10a: Chart types

Network / hierarchical data

Recap: How to design viz idioms

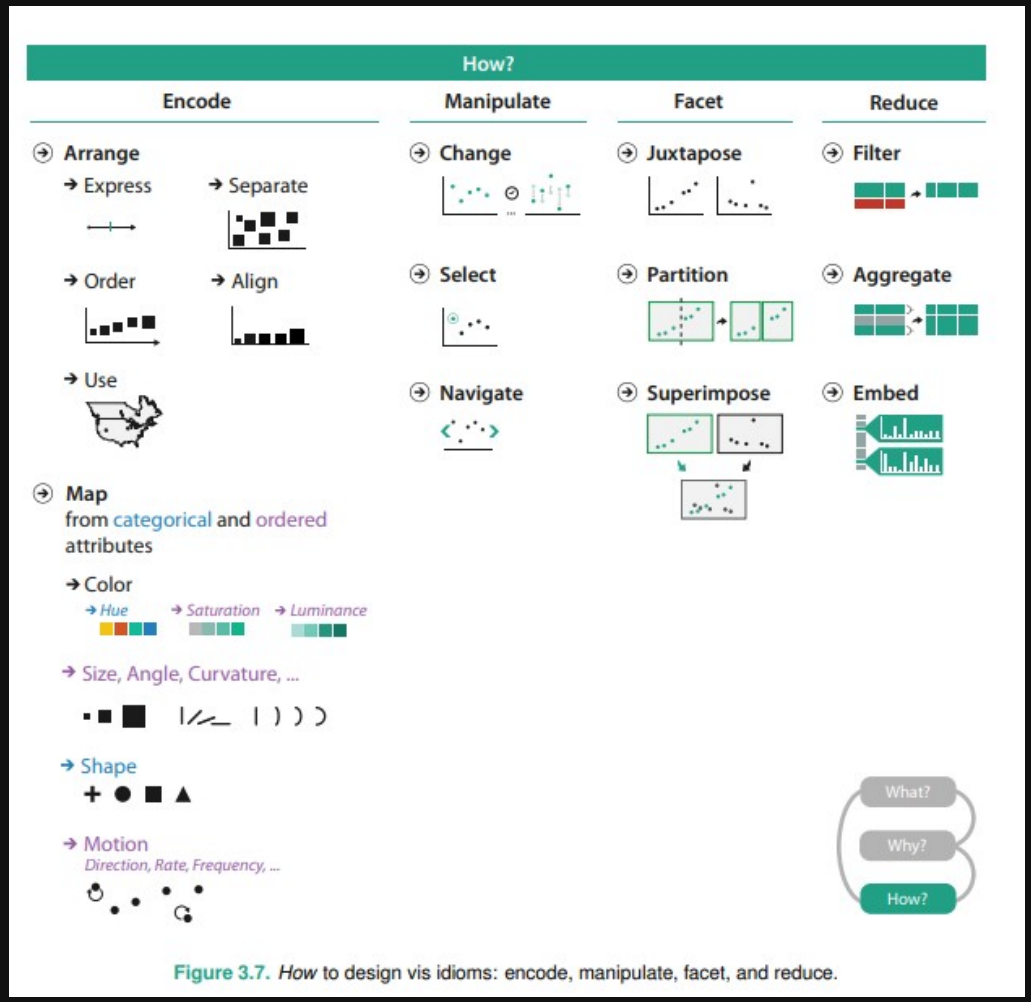
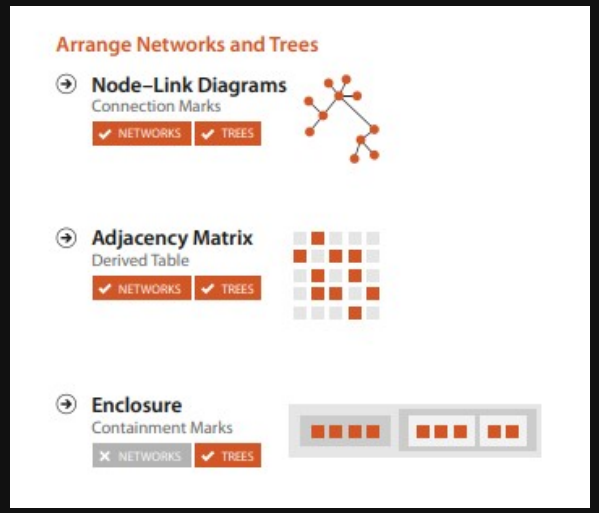


Figure 3.7. *How* to design vis idioms: encode, manipulate, facet, and reduce.

Recap: Data Types

- Tabular data
- Networks
- Geographic / spatial
- Fields
- Hierarchical

Network


Arrange Networks and Trees
Node–Link Diagrams
Connection Marks
NETWORKS
TREES
Adjacency Matrix
Derived Table
NETWORKS
TREES
Enclosure
Containment Marks
NETWORKS
TREES

Network data


```
"link": [
  {
    "sender": 1,
    "receiver": 3,
    "link protocol": "",
    "data stream": 1024
  },
  {
    "sender": 2,
    "receiver": 3,
    "link protocol": "",
    "data stream": 1024
  },
  {
    "sender": 3,
    "receiver": 4,
    "link protocol": "",
    "data stream": 1024
  },
  {
    "sender": 3,
    "receiver": 5,
    "link protocol": "",
    "data stream": 1024
  },
```

```
  "node": [
    {
      "id": 1,
      "name": "sensor-plc1",
      "type": "sensor",
      "ip": "",
      "mac": "",
      "port": [""],
      "criticality":5,
      "purdue level":0,
      "known vulnerability":[""],
      "related alert": 0
    },
    {
      "id": 2,
      "name": "actuator-plc1",
      "type": "actuator",
      "ip": "",
      "mac": "",
      "port": [""],
      "criticality":5,
      "purdue level":0,
      "known vulnerability":[""],
      "related alert": 0
    },
```


Recap: A collection of nodes and links.

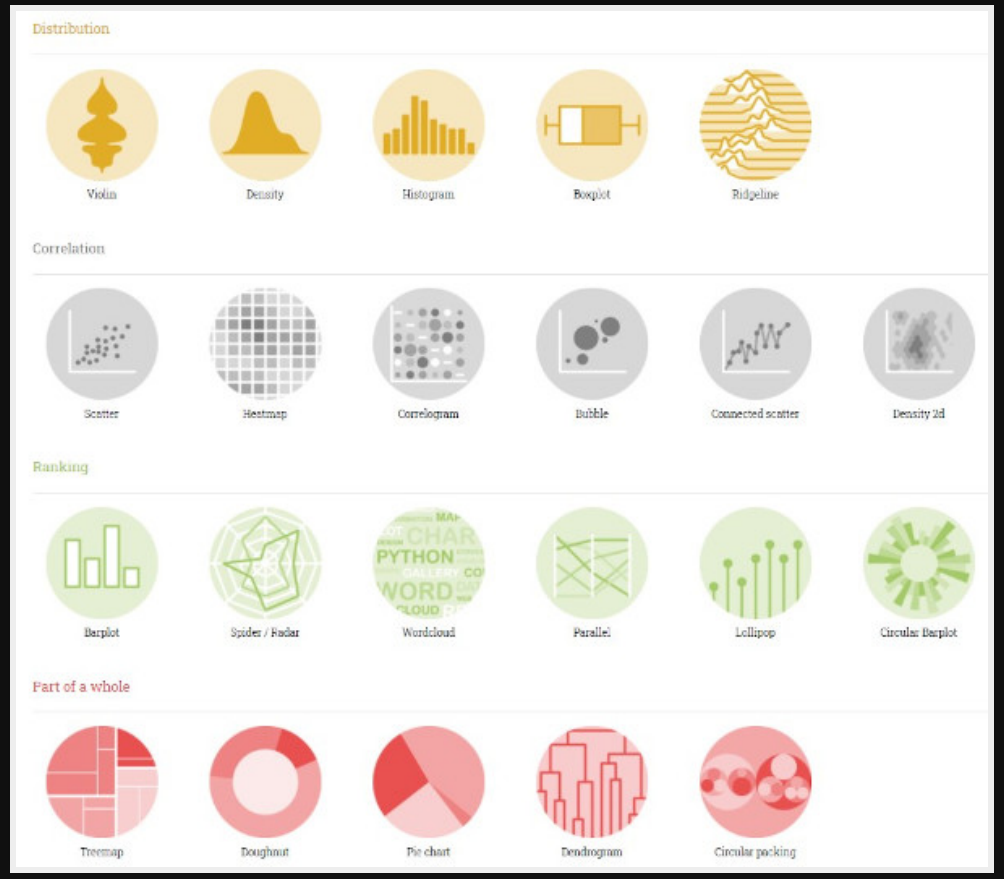
Hierarchical data

A classic example is flare.json, which is JSON with a tree-like structure.

Flare.json is commonly seen in D3 examples. This dataset is based on an ancestor of D3.

Each leaf node represents a source file while each internal node represents a folder. The leaf node's value is the size of the file in bytes.

D3 Graph Gallery



D3 Graph Gallery, by Yan Holtz

Idiom: Force directed layout

What: Data	Network. Derived: cluster hierarchy atop original network
How: Encoding	Point marks for nodes, connection marks for links.
Why: Task	Explore topology, locate paths and clusters.
Scale	Nodes: Hundreds. Links: Hundreds. Node/link density: $L < 4N$

D3 Graph Gallery - Force diagram

Cyber-security network, Chi-Loong

Bl.ocks.org: D3-force testing ground, Steve Haroz

Bl.ocks.org: Collapsible force layout, Mike Bostock

Idiom: Adjacency Matrix

What: Data	Network. Derived data — table: network values as keys, link status between two nodes as values.
How: Encoding	Area marks in 2D matrix alignment.
Why: Task	Small area marks allow for high information density to inspect network (clustering, frequency)
Scale	Nodes: 1,000. Links: a million

Compare: Adjacency matrix vs force diagram, Mike Bostock, Les Miserables dataset.

Idiom: Treemap

What: Data	Tree
How: Encoding	Area marks and containment, with rectilinear layout.
Why: Task	Query attributes at leaf nodes.
Scale	Leaf nodes: thousands. Links: thousands.

D3 Graph Gallery - Treemap

Treemap, ObservableHQ, flare.json

Idiom: Sunburst / Icicle

What: Data	Tree
How: Encoding	Marks laid out in a circular or rectangular fashion.
Why: Task	Query attributes at leaf nodes.
Scale	Leaf nodes: thousands. Links: thousands.

Sunburst, ObservableHQ, flare.json

Icicle, ObservableHQ, flare.json

Idiom: Packed circles

What: Data	Tree
How: Encoding	Area marks and containment, with circular layout.
Why: Task	Query attributes at leaf nodes.
Scale	Leaf nodes: thousands. Links: thousands.

D3 Graph Gallery - Packed Circles

Zoomable packed circles, ObservableHQ, flare.json

Idiom: Dendogram

What: Data	Tree
How: Encoding	Tree-like structure.
Why: Task	Query attributes at leaf nodes.
Scale	Leaf nodes: thousands. Links: thousands.

D3 Graph Gallery - Dendogram

Cluster Dendogram, ObservableHQ, flare.json

Idiom: Chord Diagram

What: Data	Network, where you want to show many-to-many relationships from nodes to other nodes.
How: Encoding	Radial arcs between nodes to show relationships.
Why: Task	See holistic overview of relationships.
Scale	Not so many nodes that the chart gets too messy.

D3 Graph Gallery - Chord Diagram

Data to Viz Chord Diagram

Chord Diagram, ObservableHQ

Idiom: Sankey

What: Data	Network, where you want to show paths (and especially a quantitative value in the links) from one class of input nodes to a class of output nodes.
How: Encoding	Point marks for nodes, scaled connection bands for links.
Why: Task	See holistic overview of paths from the inputs to the outputs.
Scale	Not so many nodes that the chart gets too messy.

D3 Graph Gallery - Sankey

Sankey, ObservableHQ

Idiom: Arc Diagram

What: Data	Network. Useful if there is an ordering of nodes that makes the layout tidy.
How: Encoding	Point marks for nodes, arcs for links.
Why: Task	Explore topology, locate paths and clusters.
Scale	Nodes: Hundreds. Links: Hundreds. Node/link density: $L < 4N$

D3 Graph Gallery - Arc Diagram

Arc Diagram, ObservableHQ

Idiom: Edge Bundling

What: Data	Network of adjacency relationships organized in a hierarchy.
How: Encoding	Point marks for nodes, arcs for links.
Why: Task	Reduces visual clutter and also visualizes implicit adjacency edges between parent nodes.
Scale	Leaf nodes: thousands. Links: thousands.

D3 Graph Gallery - Bundle

Edge Bundling, Data to Viz

Hierarchical Edge Bundling, ObservableHQ

Questions?

Chi-Loong | V/R