

Giving Form to Data

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BU Guest Lecture

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Giving Form to Data

Data visualization is the practice
of giving form

to the abstract and unseen.

1. What goes into **making** a chart?
2. How do we decide **which** chart to use?

Part I: How do we make a chart?

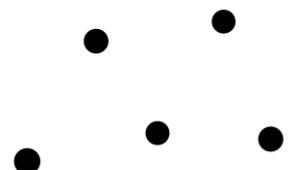
1. Understanding **visual marks**
2. Using marks to represent data

What does it mean to make a mark?



What can we do with marks?

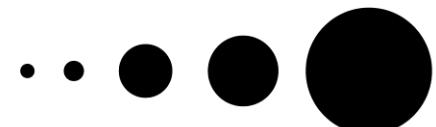
Count



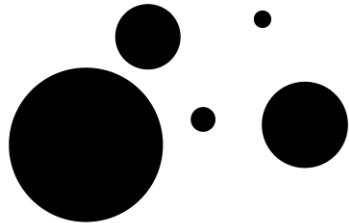
Group



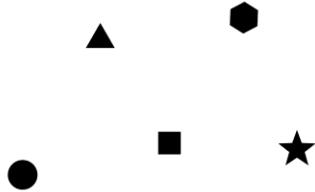
Sort/Order



Different attributes



Different kinds



Some attributes don't change the mark

Sequence



Position



The same mark can have multiple attributes

Size



Shape

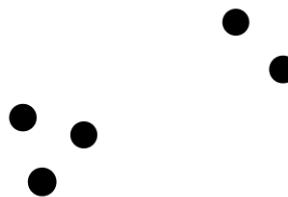


Size & Shape
(& Position)

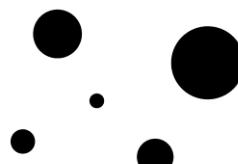


Visual Variables

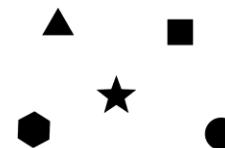
Position



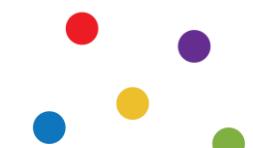
Size



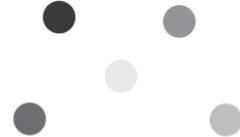
Shape



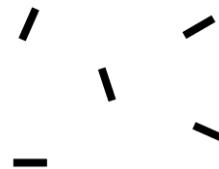
Color (hue)



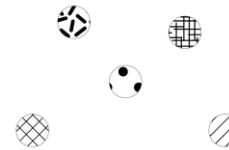
Color (value)



Orientation



Texture



Encodings turn marks into meaning



Encodings turn marks into meaning

Marks



Encoding (cipher)

a	b	c	d	e	f	g	h	i	j	k	l	m
n	o	p	q	r	s	t	u	v	w	x	y	z

Numerals

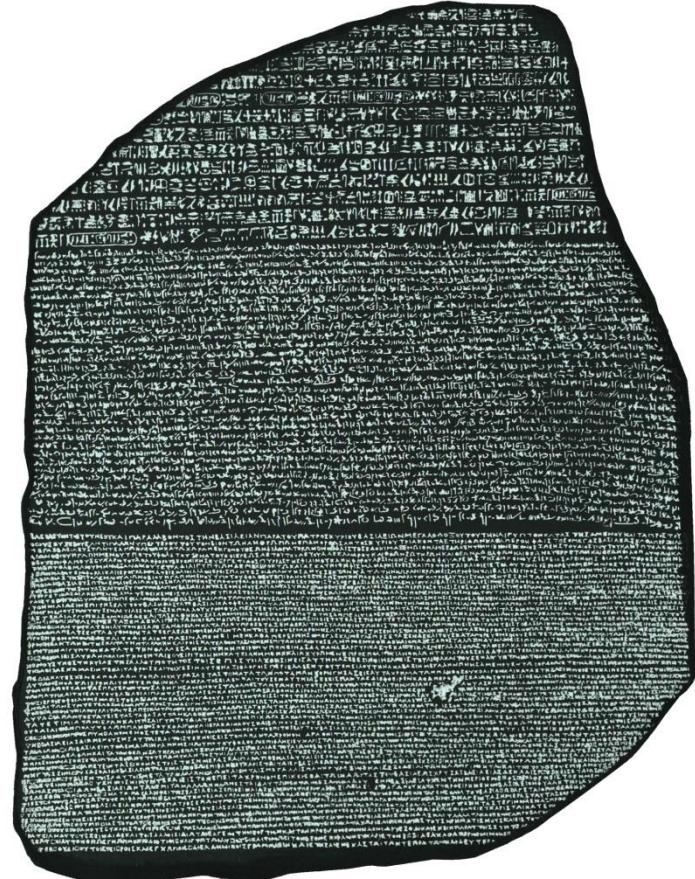
0	1	2	3	4	5	6	7	8	9

Encodings turn marks into meaning

Marks



Encoding (symbolic)



Types of encodings

Position



Length/Height/Width



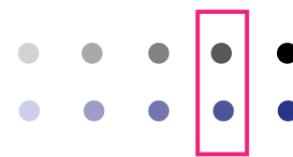
Area/Volume



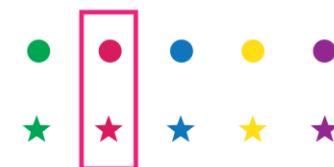
Shape/Symbol



Value/Saturation/Intensity



Color (hue)



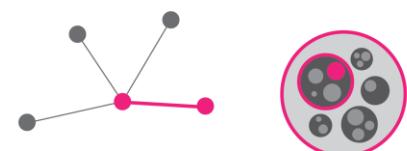
Rotation/Angle



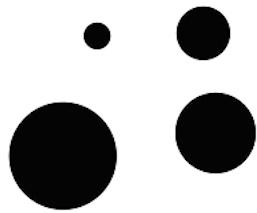
Texture



Relationship/Connectivity



Same data, different chart



A closer look

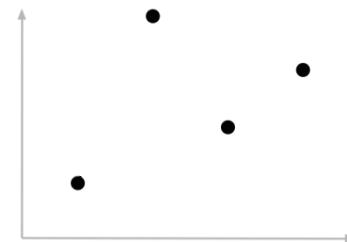
Area



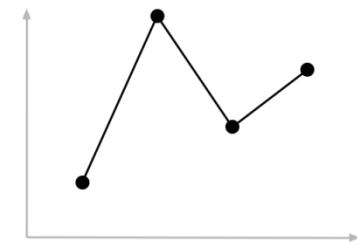
Area, Position



Position ($\times 2$)



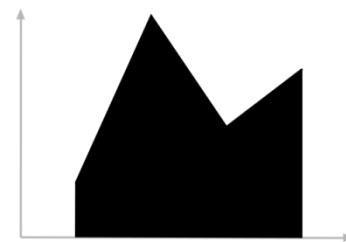
Position



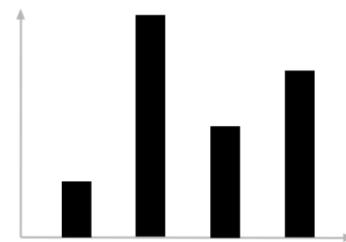
Position



Position



Position



Length, Position

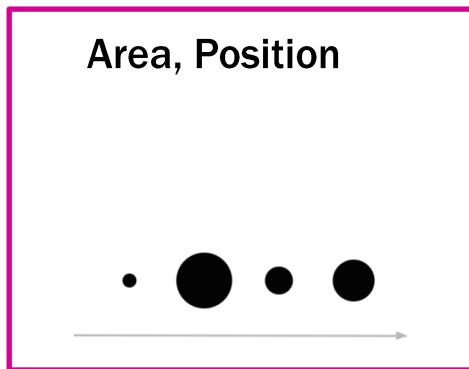


A closer look

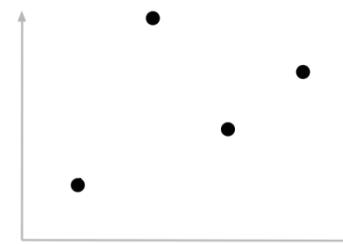
Area



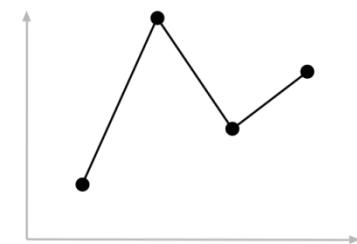
Area, Position



Position ($\times 2$)



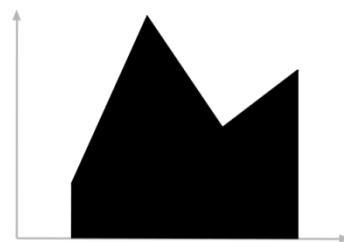
Position



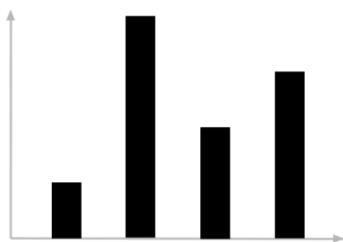
Position



Position



Position



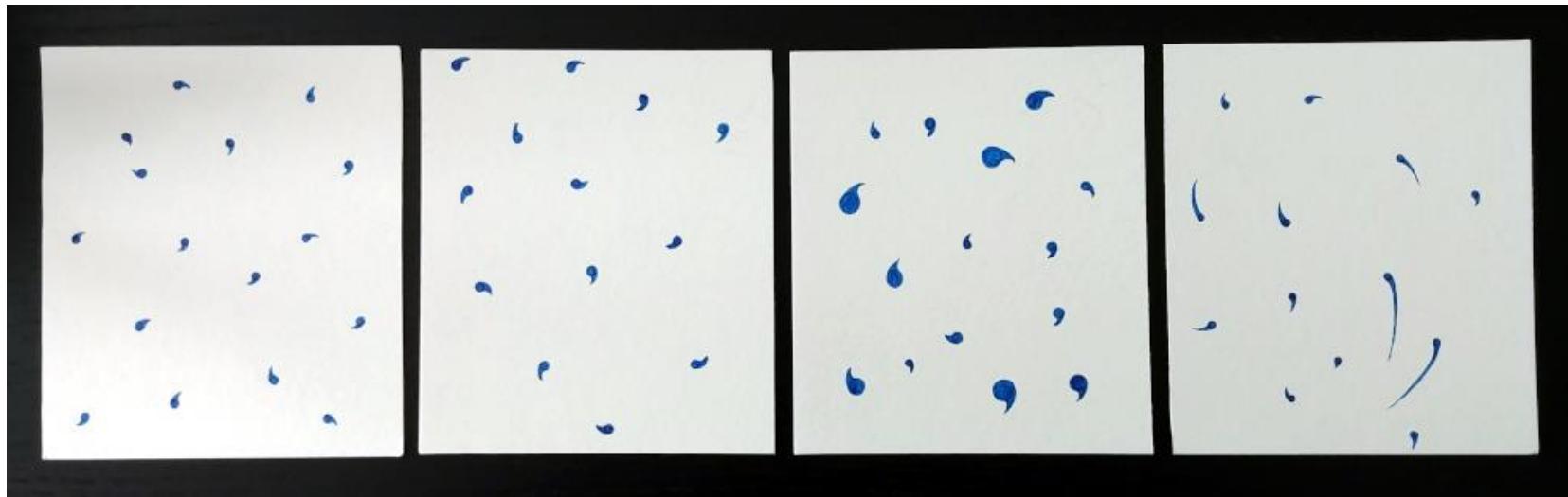
Length, Position



Non-traditional encodings



Non-traditional encodings



Non-traditional encodings and data humanism



Part II: Which chart is best?

1. Who is this visualization for?
2. What do they need to do, or see?

Know your purpose.

Audience: Who am I talking to?

Context: What kind of information do they want/expect to see?

Content: Am I communicating a quantitative insight,
or a subjective truth?

Data visualization as story

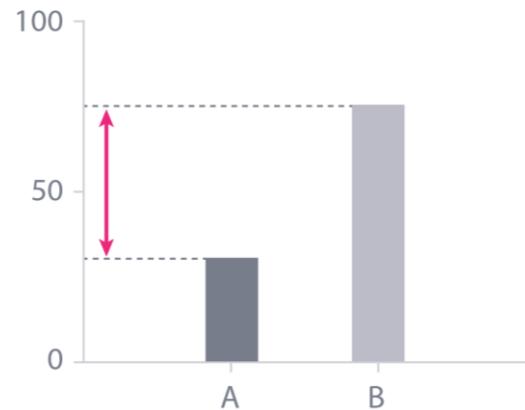
What kind of story does your data tell?

- Compare objects side by side
- Group things together
- Narrate a sequence of events
- Show membership
- Explain how things change
- Show how individuals are connected.

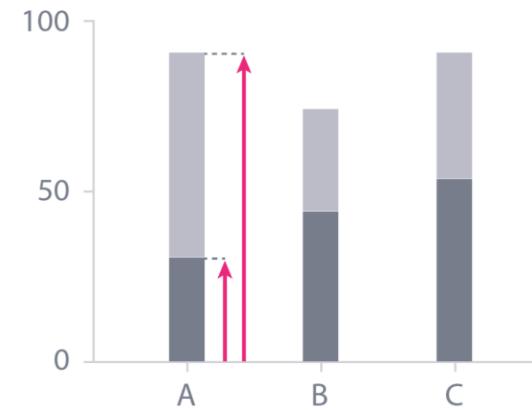
Support a user task.

Charts support visual comparisons

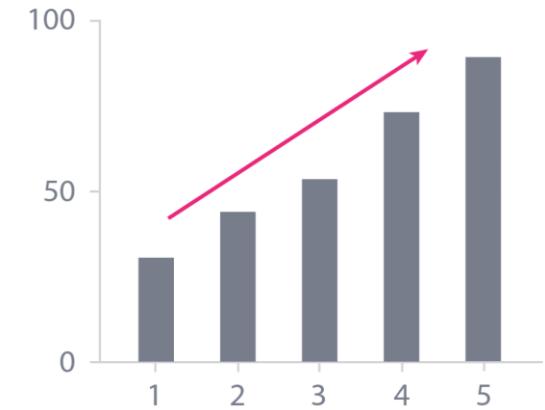
Value/size



Proportion

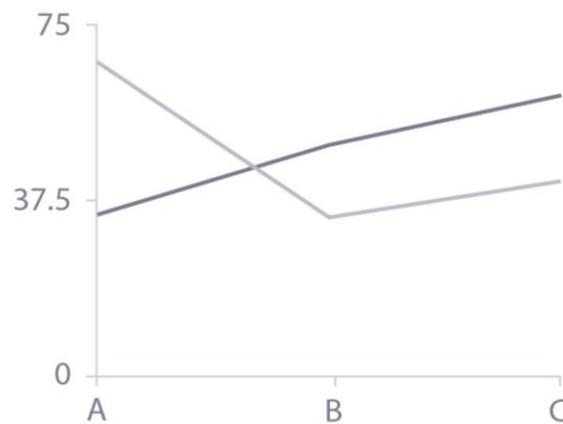


Behavior over time

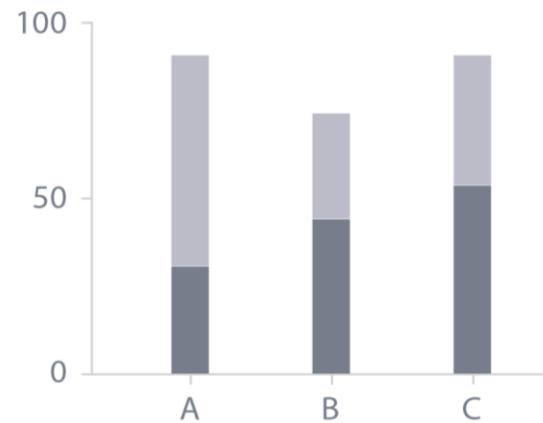
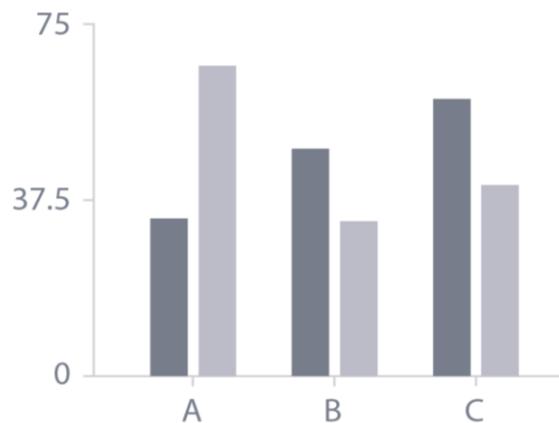
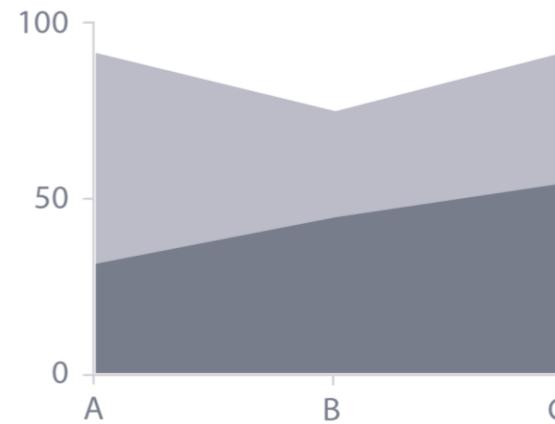


Different charts for different tasks

Absolute representations

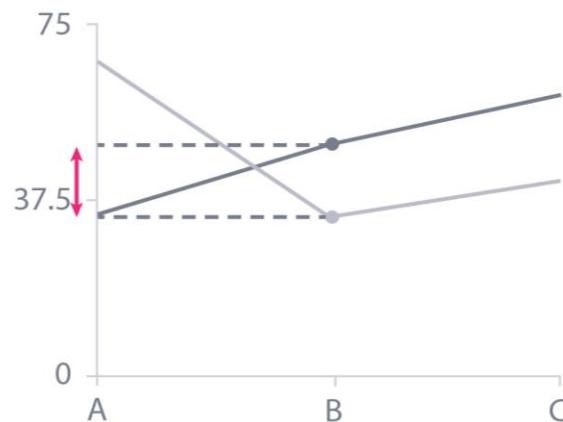


Proportional representations

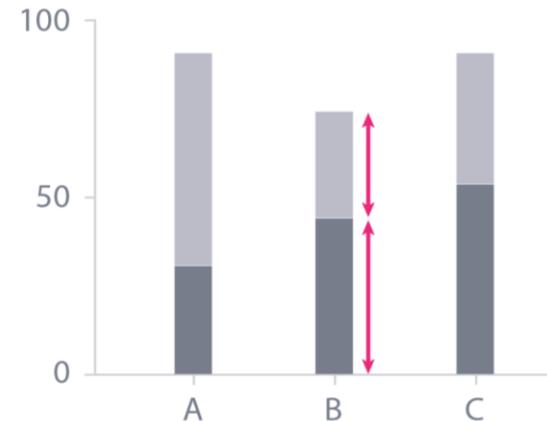
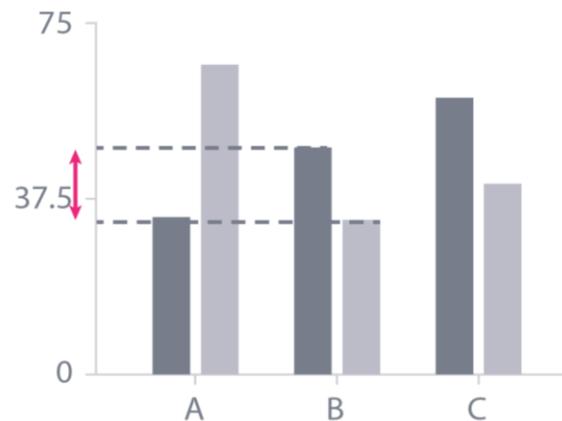
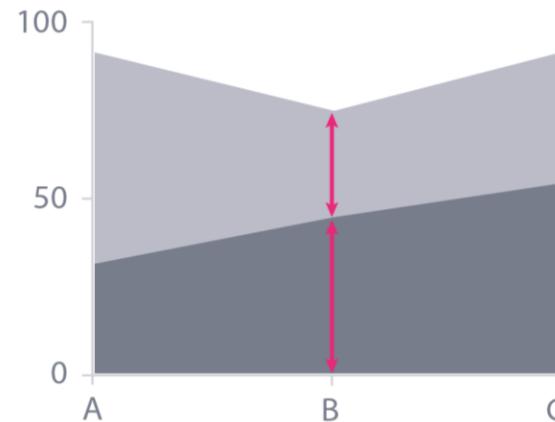


Different charts for different tasks

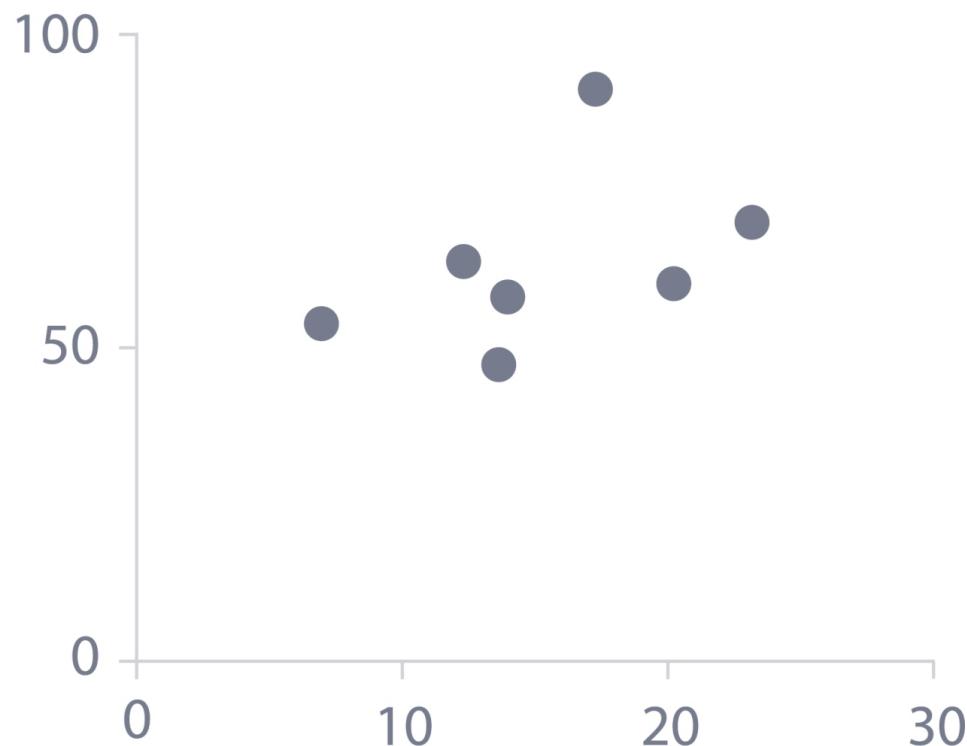
Absolute representations



Proportional representations

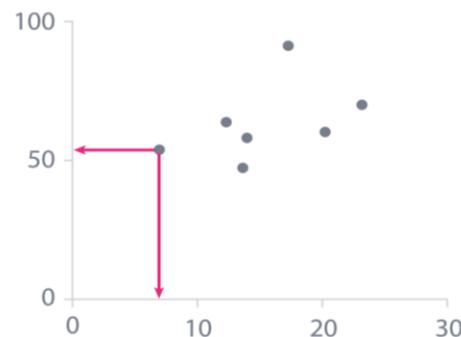


One chart, many tasks

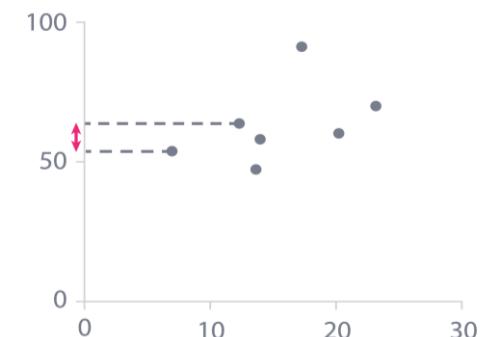


One chart, many tasks

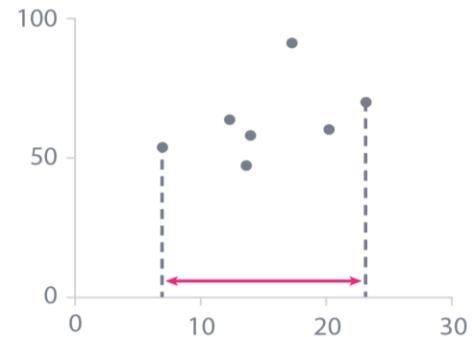
Read value of a point



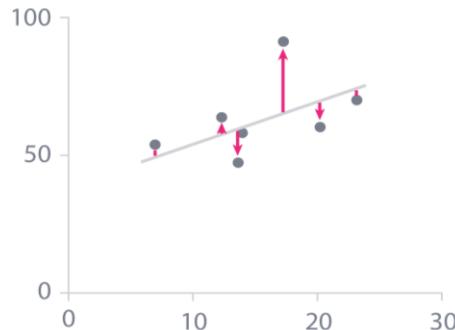
Compare two points



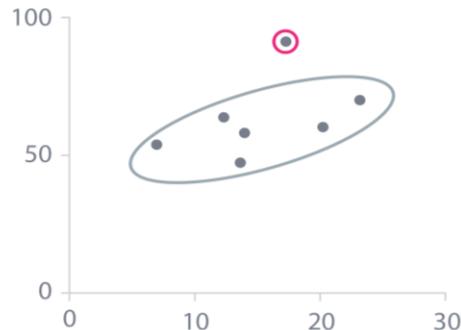
Max and min value



Compare to trendline



Look for outliers

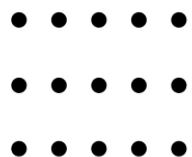


Compare series values

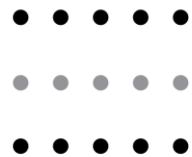


Gestalt Principles

Proximity



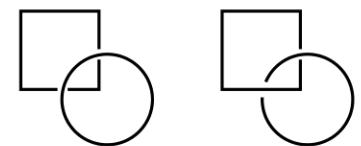
Similarity



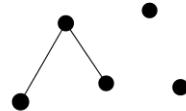
Closure



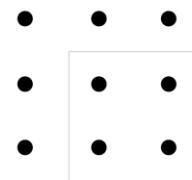
Continuity



Connectedness



Enclosure



Symmetry

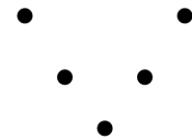
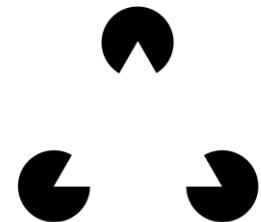
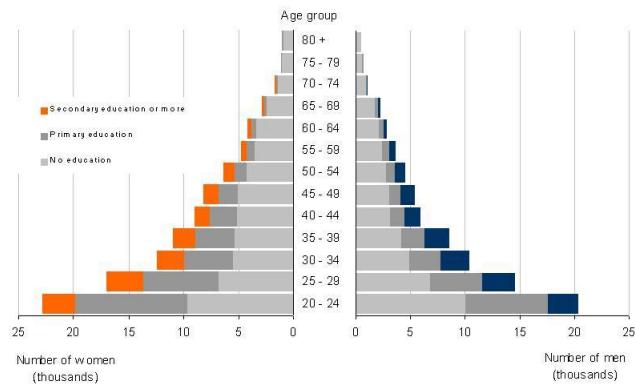
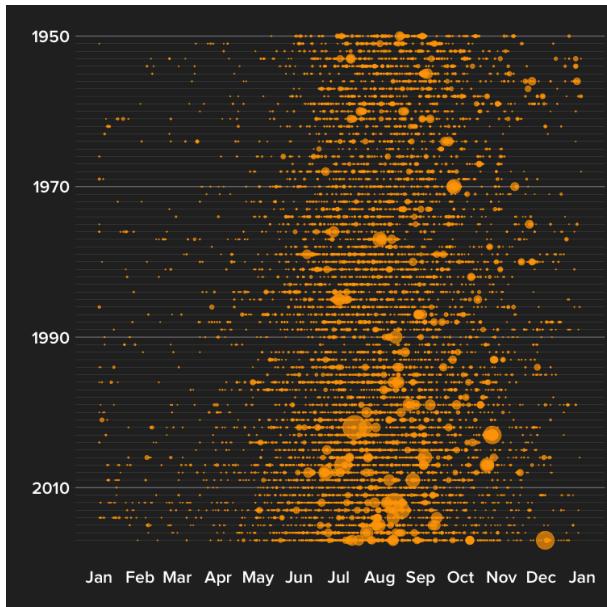


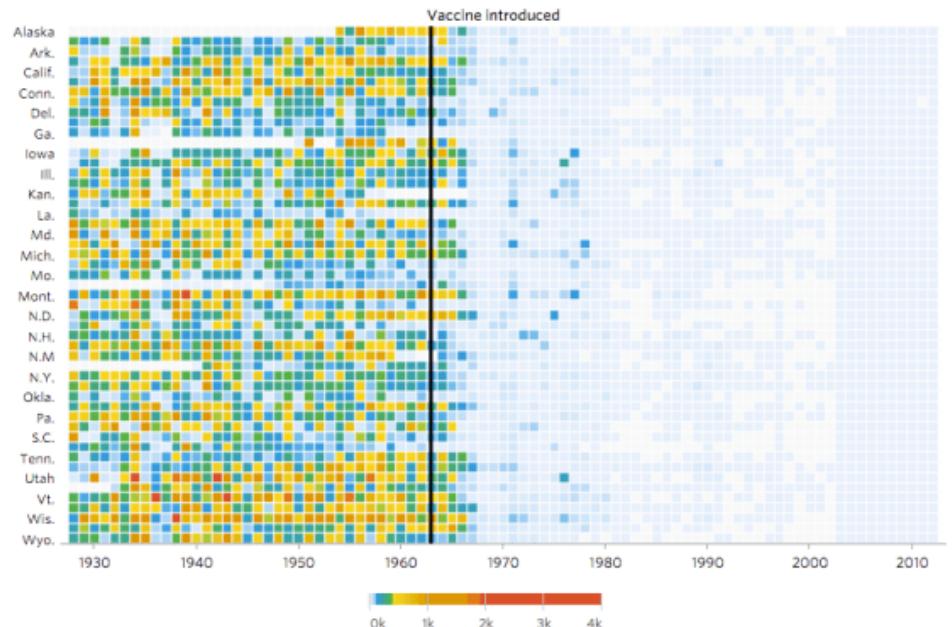
Figure & Ground



Gestalt principles in action

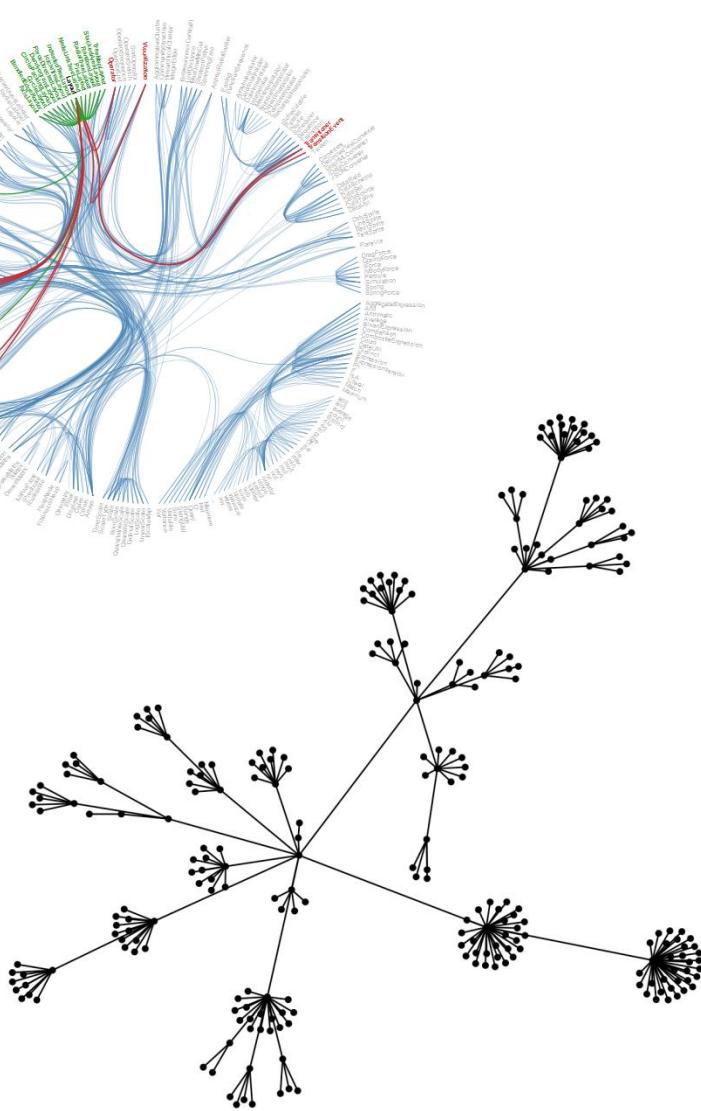


<https://flowingdata.com/2018/08/16/more-wildfires-than-ever/>
<https://medium.com/data-and-society/data-visualization-4286f78af898>

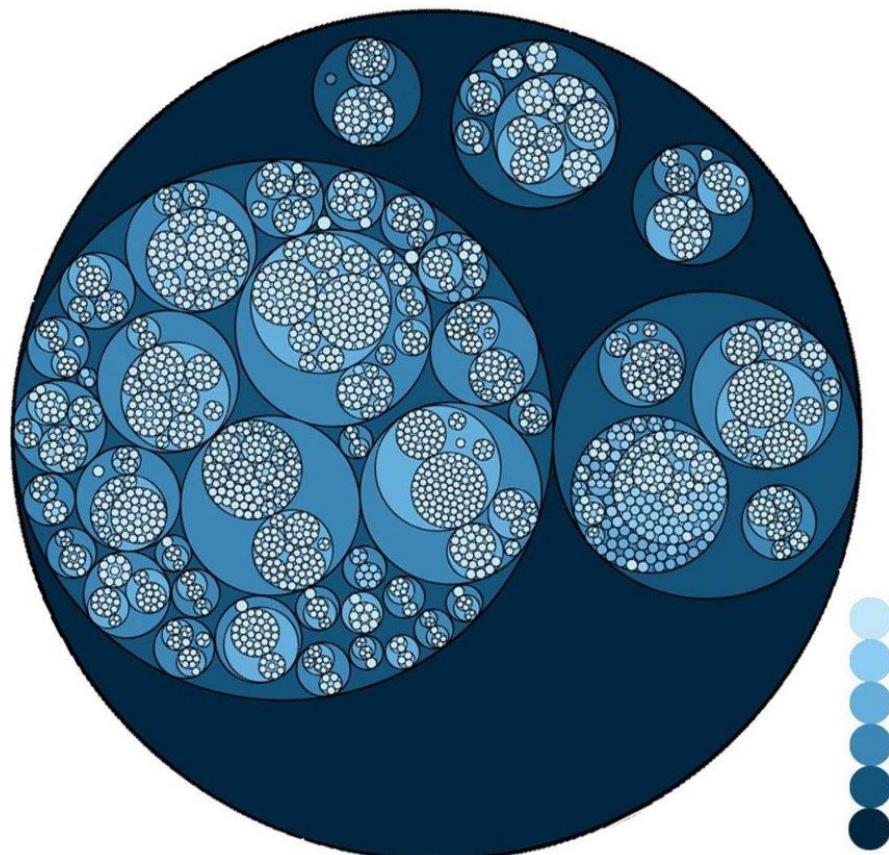


<https://www.fastcompany.com/3054064/feast-your-eyes-on-the-most-beautiful-data-visualizations-of-2015>

Gestalt principles in action



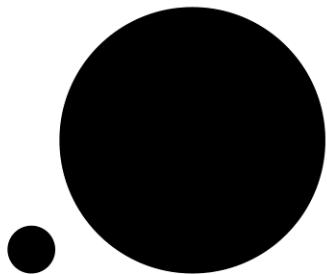
<https://wwwf.imperial.ac.uk/blog/charityinsights/2015/08/10/cdp-blog-3-chord-diagrams/>
<https://www.r-graph-gallery.com/313-basic-circle-packing-with-several-levels.html>



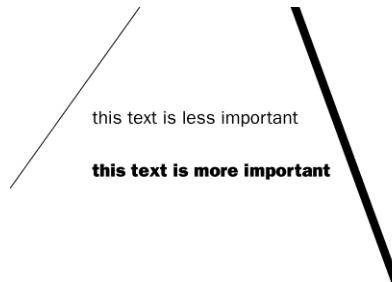
https://www.researchgate.net/figure/Circular-treemaps-automatically-generated-by-our-variational-algorithm-for-the_fig1_283095369

Visual salience: how to stand out

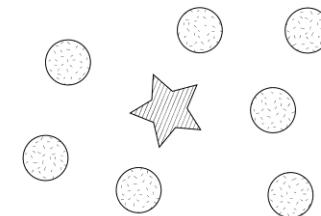
Big



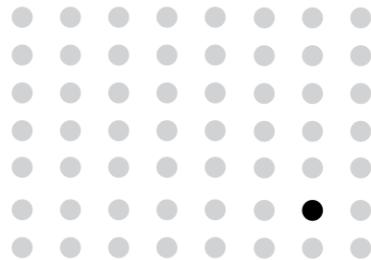
Bold



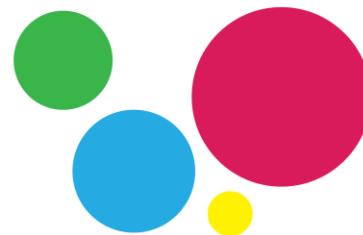
Different



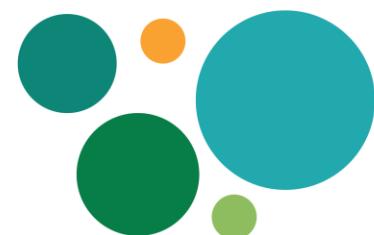
Dark



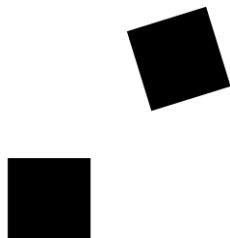
Bright



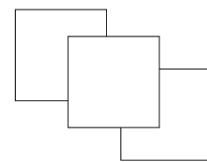
Different color group



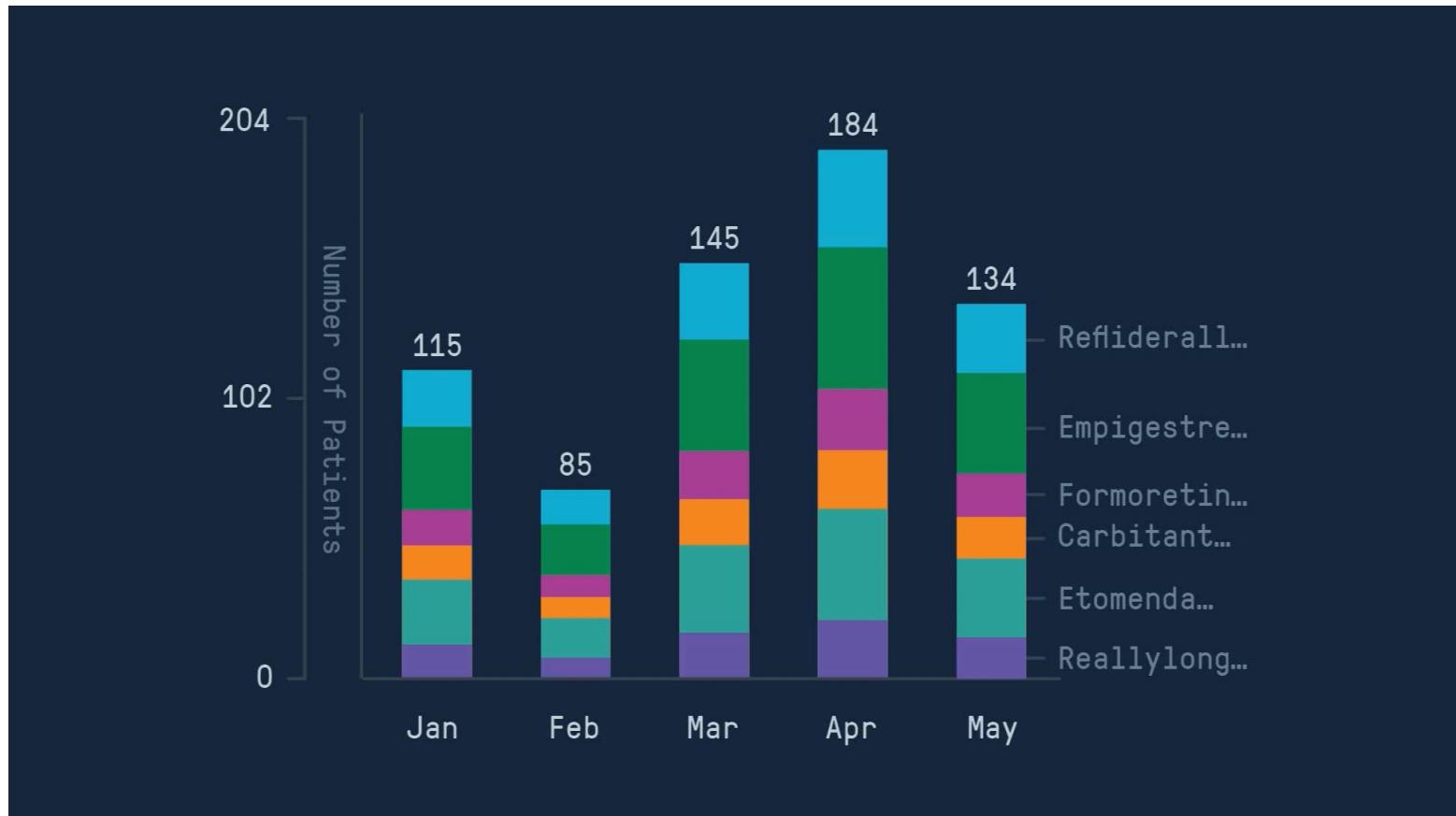
Visual Instability



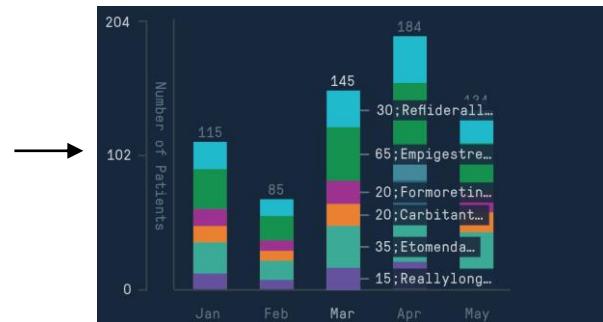
Layer order



Using hierarchy to focus attention



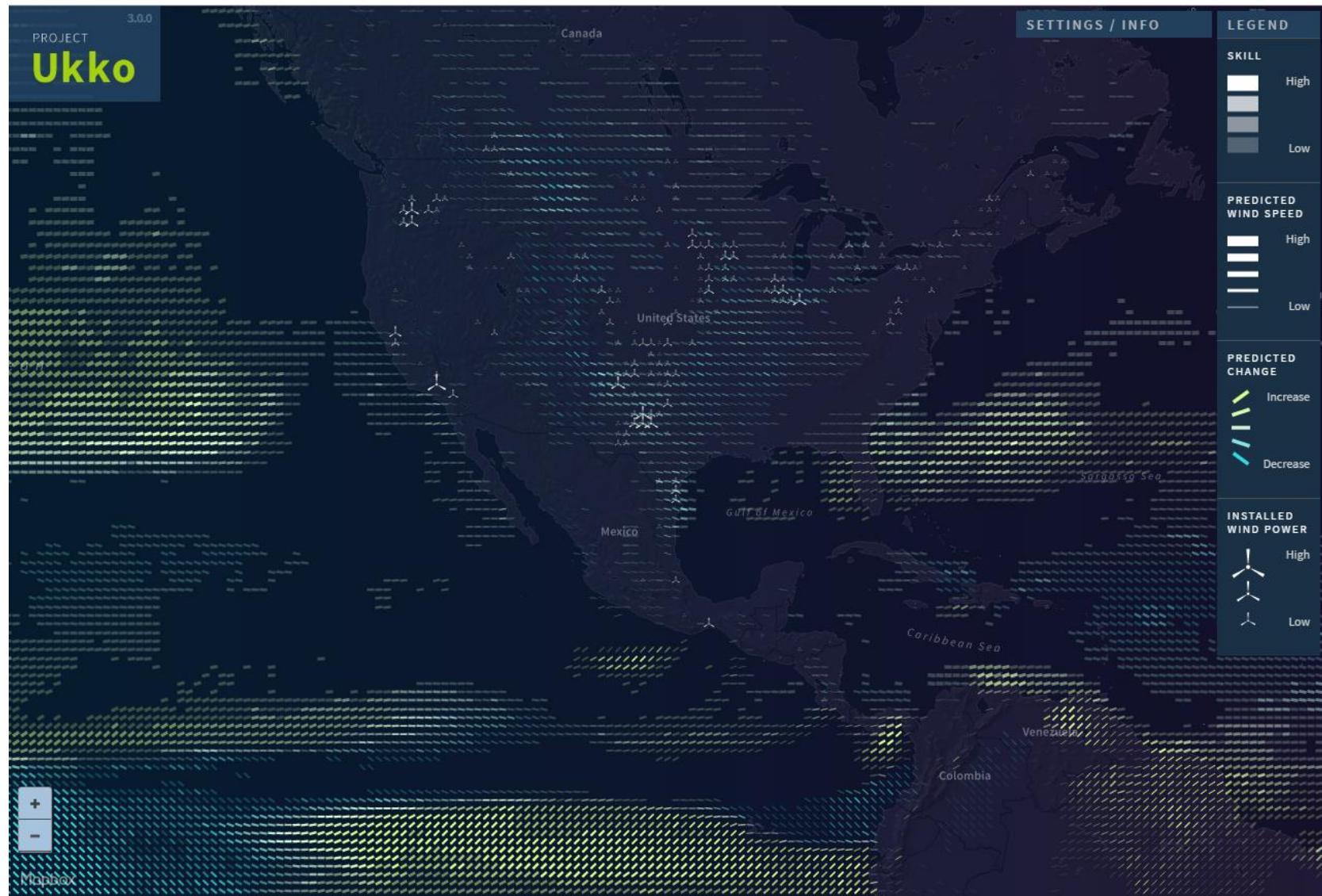
Using hierarchy to focus attention



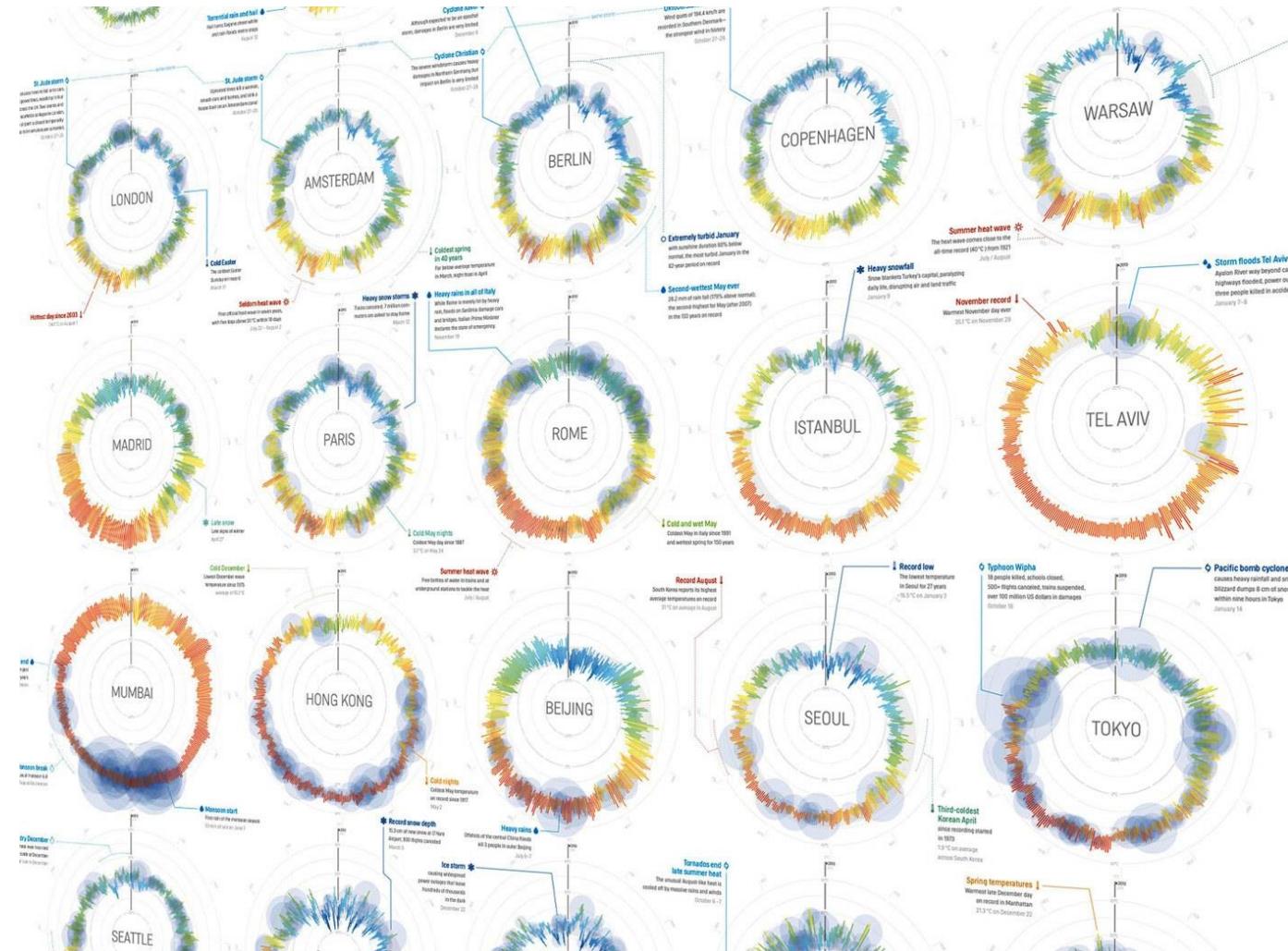
Selective Tuning

Data visualization is the graphic representation of data. It involves producing images that communicate relationships among the represented data to viewers of the images. This communication is achieved through the use of a systematic mapping between graphic marks and data values in the creation of the visualization. This mapping establishes how data values will be represented visually, determining how and to what extent a property of a graphic mark, such as size or color, will change to reflect change in the value of a datum.

Layers of data



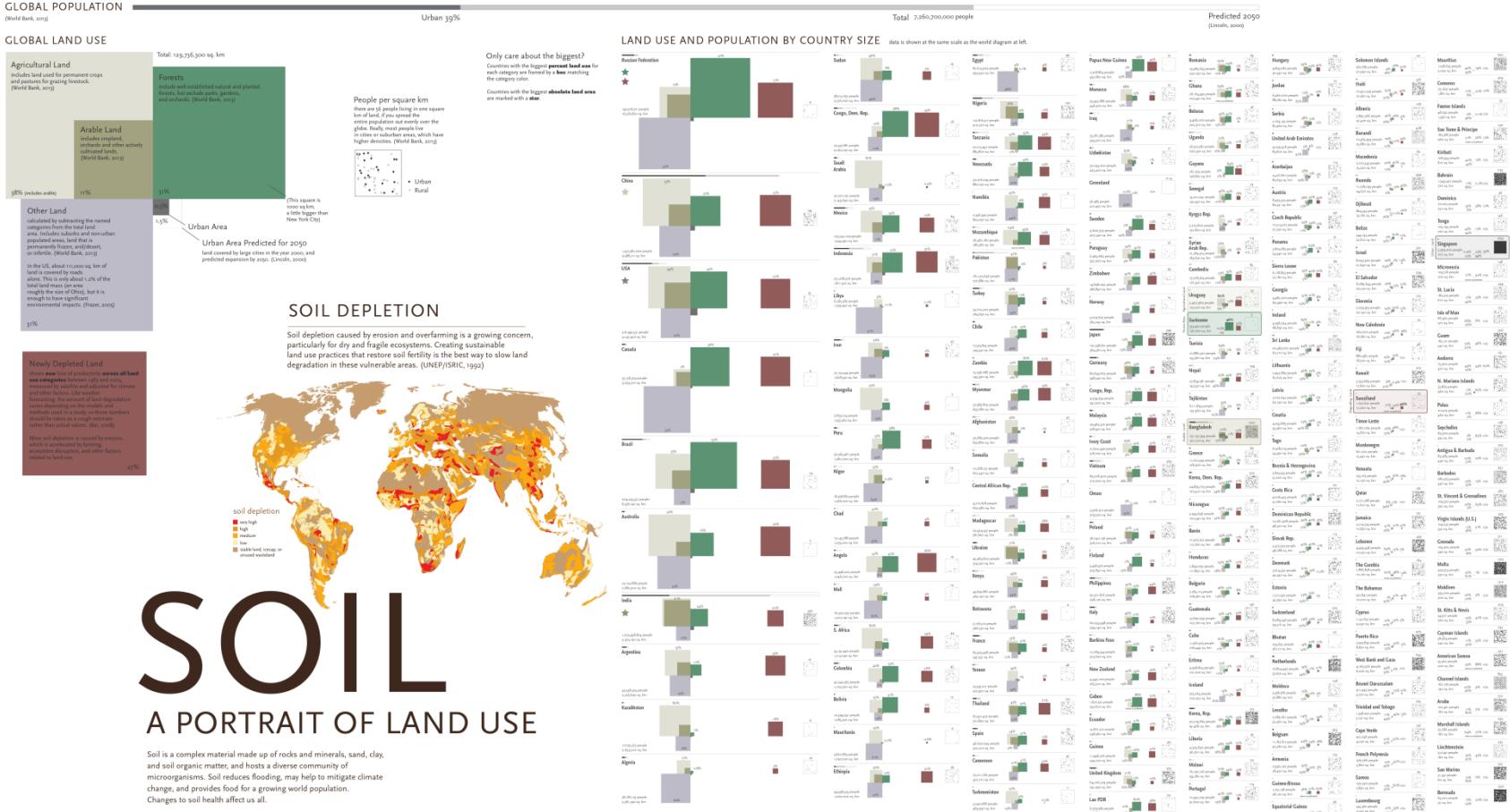
Glyphs: Compound marks



Glyphs: Compound marks



Glyphs: Compound marks



SOIL A PORTRAIT OF LAND USE

Soil is a complex material made up of rocks and minerals, sand, clay, and soil organic matter, and hosts a diverse community of microorganisms. Soil reduces flooding, may help to mitigate climate change, and provides food for a growing world population. Changes to soil health affect us all.

In summary

1. Charts use a **visual language** based on simple **rules**.
2. Experiment with those rules to suit your specific **purpose**.