
    - **# views doesn't matter, but choice of encoding does**
    - **# views still has effect on encoding choice though:**
      - **Don't pick an integral one!**

# Glyph discernability

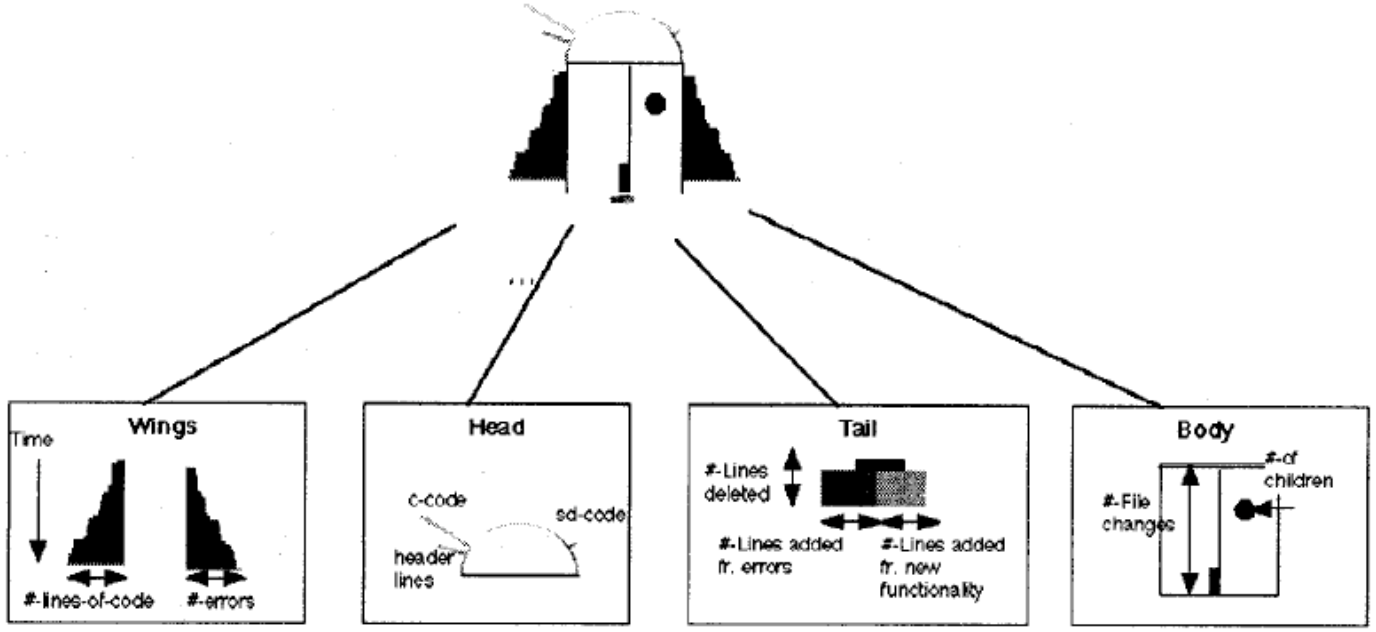
- **In re-using dimensions:**
  - **Allows for easier comparison and visual separation**
  - **However, may need more real estate**
- **But where do we draw the line?**
  - **Is it really a single perceptual unit anymore?**




(Chuah & Eick, 1997)

# Glyph discernability

- **CodeBug:**
  - **Wings represent lines of code, # errors**
  - **Other information: # file changes, inheritance level ...**
  - **Shape and size re-used for many dimensions**
  - **But is it as easy to correlate dimensions anymore?**




(Chuah & Eick, 1997)

# Glyph discernability

- **Inter-glyph discernability: compare single dimension across multiple glyphs**
- **More standard principles for relative judgements:**
  - **Straight lines, cardinal directions, discrete colors**
  - **Minimize interference from integral dimensions**
- **Star Coordinates:**
  - **Standard encoding for every dimension, flexible**
  - **Even lets you see correlations to some degree**
  - **Can even let you see correlations across multiple glyphs**
  - **(demo)**

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- **Placement As Encoding**

# Placement As Encoding

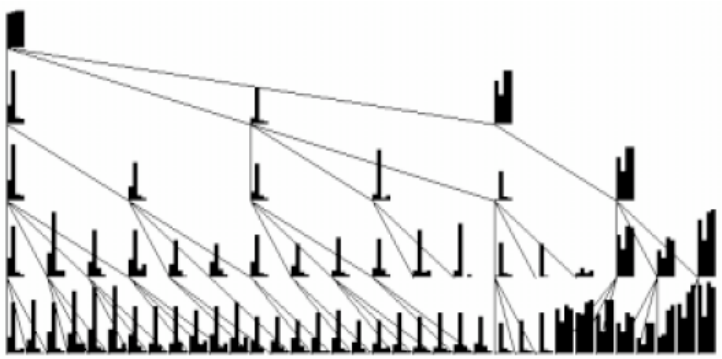
- **Notice that it uses location and placement as key component of encoding**
- **There are many ways to do location (Kandogan)**

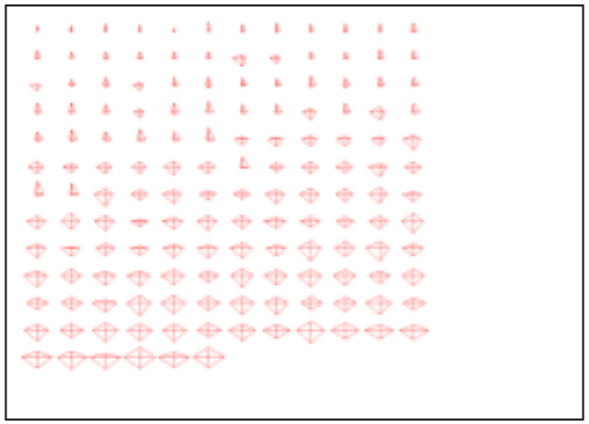
# Placement As Encoding

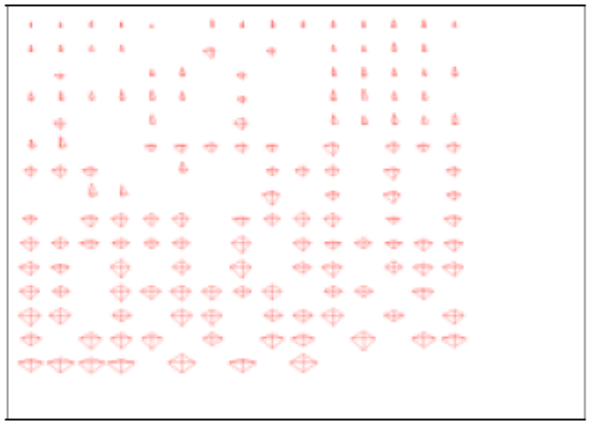
- **Data-driven placement**
  - **Direct mapping from data to on-screen location**
  - **Can be raw (star coordinates) or derived (MDS, PCA)**
  - **Raw = direct, exact, Derived = fuzzy semantics**
- **Structure-driven placement**
  - **Analytic structure is posited atop data**
  - **What do I mean?**

# Placement As Encoding

- **Structure-driven placement, cont:**
  - **Explicit graph structure or tree structure**
  - **Compare with star co-ordinates: clusters make themselves obvious**

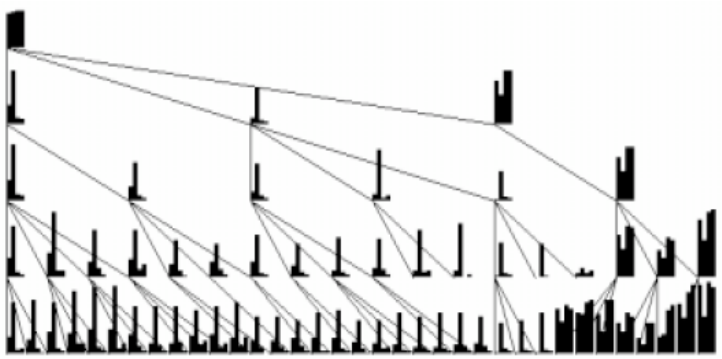


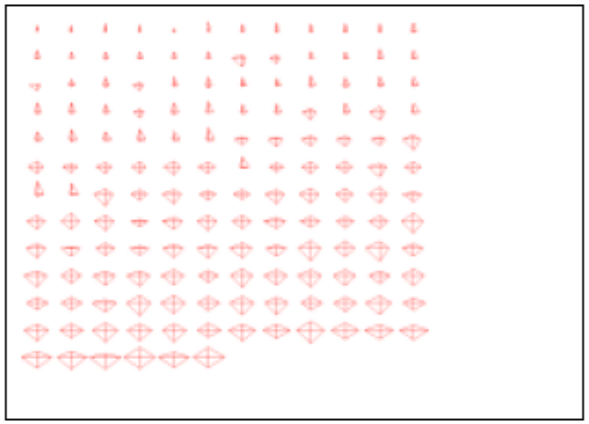


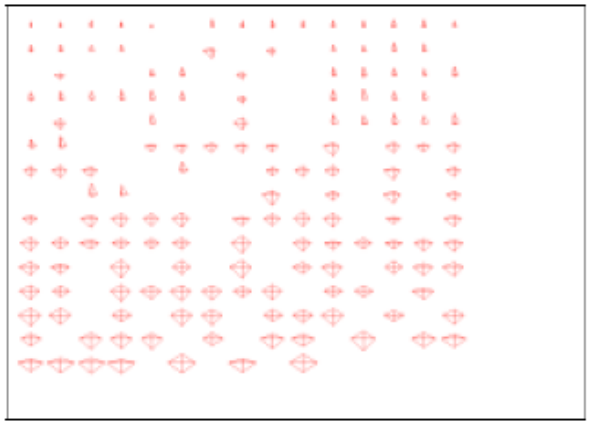


# Placement As Encoding

- **Glyph is given meaning not only in and of itself but relative to others**
- **Space is one of the best ways to order / structure data**







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- Conclusion

# Conclusion

- **Glyph design and placement is a tricky process**
  - **Tricky to define, tricky to design**
- **Many interfering and confounding factors**
  - **Simple approaches still outweigh overloaded encodings (Yost)**
  - **Concepts are generalizable and applicable in other areas of viz**
    - **(Texture, small multiples as seen through a glyph framework?)**
- **Questions?**