Custom Data Maps

IT 7113 Data Visualization
http://idi.kennesaw.edu/it7113/

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KENNESAW STATE UNIVERSITY

This lecture notes is hosted at https://www.edocr.com/v/npapy5k4/jgzheng/mapping-location-based-visualization

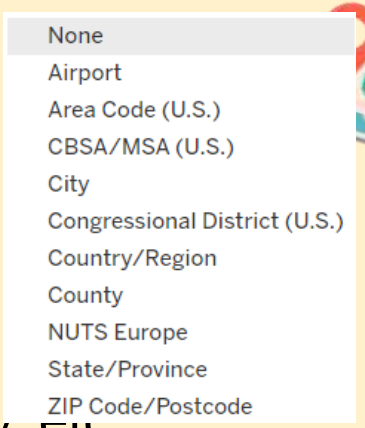
Overview

We will introduce three types of custom maps.

1. Custom geo map
2. Custom contextual map
3. Tile grid map

1. Custom Geo Map

Built-in geo location data types in Tableau - see more info at https://help.tableau.com/current/pro/desktop/en-us/maps_data.htm



- Standard (default) geo map
  - Use of GIS software or capabilities
  - Common geo location data can be recognized by the software without special settings: city, state, zip, country, etc.
  - A geo location related field needs to set as a geolocation data type
  - Standard geo areas can be grouped as a derived geo location area
- Custom geo maps include:
  - *Non-standard geo areas* that are not recognized and handled directly (lakes, nature preserves, parking space, etc.)
  - *Custom geo areas* for specific or temporary situations or events, such as natural phenomenon (rain, fire, flood, etc.), war, etc.
  - *Non-standard geo locations* that are not or difficult to be associated with a precise commonly identifiable name (building, rural place, river location, highway segment, etc.)
  - *Detailed geo locations* that are not automatically recognized by the GIS software and need some special settings. For example, Tableau cannot deal with address/street level of details directly, see https://kb.tableau.com/articles/howto/address-level-mapping.

Custom Geo Map Techniques

- Custom geo encoding
  - A user provides point-based or polygon-based geo coordinates from a separate source
  - Still use the software provided geo base map as background
- Static geo image
  - use of a static geo spatial image as background (not software provided)
  - provide custom geo or x/y coordinates
- See examples at https://public.tableau.com/app/profile/jack.zheng/viz/KSUparking/PointsonGeoMap

Custom Geo Encoding

- Where to get geo coordinates of specific locations?
  - https://cbistudio.interworks.com (recommended) - learn to use tool https://interworks.com/blog/2022/01/24/introducing-cbi-studio-from-interworks/
  - Geo encoding services, such as Google Geo API, https://www.findlatitudeandlongitude.com/batch-geocode/
- How to provide custom geo coordinates in Tableau - two ways
  - **Data blend** (see examples and next a few slides):
    - Provide with your data source directly in one table or blend from two tables
  - Custom geocoding source (not covered in this class)
    - Importing separately https://help.tableau.com/current/pro/desktop/en-us/custom_geocoding.htm
    - Use spatial file (Shapefile) as data source https://help.tableau.com/current/pro/desktop/en-us/maps_shapefiles.htm
  - Refer to https://help.tableau.com/current/pro/desktop/en-us/maps_customgeocode_datablend.htm

Point Based Geo Encoding

- Point based

shapeId	shapeLabel	longitude	latitude	peak rate	parking type
0	Lot A	-84.51876092	33.939726	95%	faculty
1	Lot B	-84.51817083	33.94019775	90%	student
2	Lot C	-84.52028441	33.94132815	77%	guest
3	Lot D	-84.51837468	33.94131035	90%	faculty

Set each location (point) with a pair of longitude and latitude coordinates.

Points (shapes in the table) are mapped on the map.

Data Blend/Join for Points

- For a point-based map, data measures may be put in the same one table, or create a one-to-one relationship between two tables
- One table – see previous slide

shapeId	shapeLabel	longitude	latitude	peak rate	parking type
0	Lot A	-84.51876092	33.939726	95%	faculty
1	Lot B	-84.51817083	33.94019775	90%	student
2	Lot C	-84.52028441	33.94132815	77%	guest

- Two tables
  - One table just for geo location data; one table for measure data; then one-to-one relationship between the two tables.
  - Refer to https://help.tableau.com/current/pro/desktop/en-us/maps_customgeocode_ex_datablend.htm

	A	B	C
1	Name	Estimated Seats	Street Address
2	La Scala	3,000	Via Filodrammatici, 2 20121 M
3	Teatro di San Calo	1,397	Via San Carlo, 98 80132 Naple
4	Teatro Colon	2,500	Cerrito 628 Buenos Aires Ciudad Autónoma de Buenos
5	The Royal Opera House	2,256	Bow St London WC2E 9DD
6	The Bolshoi	2,200	Theatre Square, 1 Moscow 12

	A	B	C
1	Street Address	latitude	longitude
2	Via Filodrammatici, 2 20121 Milan, Italy	45.46731	9.188837
3	Via San Carlo, 98 80132 Naples, Italy	40.83832	14.2417
4	Cerrito 628 Buenos Aires Ciudad Autónoma de Buenos Aires	-34.6011	-58.3824
5	Bow St London WC2E 9DD	51.5137	-0.12284
6	Theatre Square, 1 Moscow 125009	55.76016	37.61845

Table join based on the street address column.

Area/Polygon Based Geo Encoding

- Drawing custom polygons

shapeId	shapeLabel	pointId	longitude	latitude
0	Lot A	0	-84.51796698	33.9409383
0	Lot A	1	-84.51868582	33.94054667
0	Lot A	2	-84.5181601	33.93979899
0	Lot A	3	-84.51724815	33.9398702
0	Lot A	4	-84.51709795	33.94071578
1	Lot B	0	-84.5201664	33.94186398
1	Lot B	1	-84.52133584	33.94173047
1	Lot B	2	-84.52119636	33.94110742
1	Lot B	3	-84.51985526	33.94130323
2	Lot C	0	-84.52347088	33.93755593
2	Lot C	1	-84.52350306	33.93663021
2	Lot C	2	-84.52244091	33.93663021
2	Lot C	3	-84.52264476	33.93752033

Areas (shapes with multiple points in the table) are mapped as polygons on the map.

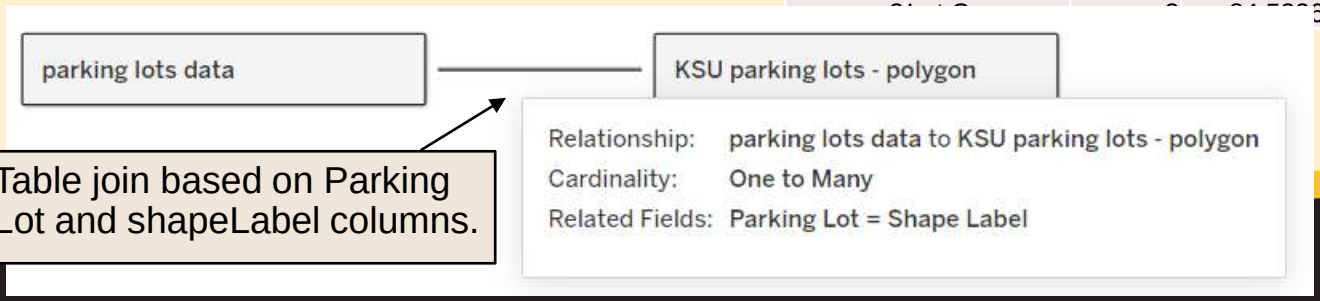
Set each location area (shape) with a set of points (starting from 0); each point has a pair of longitude and latitude coordinates. The software will connect these points by order to forma a area/polygon.

Data Blend/Join for Areas

- For polygon-based map, blend or join two tables
  - one table just for geo location point/polygon data
  - one table for measure data
  - then one-to-many relationship between the two tables.

Parking Lot	peak rate	parking type
Lot A	95%	faculty
Lot B	90%	student
Lot C	77%	guest

shapeId	shapeLabel	pointId	longitude	latitude
0	Lot A	0	-84.51796698	33.9409383
0	Lot A	1	-84.51868582	33.94054667
0	Lot A	2	-84.5181601	33.93979899
0	Lot A	3	-84.51724815	33.9398702
0	Lot A	4	-84.51709795	33.94071578
1	Lot B	0	-84.5201664	33.94186398
1	Lot B	1	-84.52133584	33.94173047
1	Lot B	2	-84.52119636	33.94110742
1	Lot B	3	-84.51985526	33.94130323
2	Lot C	0	-84.52347088	33.93755593
2	Lot C	1	-84.52350306	33.93663021
2	Lot C	2	-84.52244091	33.93663021
			84476	33.93752033



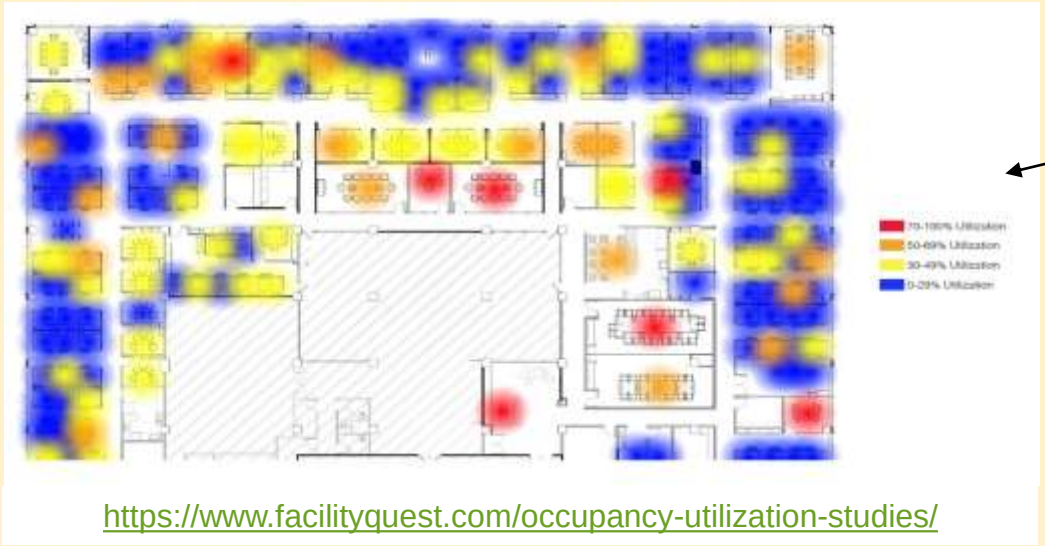
Static Geo Image

- Static geo image is just one image of a geo region, without capability of zooming and panning, and all kinds of map layers.
- The image is placed as the background image of the map.
- Then, points and polygons can be placed on the image, just like geo maps.
- There are two ways of setting position coordinates
  1. Relative geo codes – refer to https://help.tableau.com/current/pro/desktop/en-us/bkimages_maps.htm (recommend the second option using https://www.openstreetmap.org)
  2. Custom X/Y coordinates (similar as context map in the next section) – refer to https://help.tableau.com/current/pro/desktop/en-us/bkimages_coordinates.htm
- The process of setting the data source (either as points or areas) is the same as the previous methods (slide 6 and 7)

2. Contextual Map

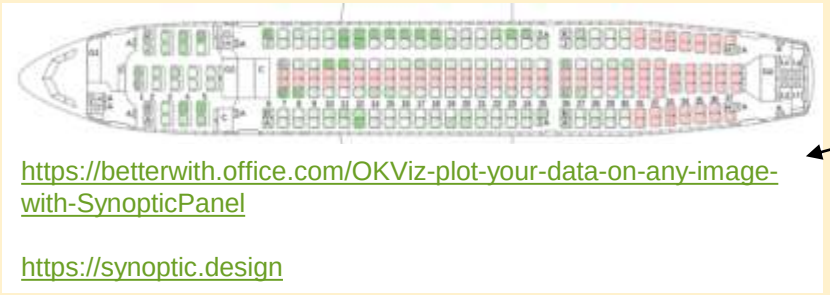
- Contextual maps do not use geo location data and the area is smaller or confined in a specific place.
- The context is closely associated with a particular type of place or activity
- Examples of local contextual spaces
  - Space/seating utilization
    - Building, mall, park, stadium (https://public.tableau.com/profile/stanke#!/vizhome/HackyourMNTwinsTickets/TicketHack), hospital, classroom, airplane, parking
  - Playing court/field
    - Especially used in sports, like tennis, basketball, soccer, etc.
    - https://www.espn.com/nba/story/_/id/27587041/the-absolute-best-shooters-nba-decade
  - Space or layout of smaller objects like keyboards, screens, etc.
  - Open air space

Contextual Data Maps used in Space Management



https://www.facilityquest.com/occupancy-utilization-studies/

Room/space utilization – using color (heat map) for coding utilization rate. Commonly used by campus, office building, mall, hospital etc.,

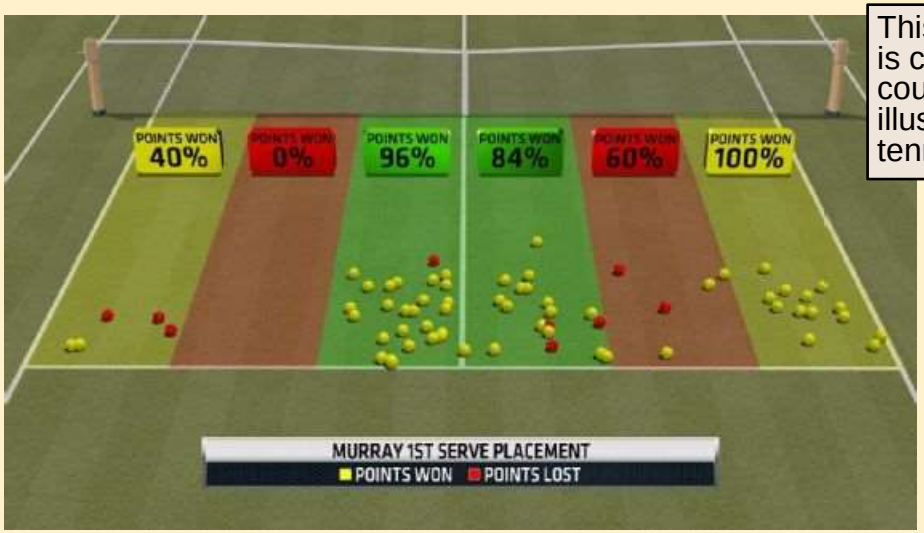


https://betterwith.office.com/OKViz-plot-your-data-on-any-image-with-SynopticPanel

https://synoptic.design

Seating management and insights – commonly used for airlines, theaters, stadiums, and other events.

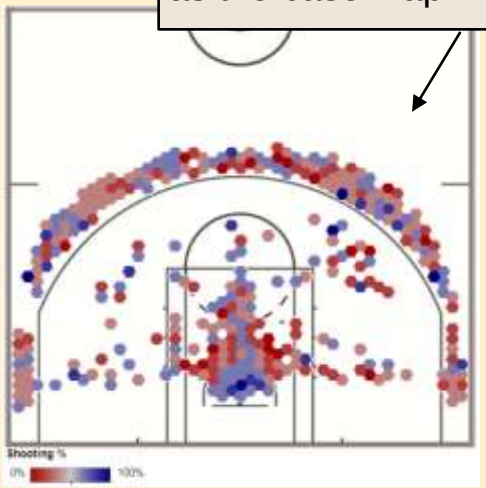
Contextual Data Maps used in Sports



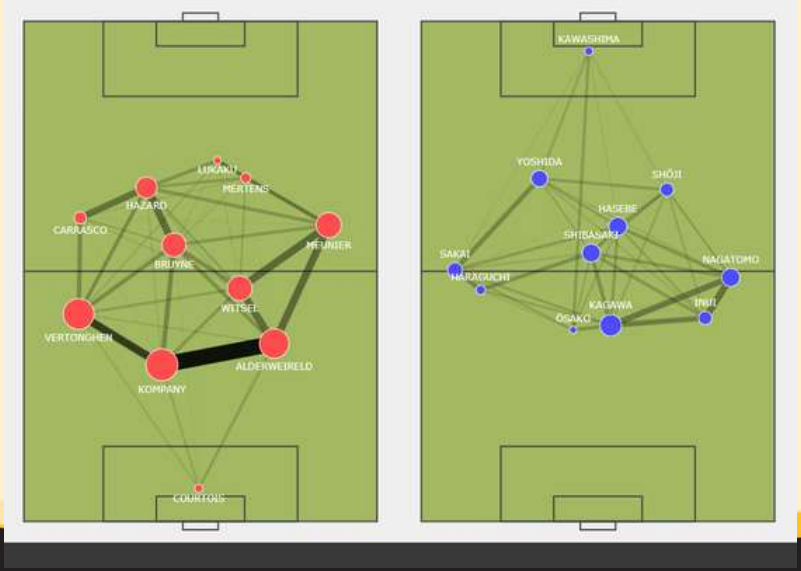
This base map looks real, but it is computer generated tennis court – still considered to be illustrational. But it can be real tennis court based.

https://www.espn.com/tennis/story/_/id/16954858/how-andy-murray-took-milos-raonic-become-wimbledon-champion

This is a typical illustrational diagram of basketball half court used as the base map.



https://public.tableau.com/en-us/s/gallery/seasons-nba-shots

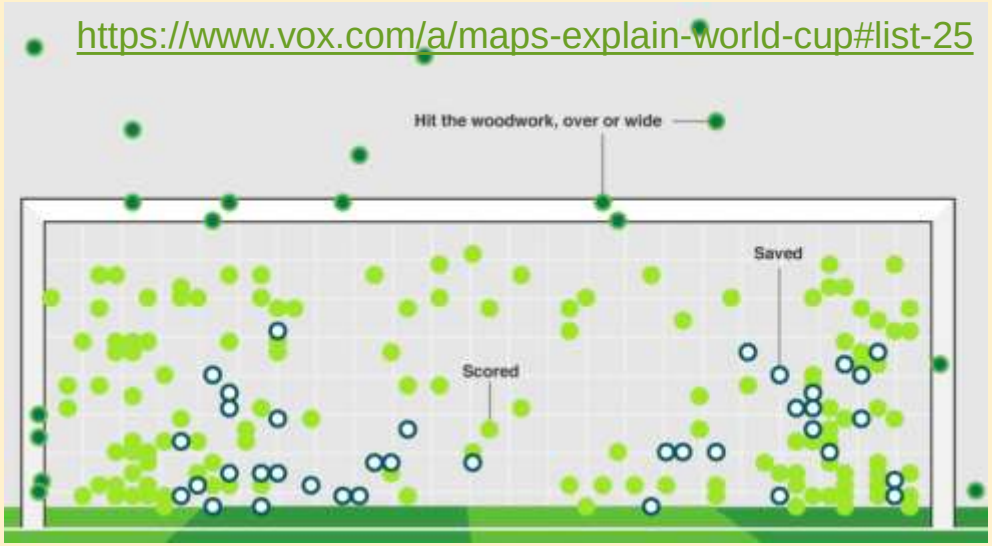


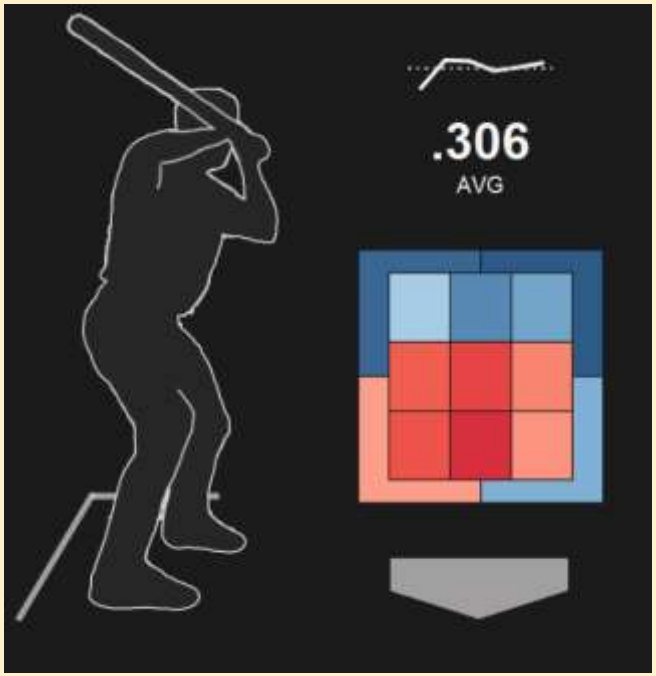
https://www.informationisbeautifulawards.com/showcase/4115-2018-fifa-world-cup-match-explorer

Open Space in the Air

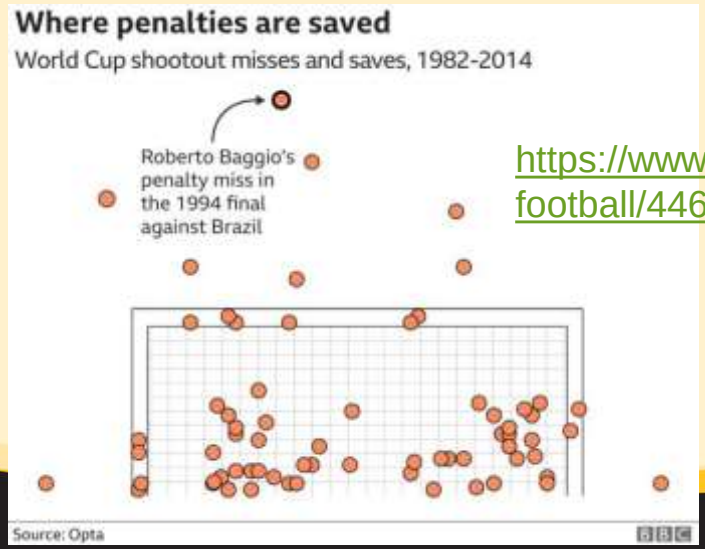
- The “background” is open air (or space that is relative to some kind of reference, such as player standing position, height, etc.)

https://www.vox.com/a/maps-explain-world-cup#list-25





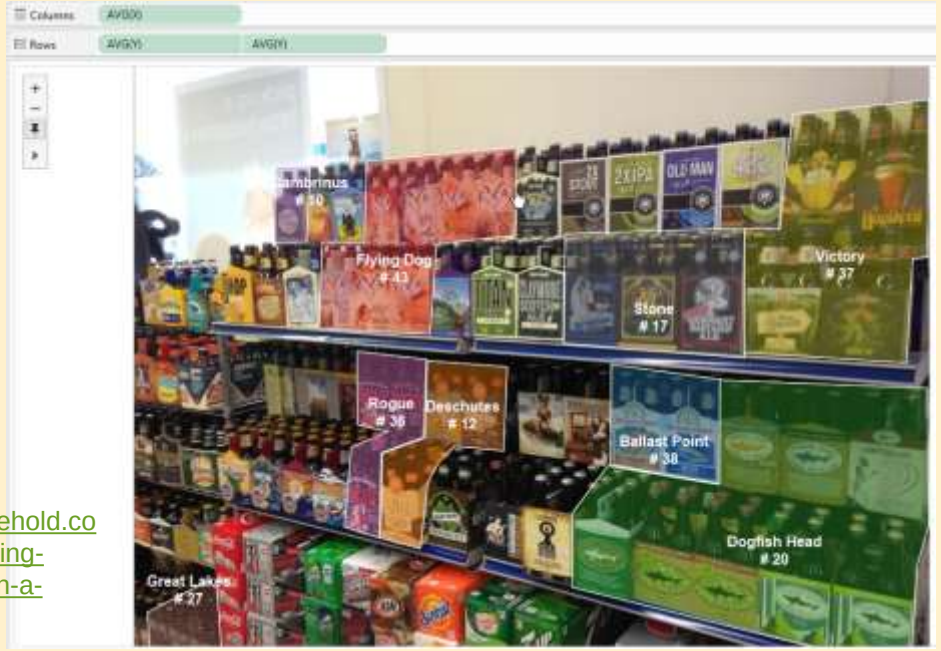
http://public.tableau.com/profile/datavizard#!/vizhome/MLBBatterHotColdZones/BatterHotCold



https://www.bbc.com/sport/football/44641247

Contextual Maps used in Other Places

https://www.patrick-wied.at/projects/heatmap-keyboard/



https://tableauandbehold.com/2015/04/13/creating-custom-polygons-on-a-background-image/

Contextual base maps

- Contextual base maps can have two styles
  - more realistic, based on actual photo or image
  - abstract diagrams (illustrational map)

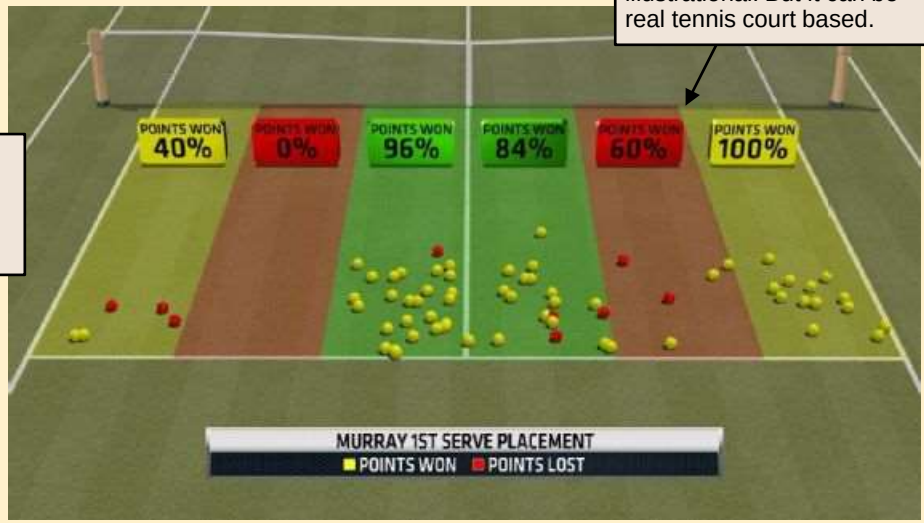
Photos and Image as Contextual Base Maps

- Real world imaging/photo, or even sight

This parking lot base map is from satellite image.

https://www.esri.com/about/newsroom/publications/whereext/nexttech-ai-and-location-intelligence-in-business/

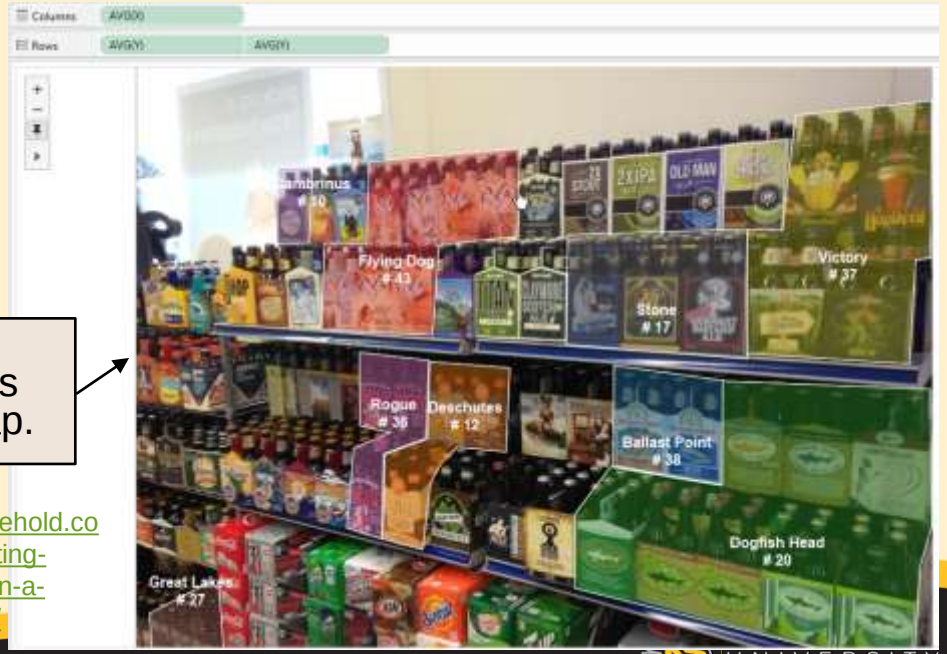
This base map looks real, but it is computer generated tennis court – still considered to be illustrational. But it can be real tennis court based.



https://www.espn.com/tennis/story/_/id/16954858/how-andy-murray-took-milos-raonic-become-wimbledon-champion

https://www.patrick-wied.at/projects/heatmap-keyboard/

A photo of a store shelf as the base map.



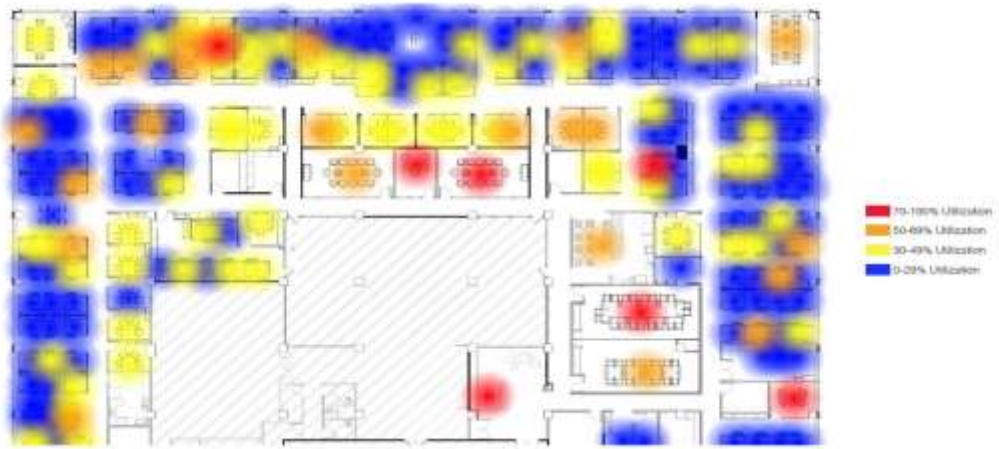
https://tableauandbehold.com/2015/04/13/creating-custom-polygons-on-a-background-image/

Illustrational Diagram or Map

- Illustrational maps simplify map details, and use symbols to represent map objects
  - the goal is to illustrate relative positioning rather than accuracy.
- In this example, the real-world roads are not displayed based on geo maps and coordinates, but rather as a representative illustration

http://fatalities.safer63and881.com/#highway

Illustrational Base Map/Diagram



https://www.facilityquest.com/occupancy-utilization-studies/

This is a typical illustrational diagram of floor plan used as the base map.

https://betterwith.office.com/OKViz-plot-your-data-on-any-image-with-SynopticPanel

https://synoptic.design

This is a typical illustrational diagram of seat plan used as the base map.

Build Custom Contextual Map

- We can use the same technique as the static geo image solution, but with custom X/Y coordinates
  - Use a static background image https://help.tableau.com/current/pro/desktop/en-us/bkimages.htm
  - Find Background Image Coordinates https://help.tableau.com/current/pro/desktop/en-us/bkimages_coordinates.htm
- Use a tool for finding coordinates!!
  - https://cbistudio.interworks.com
  - Learn to use tool https://interworks.com/blog/2022/01/24/introducing-cbi-studio-from-interworks/
- Example
  - https://public.tableau.com/app/profile/jack.zheng/viz/tennis_16968525406280/ServeLandingPoints

3. Tile Grid Map

- Tile grid maps abstractly use simplified symbols (tiles) to represent geo regions
  - just like geo charts, but even more abstract and less accurate.
  - Purely representational, least accurate
- Common use cases
  - Eliminate the Alaska effect on US maps
  - Places are of irregular shape and different sizes
  - Provide a more modern look
- Not ideal when
  - Geographical precision is important

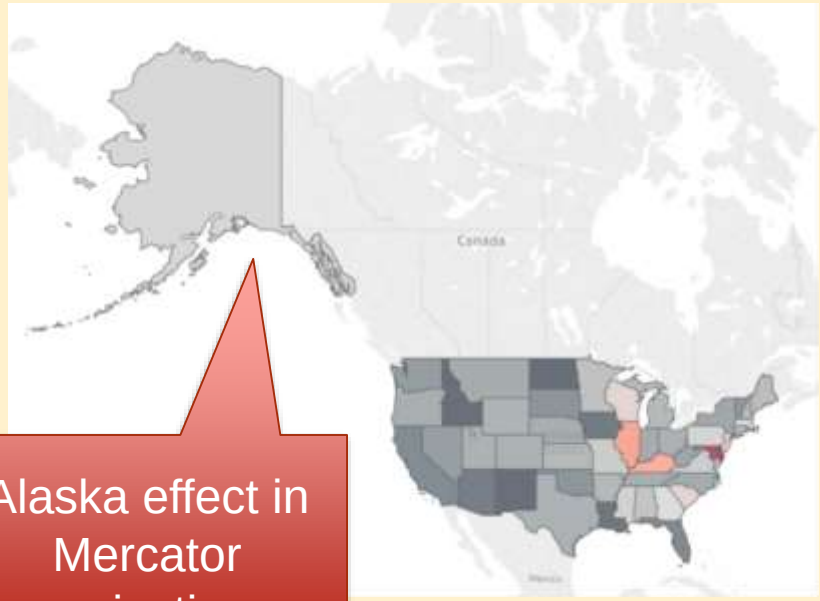
Key readings about tiled grid map:

- http://blog.apps.npr.org/2015/05/11/hex-tile-maps.html
- https://www.forumone.com/insights/blog/good-data-visualization-practice-tile-grid-maps-0/

https://fivethirtyeight.com/features/where-your-state-gets-its-money/

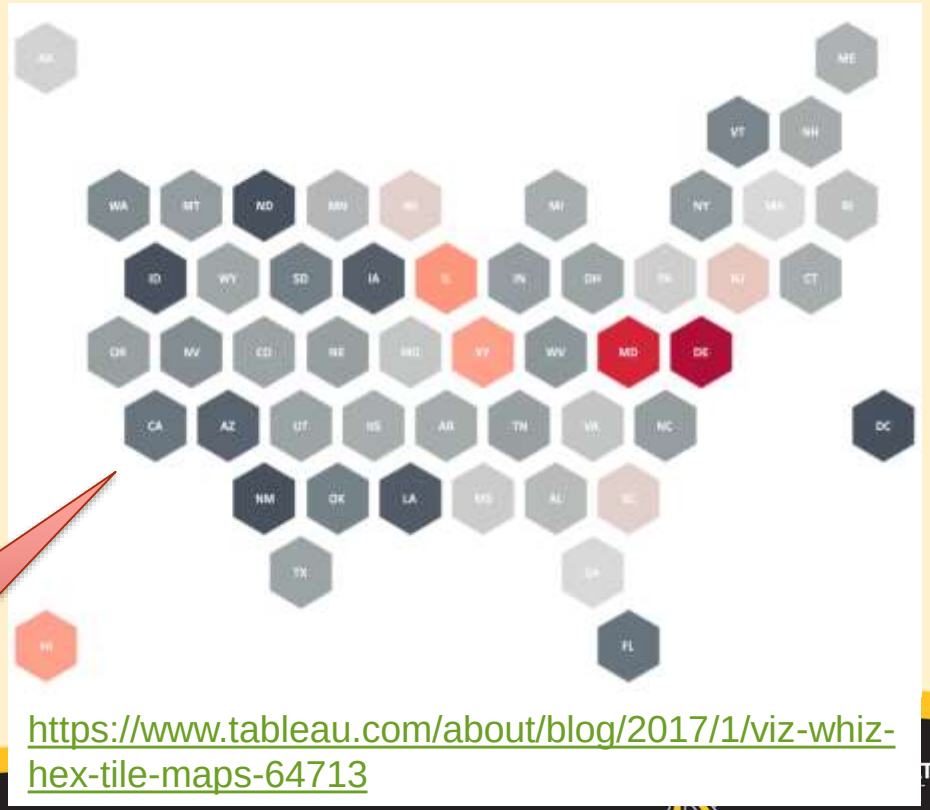
Why Tiles?

- Map project distortion
  - https://en.wikipedia.org/wiki/Map_projection
  - https://observablehq.com/collection/@d3/d3-geo-projection
- Tiny states are hard to be visualized



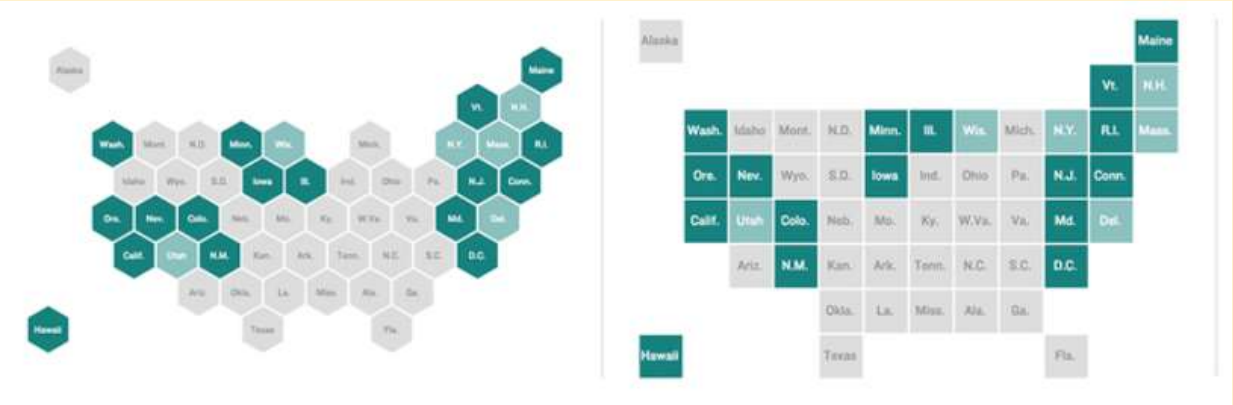
Alaska effect in Mercator projection

States are now represented in shapes with equal sizes



https://www.tableau.com/about/blog/2017/1/viz-whiz-hex-tile-maps-64713

Tile Grid Map Variations

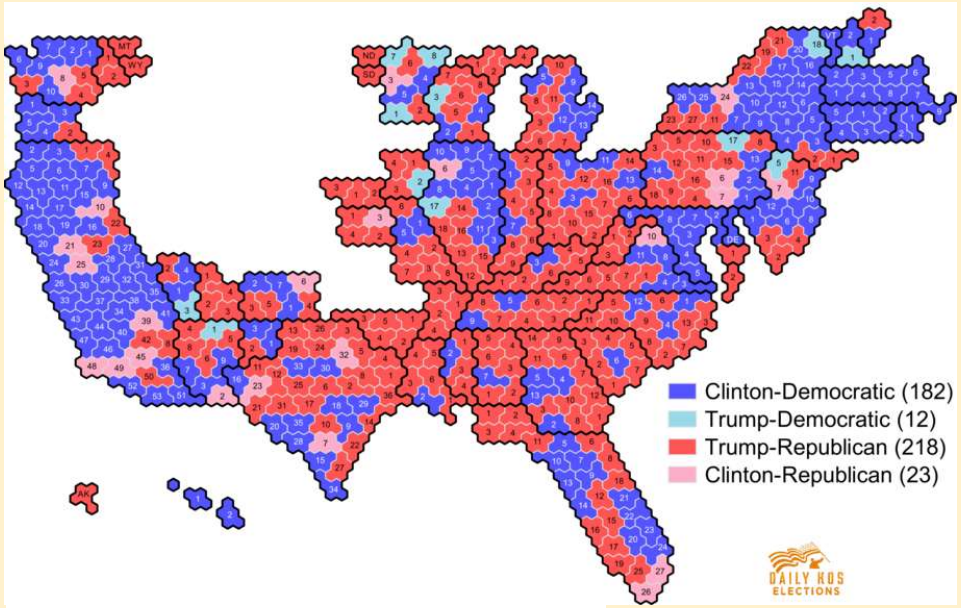


http://blog.apps.npr.org/2015/05/11/hex-tile-maps.html

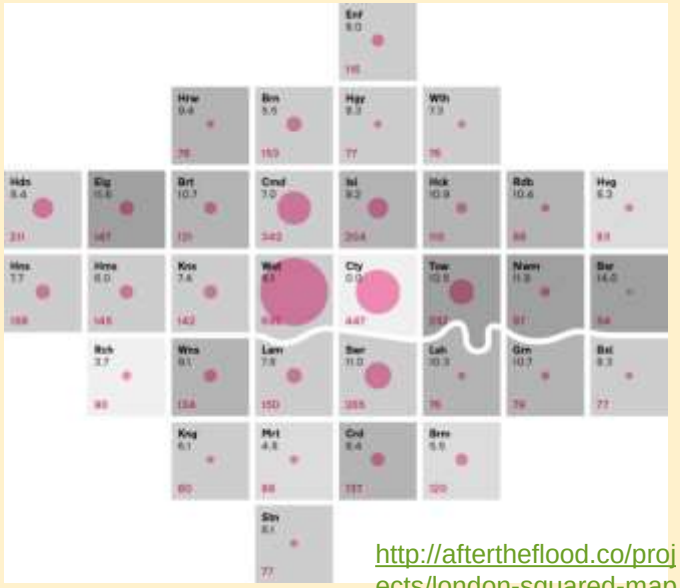
http://bfongdata.blogspot.com/2015/11/periodic-table-map.html

https://public.tableau.com/app/profile/datavizard/viz/EnergyinAmerica/Energy

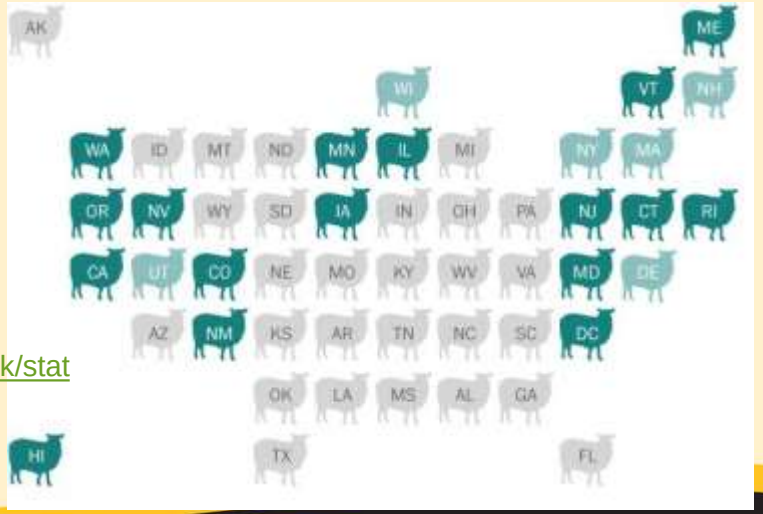
Tile Grid Map Variations



https://www.dailykos.com/stories/2013/7/9/1220127/-Daily-Kos-Elections-2012-election-results-by-congressional-and-legislative-districts

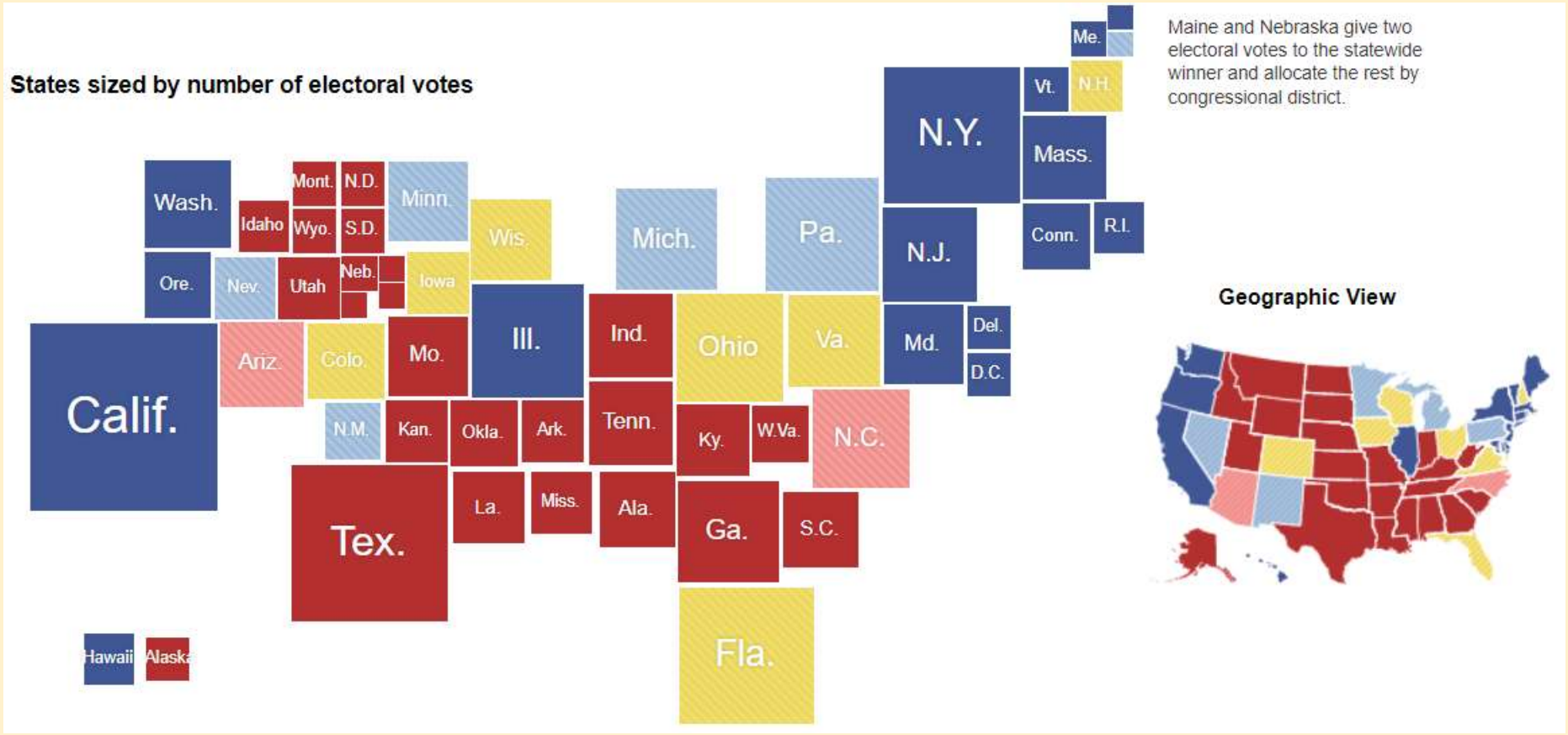


http://aftertheflood.co/projects/london-squared-map



https://twitter.com/katiepark/status/598139293509492736

Tiled Cartogram



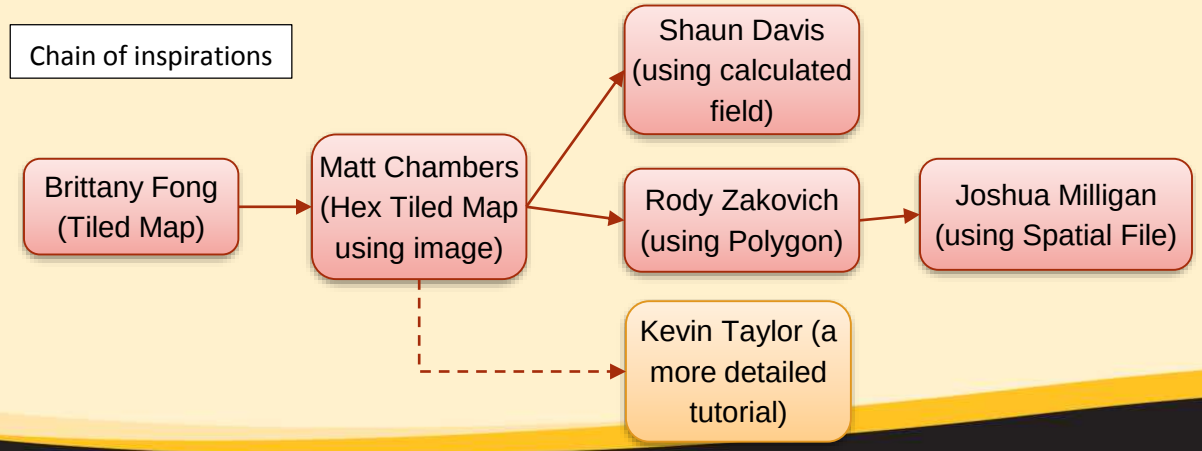
https://www.nytimes.com/elections/2012/ratings/electoral-map.html

Basic Technique

- Creating a tile grid map is similar to scattered plot
  - Determine the grid size (rows and columns); use X/Y axes to set the grid.
  - Use dots in the grid to represent a region; arrange dots with specific location (row/column) in the grid.
  - Present the dots as a consistent/uniform shape.
  - Associate measures to dots - encoded using color/value or other visual properties.
- Refer to https://www.tableau.com/blog/viz-whiz-hex-tile-maps-64713 by Kevin Taylor
- See examples at https://public.tableau.com/app/profile/jack.zheng/viz/tilegridmap_16968521771450/SuperStore

More Techniques

- Using built-in shape
  - Brittany Fong http://bfongdata.blogspot.com/2015/11/periodic-table-map.html or https://www.tableau.com/blog/how-make-tile-grid-maps-tableau
- Using custom shape from an image
  - Matt Chambers https://www.sirvizalot.com/2015/11/hex-tile-maps-in-tableau.html
  - Kevin Taylor https://www.tableau.com/blog/viz-whiz-hex-tile-maps-64713
- Using polygon
  - Rody Zakovich http://www.datatableauandme.com/2017/12/polygon-hex-map-in-tableau.html
  - Note: polygons cannot display data values on the mark.
- Using spatial file (Shapefile)
  - Joshua Milligan https://vizpainter.com/hex-map-spatial-file/ and a video by Anthony Smoak https://anthonysmoak.com/2018/03/11/create-a-hex-map-in-tableau-the-easy-way/
- Using calculated field without data blending
  - Shaun Davis https://www.phdata.io/blog/create-a-hex-map-in-tableau-without-data-blending/



Which style should I choose?

- Point or area?
- Realistic map image or representational diagram?
- Real geo/location area shape or uniform abstract shape?

Learning Resources

- Custom map
  - https://www.superdatascience.com/blogs/art-using-tableau-custom-maps
- Build custom contextual map in Tableau:
  - Use background image (base map) https://help.tableau.com/current/pro/desktop/en-us/bkimages.htm
  - Background Image Coordinates https://help.tableau.com/current/pro/desktop/en-us/bkimages_coordinates.htm
- CBI Studio https://cbistudio.interworks.com
  - Learn to use tool https://interworks.com/blog/2022/01/24/introducing-cbi-studio-from-interworks/
- Tile Grid Map:
  - Hexagons For Tile Grid Maps http://blog.apps.npr.org/2015/05/11/hex-tile-maps.html
  - Good Data Visualization Practice: Tile Grid Maps https://forumone.com/ideas/good-data-visualization-practice-tile-grid-maps-0
- Creating Tile Grid Map:
  - Brittany Fong http://bfongdata.blogspot.com/2015/11/periodic-table-map.html or https://www.tableau.com/blog/how-make-tile-grid-maps-tableau
  - Matt Chambers https://www.sirvizalot.com/2015/11/hex-tile-maps-in-tableau.html
  - Rody Zakovich http://www.datatableauandme.com/2017/12/polygon-hex-map-in-tableau.html
  - Joshua Milligan https://vizpainter.com/hex-map-spatial-file/ and a video by Anthony Smoak https://anthonysmoak.com/2018/03/11/create-a-hex-map-in-tableau-the-easy-way/
  - Without data blending: https://www.phdata.io/blog/create-a-hex-map-in-tableau-without-data-blending/