

CPSC 447, Foundations 2

Out: Thu Sep 28 2023. Due: Wed Oct 11 2023, 6pm

Submit through Gradescope, as a file in PDF format, following this [Google doc](#) answer template.

Administrative overhead penalty of up to 10% will be imposed if additional processing work is required to handle your assignment, such as: did not follow answer template, unreadable file loaded into Gradescope, pages and questions not matched in Gradescope, etc.

Learning goal

Train yourself in decoding charts so that you can better understand how visual representations can be described using the language and rules of visual encoding and decomposed into low-level graphical components.

General hints

Be specific when describing what marks and channels encode, when you come up with terms for items and attributes. Imagine you are trying to introduce a visualization to a random person on the street: you would not say a mark in this chart represents something generic like a "data item". You would say a mark represents something concrete and understandable, like a person or a university (for example). You will find this precision useful when you deal with complex data.

1 Generate: Two Numbers (6%)

Sketch three different ways to show the two numbers: **8** and **23**, with each sketch using a different combination of channel(s). Write down the channels used in each of your sketches, using the precise terms covered in this class (see list below for Q2). If you worked in an in-class group on this problem, provide the names of your group members.

Sketches do **not** need to be polished: very rough sketches are fine as long as they are legible, the point is to show the design idea not to make something elegant. We do **not** expect you to redraw the sketches you made in class in a more polished form, just turn in what you did then. The intent behind sketching assignments is not to create something that looks fully finished. The purpose of sketching is to generate ideas and explore alternative designs quickly, instead of spending time in polishing one design. (Studies shows that polished "sketches" actually discourage people to explore more ideas!) When we tell you to make sketches in this course, we would like you to draw them yourself using drawing software on a tablet, or hand-draw the sketches with paper and pen and then snap a photo with your phone.

Rubric: 2% each for 3 examples, 1% sketch and 1% channel analysis

2 Channels: Name Them (27%)

For each example below, for each of the possible visual channels, state whether that channel is used/unavailable in the visual encoding, as opposed to available for encoding.

(A channel is available if it could be used to encode a different attribute, to augment the chart without interfering with the current visual encoding.)

Choose from the following channel types

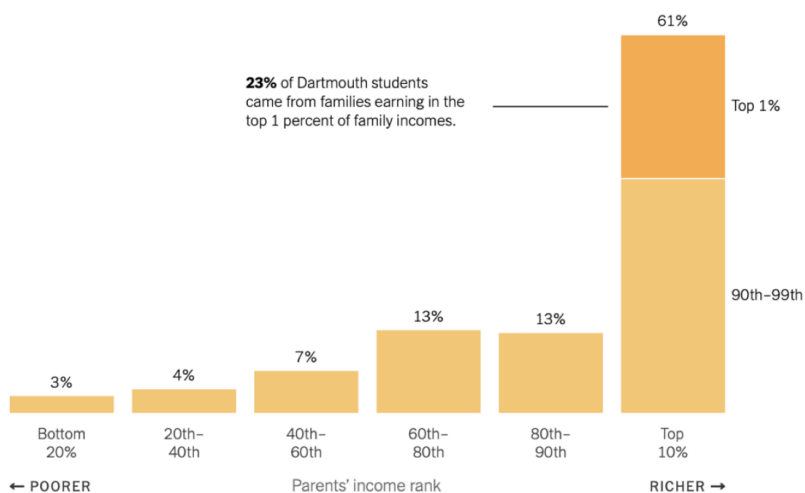
- color
- horizontal position
- vertical position
- combined 2D position
- length (1D size)
- area (2D size)
- volume (3D size)
- radial/angular position
- angle/orientation
- depth (3D position)
- motion
- shape

*Rubric: 0.15% for each of 12 channels * 15 questions = 27%; -0.15% for any missing or incorrect channel.*

2.1 College Income

Family income of Dartmouth students

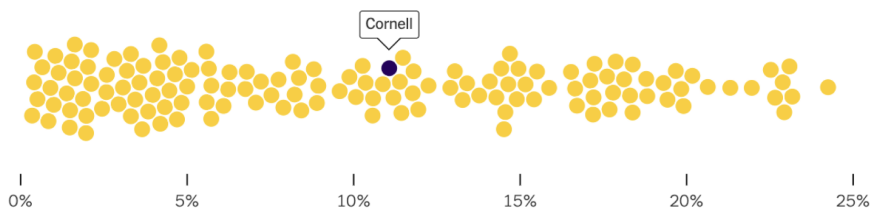
Estimated as of 2015



More info: <https://www.nytimes.com/interactive/2023/09/11/upshot/college-income-lookup.html>

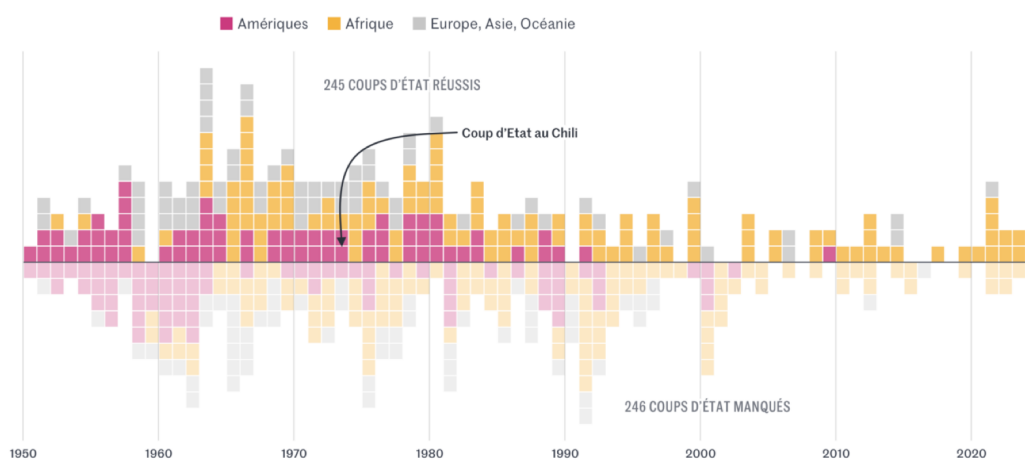
2.2 College Income Top 1%

Top 1% share, by college



More info: <https://www.nytimes.com/interactive/2023/09/11/upshot/college-income-lookup.html>

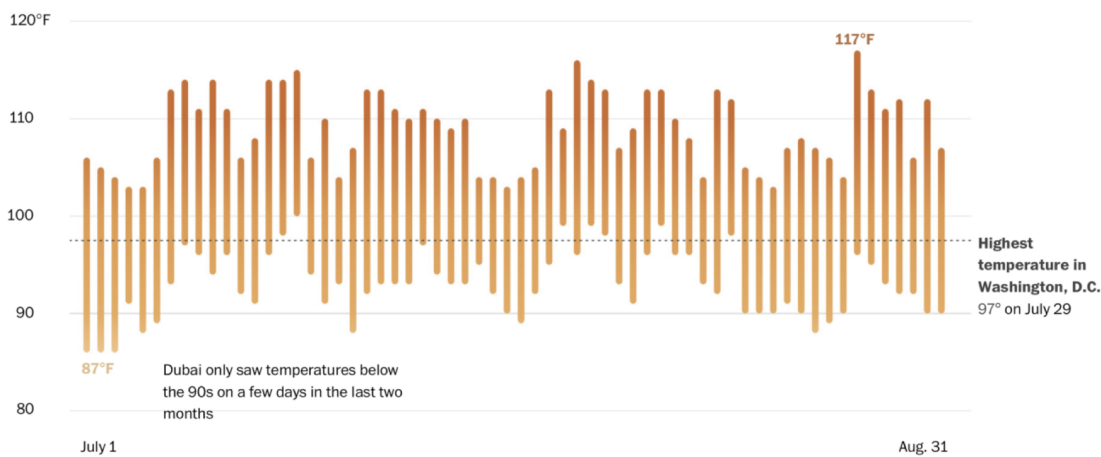
2.3 Coups d'Etat



More info: https://www.lemonde.fr/les-decodeurs/article/2023/09/11/depuis-1950-pres-de-cinq-cents-coups-d-et-at-tentes-ou-reussis-surtout-en-amerique-latine-et-en-afrique_6188906_4355770.html

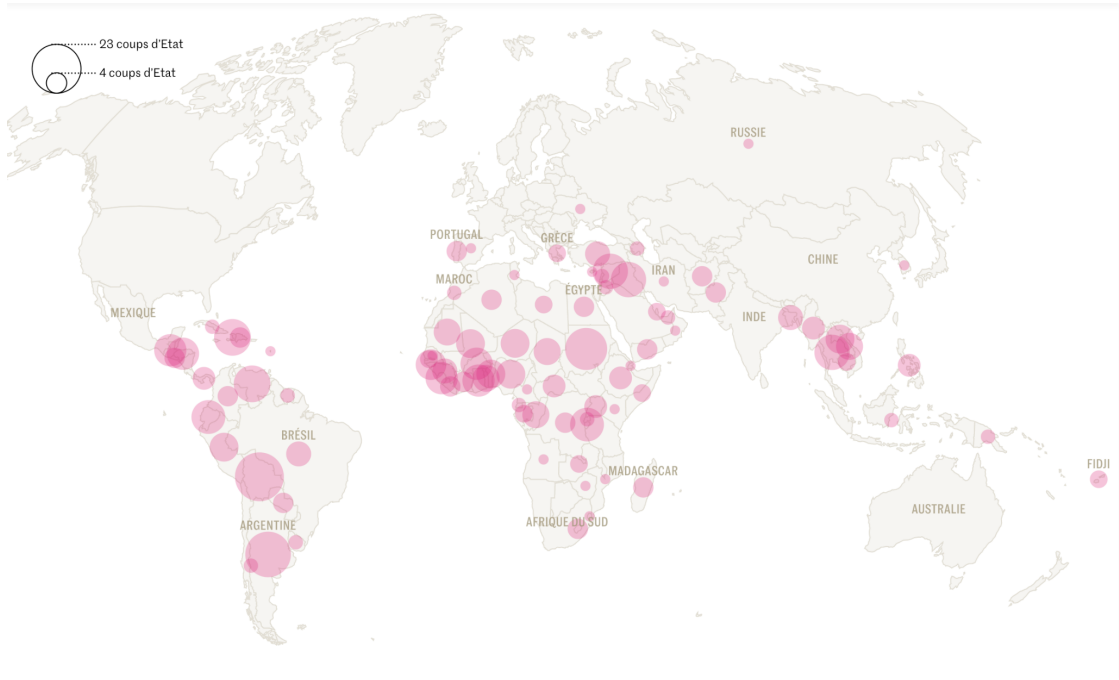
2.4 Dubai Temperatures

Daily low and high temperatures in Dubai in July and August 2023



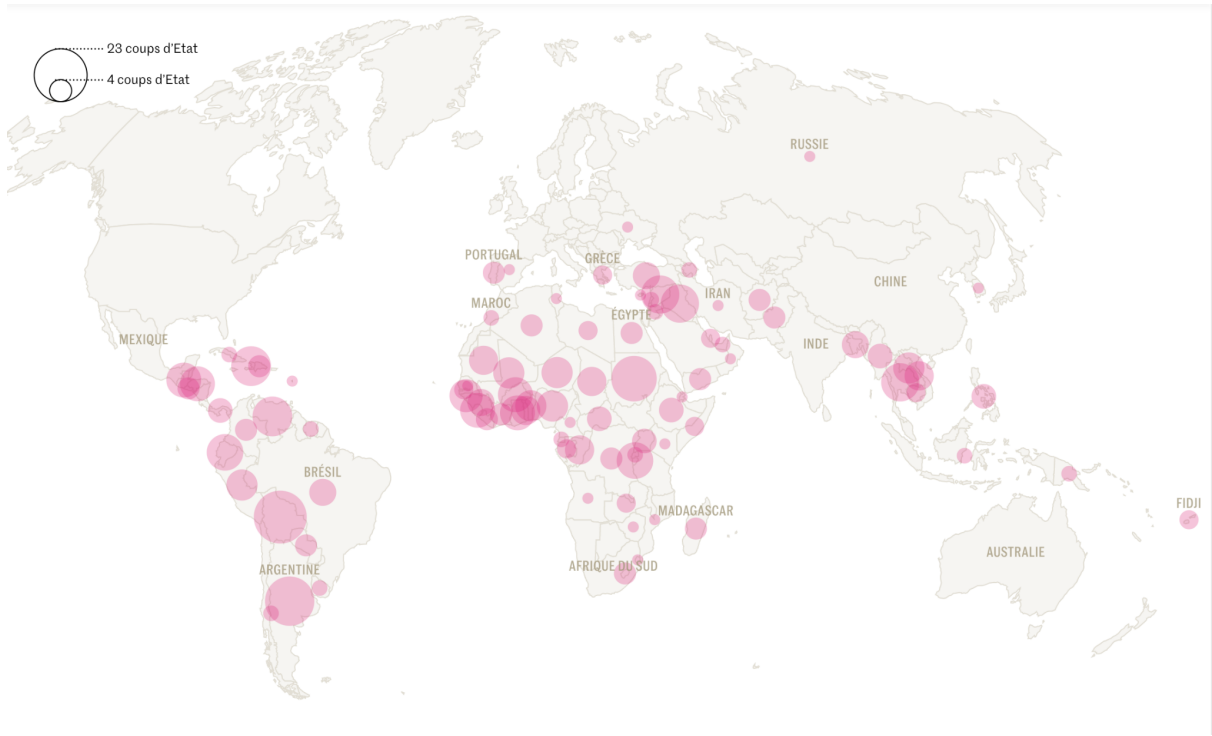
More info: <https://www.washingtonpost.com/world/2023/09/10/dubai-heat-staying-cool>

2.5 Coups d'Etat 2, Point Marks



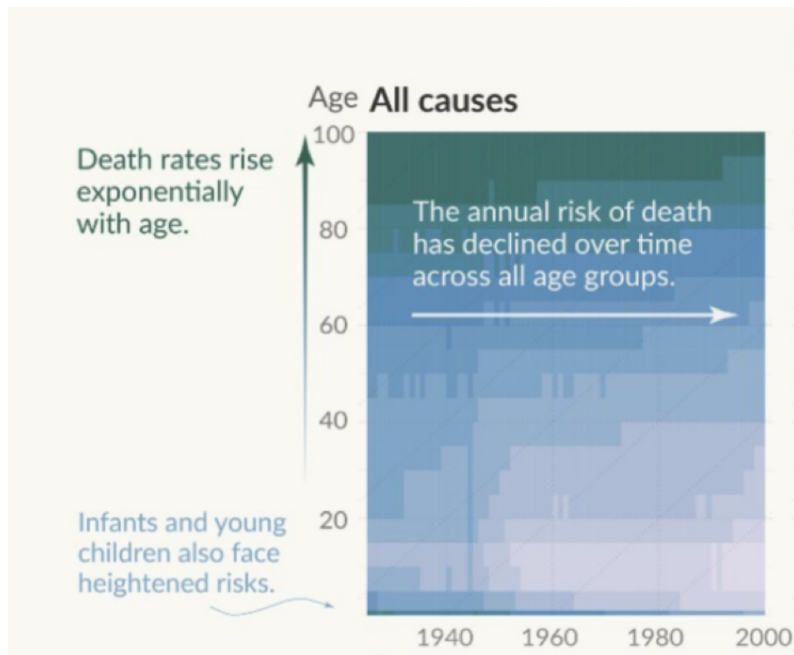
More info:
https://www.lemonde.fr/les-decodeurs/article/2023/09/11/depuis-1950-pres-de-cinq-cents-coups-d-et-at-tentes-ou-reussis-surtout-en-amerique-latine-et-en-afrique_6188906_4355770.html

2.6 Coups d'Etat 2, Geographic Location Interlocking Area Marks



More info:
https://www.lemonde.fr/les-decodeurs/article/2023/09/11/depuis-1950-pres-de-cinq-cents-coups-d-et-at-tentes-ou-reussis-surtout-en-amerique-latine-et-en-afrique_6188906_4355770.html

2.7 Death Causes



More info:

<https://ourworldindata.org/causes-of-death?insight=causes-of-death-have-changed-over-time-and-vary-by-age#key-insights>

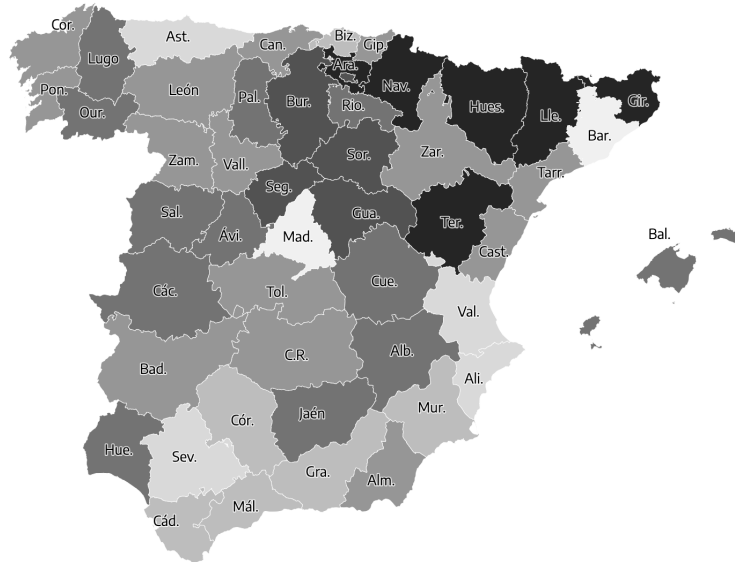
2.8 Spain Votes

Los votos perdidos en cada provincia en las elecciones generales

Porcentaje medio de votos que no consiguieron representación en escaños en cada provincia desde 1977

Votos sin representación (%)

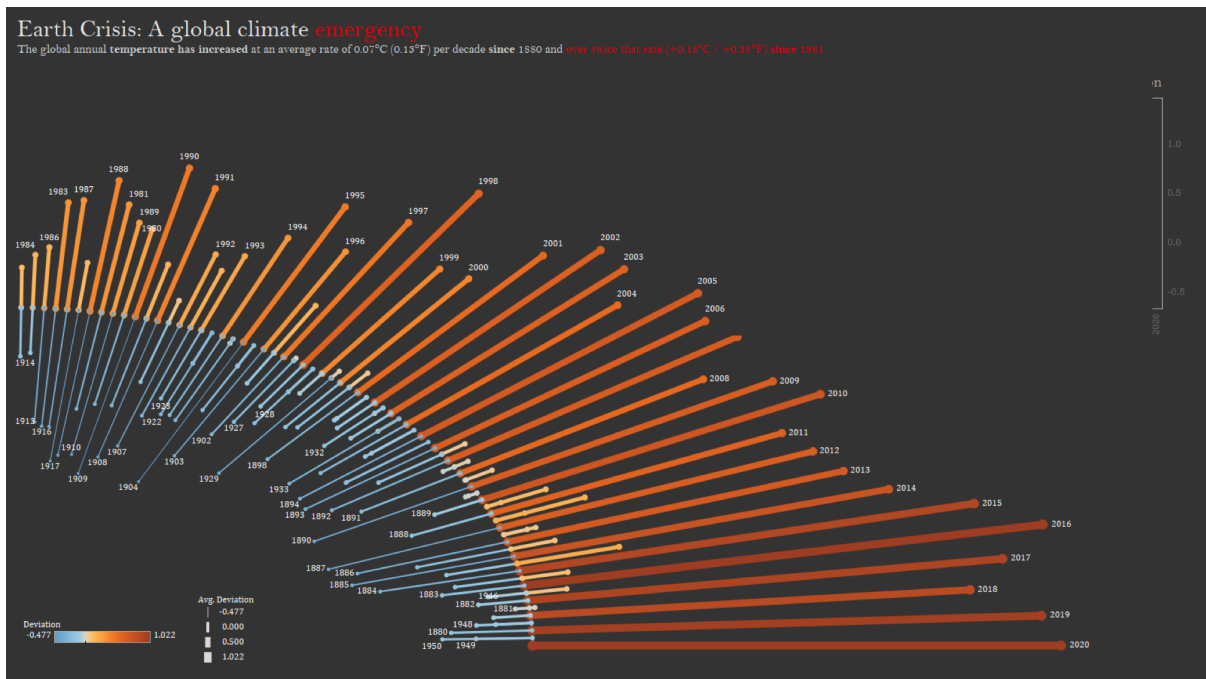
0% 12% 24%



More info:

https://www.eldiario.es/politica/sistema-electoral-beneficia-provincias-pobladas-grandes-partidos_110336601.html

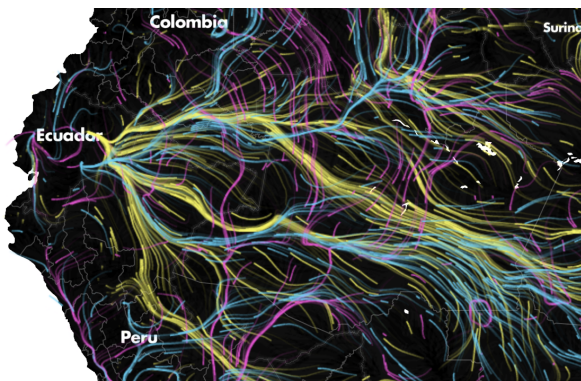
2.9 Climate Emergency



More info:

<https://www.informationisbeautifulawards.com/showcase/5872-earth-crisis-a-global-climate-emergency>

2.10 Migrations



More info: <https://maps.tnc.org/migrations-in-motion/#5/-7.101/-67.939>

Do click through to see the complete version of this example.

Ignore geographic boundaries (they are very faint)

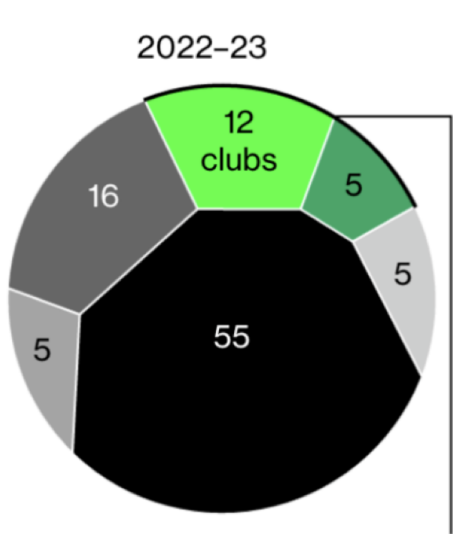
2.11 Football Club Owners

Funds Build Control Over European Football

Clubs in five top-tier domestic leagues by type of owner or major shareholder

- Private-investment firms
- High-net-worth individuals
- Corporates
- Sovereign-backed firms
- Club supporters, members, self-owned
- Other, multiple

ACROSS FIVE LEAGUES | OUT OF 98 CLUBS



Investment firms own **17% of clubs** in Europe's biggest domestic leagues

More info:

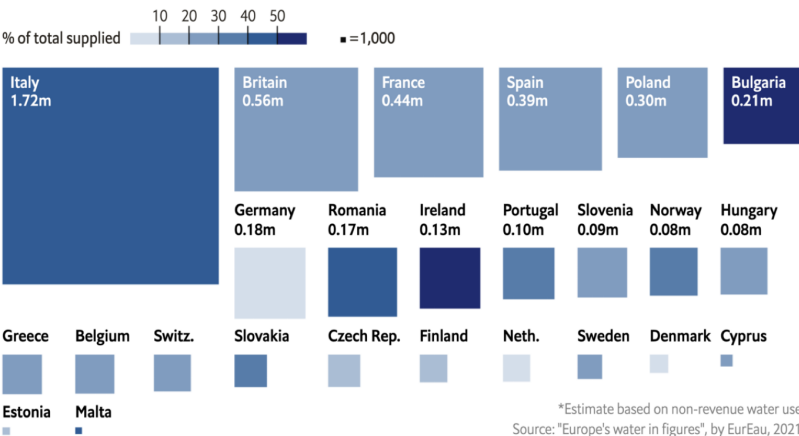
<https://blog.datawrapper.de/data-vis-dispatch-june-13-2023/>

<https://www.bloomberg.com/graphics/2023-european-football-owners-premier-league-la-liga-serie-a/>

2.12 Lost Water

Splash splash

Lost water supply*, equivalent number of Olympic-sized swimming pools per year, 2017-19



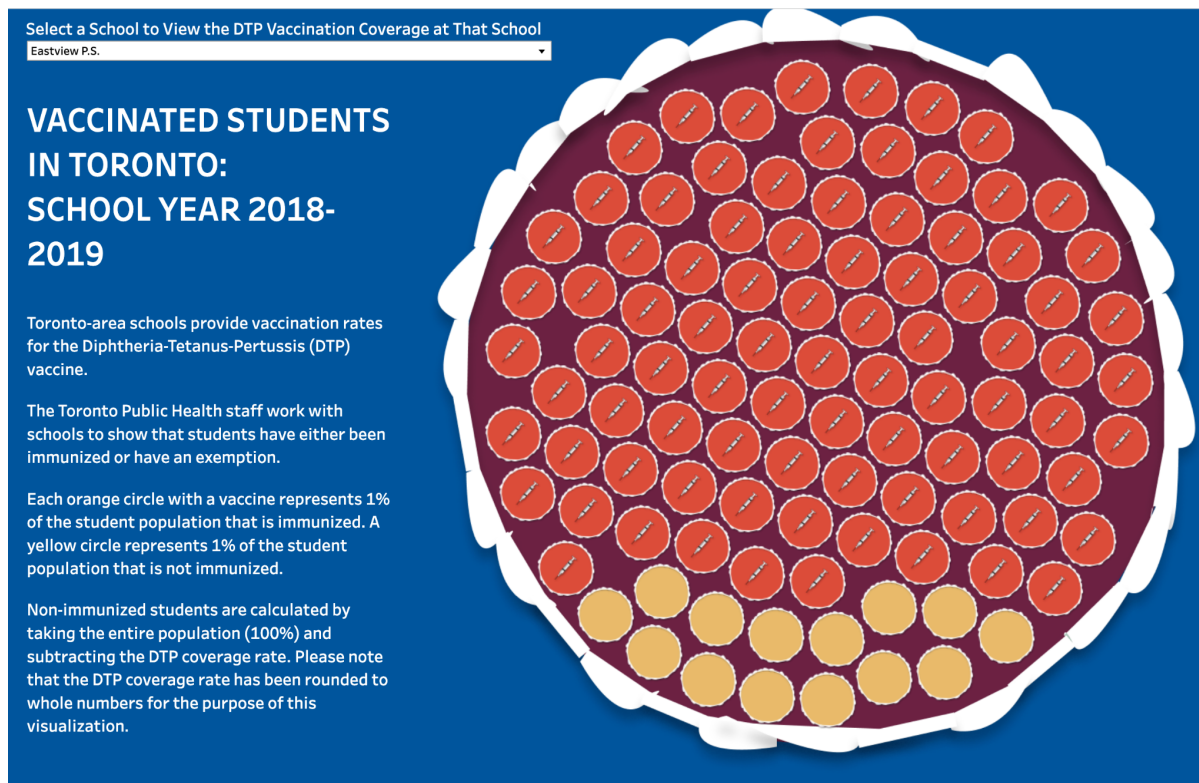
*Estimate based on non-revenue water use
Source: "Europe's water in figures", by EurEau, 2021

More info:

<https://blog.datawrapper.de/data-vis-dispatch-july-18-2023/>

<https://www.economist.com/graphic-detail/2023/07/18/in-drought-stricken-europe-leaky-pipes-are-worsening-the-problem>

2.13 Toronto Vaccinations



More info:

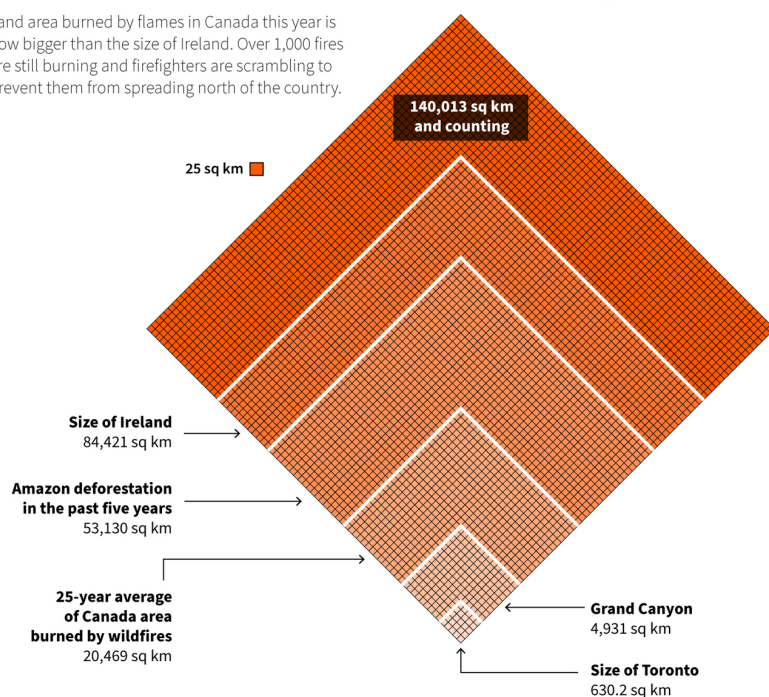
<https://www.informationisbeautifulawards.com/showcase/6163-vaccinated-students-in-toronto-school-year-2018-2019>

https://public.tableau.com/app/profile/amy.r.wu/viz/DTP_16715915193810/DTPDashboard

2.14 Canada Wildfires

Wildfires in Canada burned this much land so far this year

Land area burned by flames in Canada this year is now bigger than the size of Ireland. Over 1,000 fires are still burning and firefighters are scrambling to prevent them from spreading north of the country.



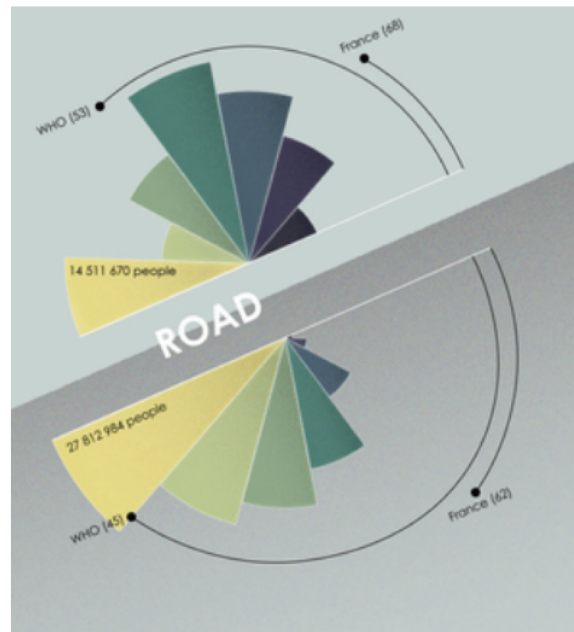
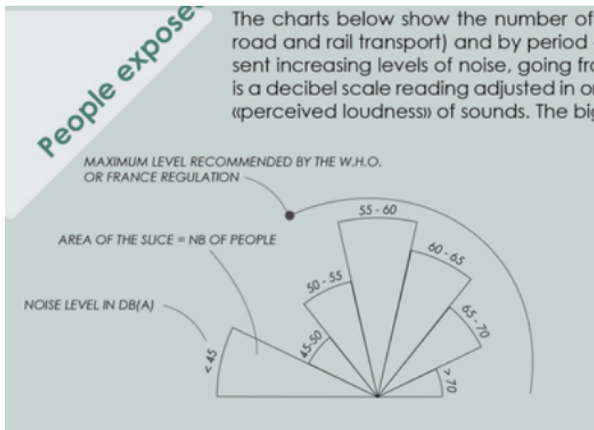
Note: As of Aug. 20, 4 p.m.

Source: Canadian Interagency Forest Fire Centre

Prinz Magtulis | Reuters, Aug. 21, 2023

More info: <https://twitter.com/prinzmagtulis/status/1693684342818574675>

2.15 French Road Noise



More info:

<https://www.informationisbeautifulawards.com/showcase/5866-the-cost-of-noise-in-france>

<https://www.behance.net/gallery/159687435/The-cost-of-noise-in-France>

3 Decode: Marks & Channels (24%)

Instructions: For each of the 3 charts following, you will identify the mapping from **marks** to data **items**, and for each kind of mark the visual **channels** and the **attributes** encoded with them. There may be more than one kind of mark, if so fill in the channels used for each kind of mark that you identify. For each chart, fill in

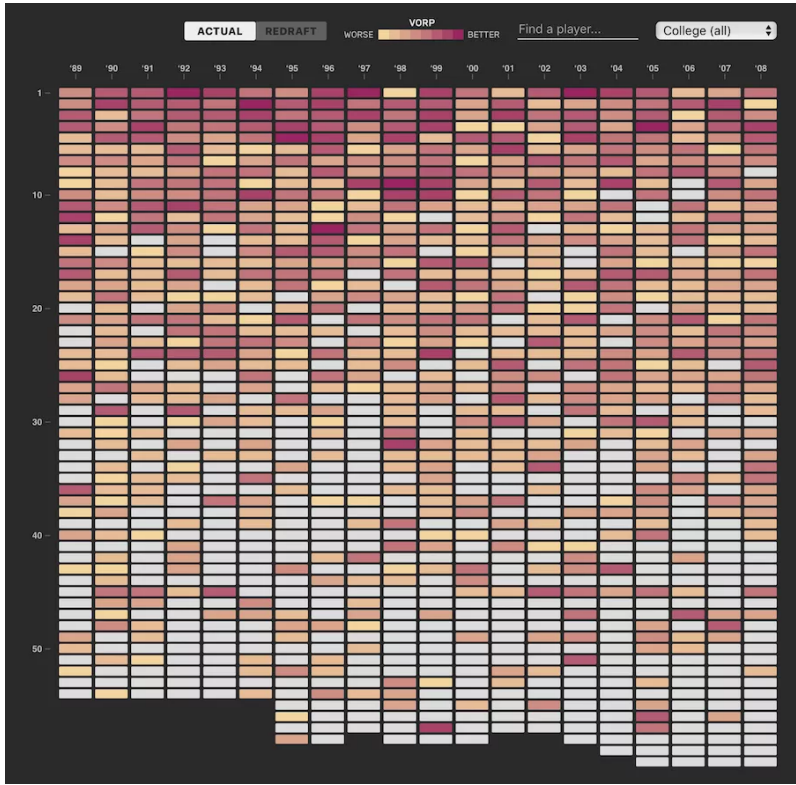
- Mark encodes item Y
 - Channel X encodes attribute Y
 - Channel X encodes attribute Y
 -
- Mark encodes item Y
 - Channel X encodes attribute Y
 - Channel X encodes attribute Y
 -

Underneath each charts there is a link to a web page providing details about the project, including information about the data and in many cases supporting interactivity. However, for now, just encode what you see in the static image in this document; you might notice that interactivity is being used a lot for emphasis (hover highlight, animated transitions, reordering, details popups, small multiples zooming). Think about how you would reconstruct the dataset underlying this picture. Assume one mark per item, think of items as rows of a table. Assume each channel is showing an attribute, where channel is a column in a simple data table or network. Remember that multiple channels could redundantly encode the same attribute. Notice that a mark is not every single bit of ink on the page - for example, labels and annotations are not marks in the sense that we're doing this analysis!

Rubric: 0.75 point for each correct answer. -0.5 for any incorrect or missing answer (mark/item mapping or channel or attribute), up to a max deduction of subquestion value.

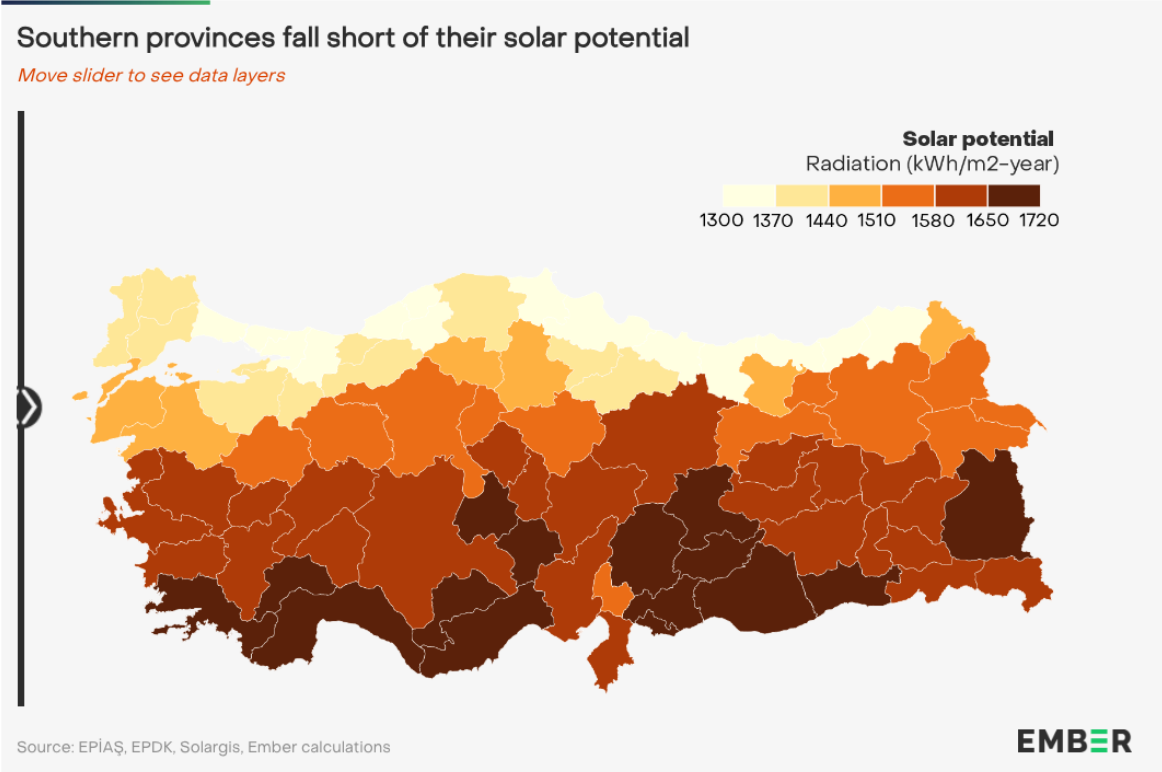
Channel names must be precise. Attribute and item names can be more loose, as long as it's understandable to mean the same as what's in the solution below.

3.1 NBA Draft



<https://pudding.cool/2017/03/redraft/>

3.2 Turkish Solar



More info: <https://ember-climate.org/insights/research/the-south-can-unlock-turkiyes-solar-ambitions/>
<https://blog.datawrapper.de/data-vis-dispatch-april-11-2023/>

3.3 Sunsquatch



More info: <https://flowingdata.com/2017/08/20/sunsquatch-the-only-eclipse-map-you-need/>

4 Generate: Table Alternatives (20%)

Table A (left)

	Age	Best 100 m	Furthest Jump	Sex
Amy	16	13.2	5.2	F
Basil	18	12.4	4.2	F
Clara	14	14.1	2.5	F
Desmond	22	10.01	6.3	M

Table B (right)

	BPM T1	BPM T2	BPM T3
Amy	90	130	150
Basil	70	110	109
Clara	60	140	141
Desmond	84	100	108

4.1 Sketch a suitable visual encoding for Table A. The sketch should include all of the items and attributes for that table as a static visual encoding: do not assume any interaction will take place. You may use a single view, or multiple views.

Analyze the sketch, considering whether it is suitable according to alignment between

- attribute types and channel choices (in terms of expressiveness and effectiveness)
- semantics of the attributes (an important part of data abstraction), and
- information density.

4.2 Same as above, for Table B. Note that 'BPM' stands for Beats Per Minute, a measure of heart rate.

4.3 Sketch a different visual encoding for Table A. Try to address any limitations you identified in your previous analysis.

4.4 Same as above, for Table B.

Do your best to create reasonable designs that you can justify. However, if your analysis adequately explains why a design is unsuitable, you will receive full credit for both. Sketches do not need to be polished: very rough sketches are fine as long as they are legible. The point is to show the design idea, not to make something polished. (See above, as with Q1.)

Rubric: 5% each of 4 tables: 2% sketch/design & 3% analysis.

5 Redesign: New Zealand Table (23%)

Consider this visual encoding from a newspaper:



Answer the following questions:

5.1 Describe the data abstraction in the abstract language covered in this class

- dataset type
- for each attribute
 - Type (categorical, ordinal, quantitative)
 - Either number of levels for categorical attributes, or min-max ranges for quantitative or ordinal attributes

5.2 How is this data visually encoded, in terms of channels and the attributes they encode?

5.3 If the numeric labels were not visible, would you be able to decode the data precisely? Why or why not?

5.4 Develop one better alternative design to visualize this data. Show it with a sketch. Provide a brief rationale for why it is better in terms of a task that is poorly supported by their design. When discussing the task, use both domain-specific language and also describe it more abstractly using {action,target} pairs.

Rubric: 5.1 (4%), 5.2 (7%), 5.3 (2%), 5.4 (10%): sketch 4%, explanation 6%