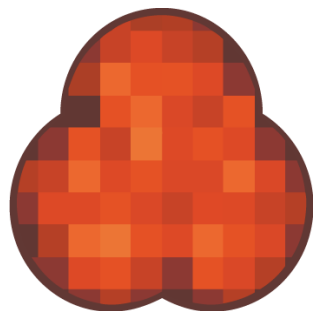


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IT Innovation Conference

06.- 08.09.2019.
OSIJEK CROATIA



DATA VISUALIZATION 101

HOW TO PROPERLY DISPLAY DATA

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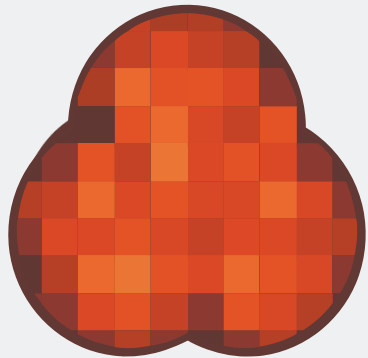


SUPPORTED BY



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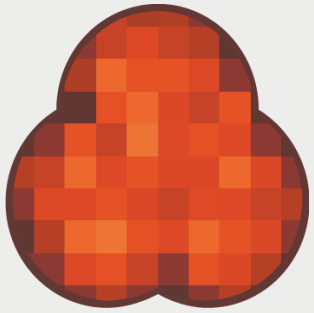
Hello

JOSIP ŠABAN, M. Sc., MBA

Erste Group IT, Vienna / Meridian Data, Worldwide

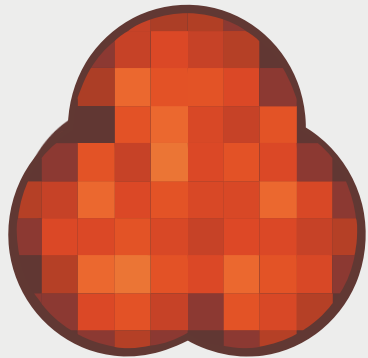
RENEE AHREL, M. Sc.

Optimum, Worldwide



AGENDA

- Human visual perception
- Basic data visualization lessons
- Graphical form & integrity
- Dashboards



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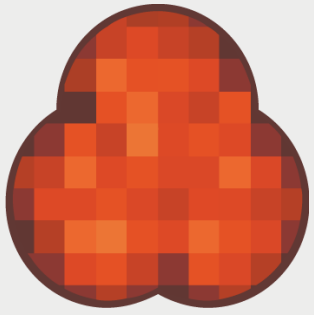
Human visual perception



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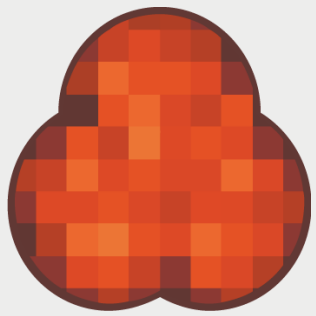


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INTRODUCTION

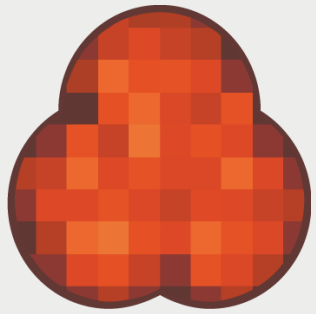
- To use and communicate using visual perception, you must understand its rules
- Effective visualization is a product of proper design



INTRODUCTION

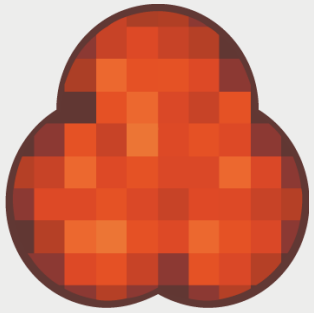


- Visual is the most powerful sense
- To display data effectively you must understand visual perception
 - What works?
 - What doesn't work?
 - Why it works?



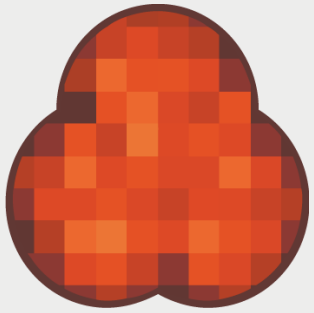
INTRODUCTION

- I will discuss a small part
 - Pattern principles of visual perception



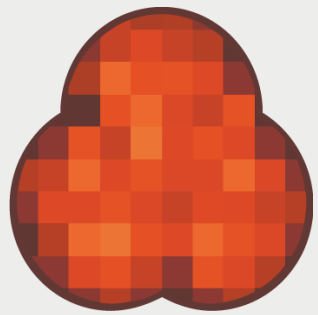
VISUALLY ENCODING DATA FOR RAPID PERCEPTION

- Preattentive processing is tuned to detect a specific set of visual attributes
- Attentive processing is sequential, and therefore much slower
 - Let's demonstrate...



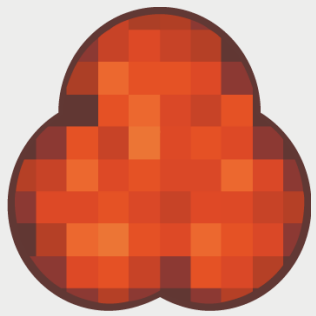
TWENTY SECOND TEST...HOW
MANY FIVE'S IN THE LIST (
ATTENTIVE PROCESSING)

9813347899349533489928429238483911298498998
98134123412388239146100913280953891208955131
1234123932304912088679786541298048195231314
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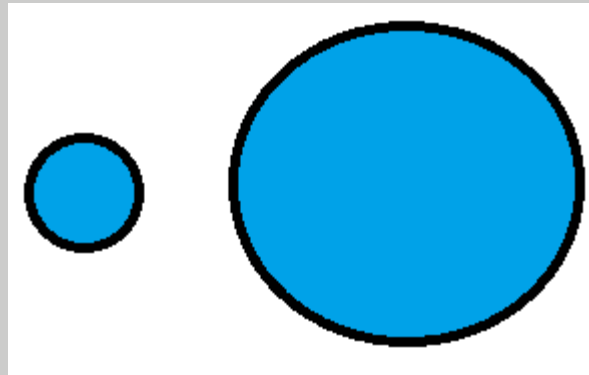
TWENTY SECOND TEST...HOW
MANY FIVE'S IN THE LIST (PRE-
ATTENTIVE PROCESSING)

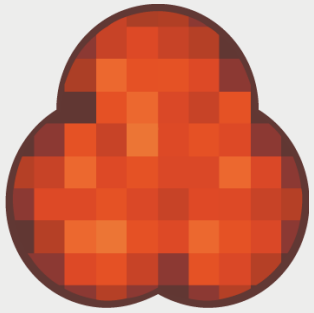
9813347899349**5**33489928429238483911298498998
981341234123882391461009132809**5**38912089**55**131
1234123932304912088679786**5**4129804819**5**231314
123124412349841**5**26782**5**1283876**5**14**5**8911989213
13049128**5**176421491280949324**55**78881238719283**5**



ENCODING QUANTITATIVE VERSUS CATEGORICAL DATA

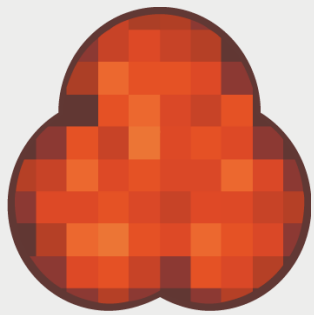
- While some attributes allow us to perceive one thing as greater than others in some way (bigger, taller, more important), others merely indicate that items are distinct from one another, without any sense of some being greater than or less than others
 - It is obvious that the circle on the right is bigger than the circle on the left, but how much bigger?





PATTERN PRINCIPLES OF VISUAL PERCEPTION

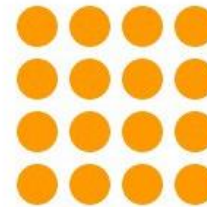
- We will discuss some of perception principles
 - Proximity
 - Closure
 - Similarity
 - Enclosure



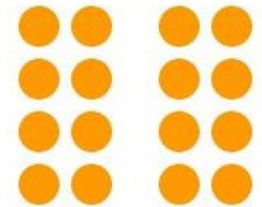
THE PRINCIPLE OF PROXIMITY

- We perceive objects that are located near one another as belonging to the same group
- This is the simplest way to link data that you want to be seen together
- White space alone is usually all you need to separate these groups from the other data that surrounds them

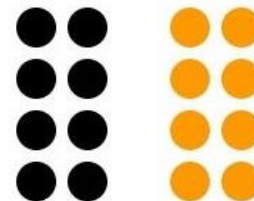
This is perceived to be one group and the components somehow related to each other.



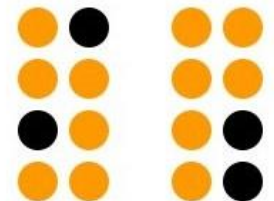
We perceive two groups here, and understand that there are differences between them.

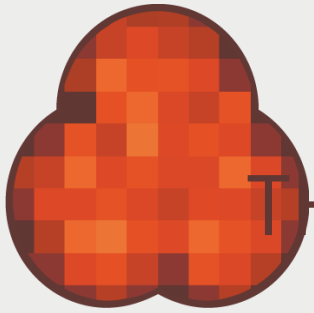


These groups appear to be separated by color or contrast.



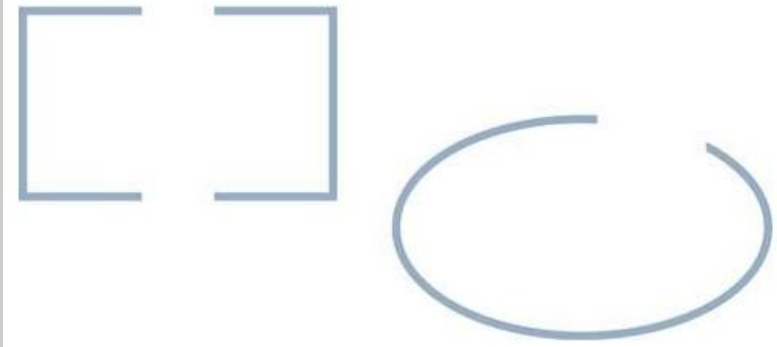
Proximity overpowers other signals of distinction, as seen in this example.

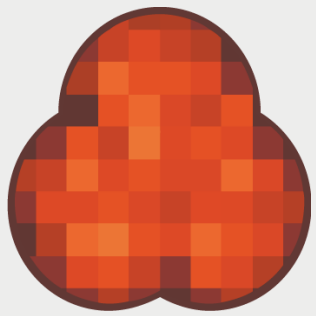




THE PRINCIPLE OF CLOSURE

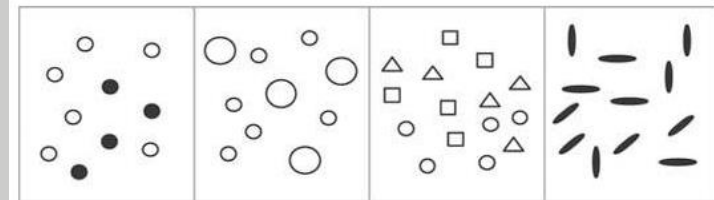
- We as humans have a keen dislike for loose ends
- When faced with ambiguous visual stimuli, objects that could be perceived either as open/incomplete/unusual or as closed/complete/regular, we naturally perceive them as the latter

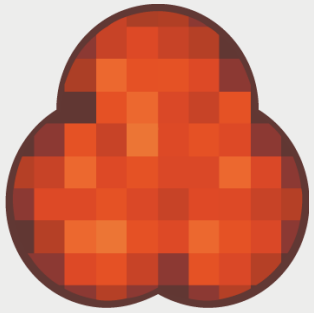




THE PRINCIPLE OF SIMILARITY

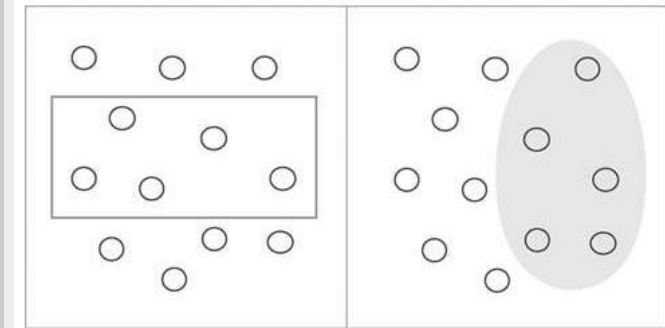
- We tend to group together objects that are similar in color, size, shape, and orientation
- The principle of similarity applies very effectively to groups of visual objects that vary as different expressions of preattentive attributes
- It works especially well as a means of identifying different data sets in a graph (for example, income, expenses, and profits)

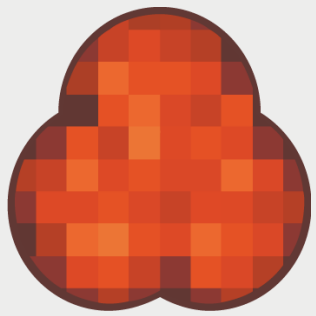




THE PRINCIPLE OF ENCLOSURE

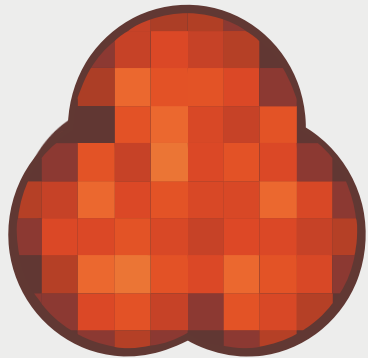
- We perceive objects as belonging together when they are enclosed by anything that forms a visual border around them
- This enclosure causes the objects to appear to be set apart in a region that is distinct from the rest of what we see





CLOSING THOUGHTS

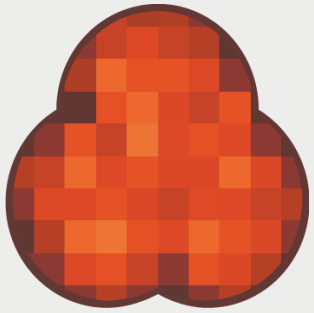
- Vision is fast, reason is slow
- Human brain is natural cartographer
- Seeing, perceiving, and knowing are not the same thing
- Vision is the result of mapping your environment based on the aggregated information your eyes obtain from multiple fixations
- They are attracted first to certain features before they move to others...they prioritize



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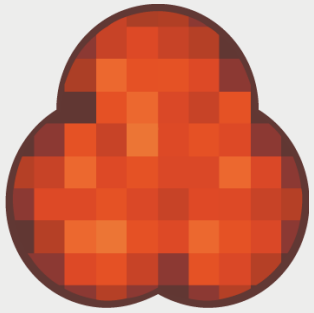
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Basic data visualization rules



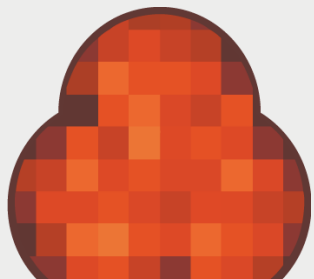
INTRODUCTION

- We discuss details about some basic topics
 - Maximize data ink
 - Avoid chart junk
- There is many more we don't have time to cover

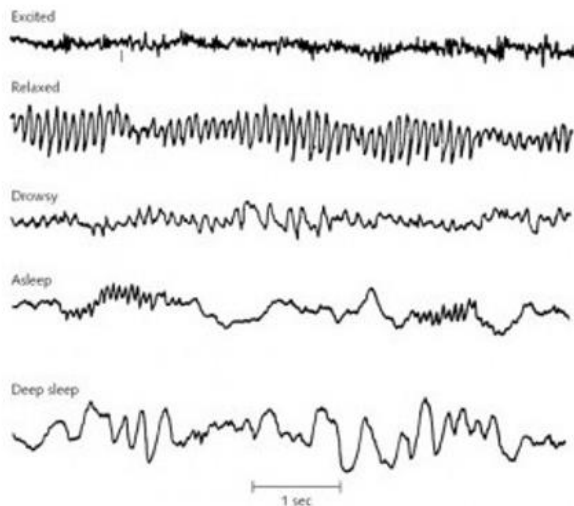


MAXIMIZE DATA INK

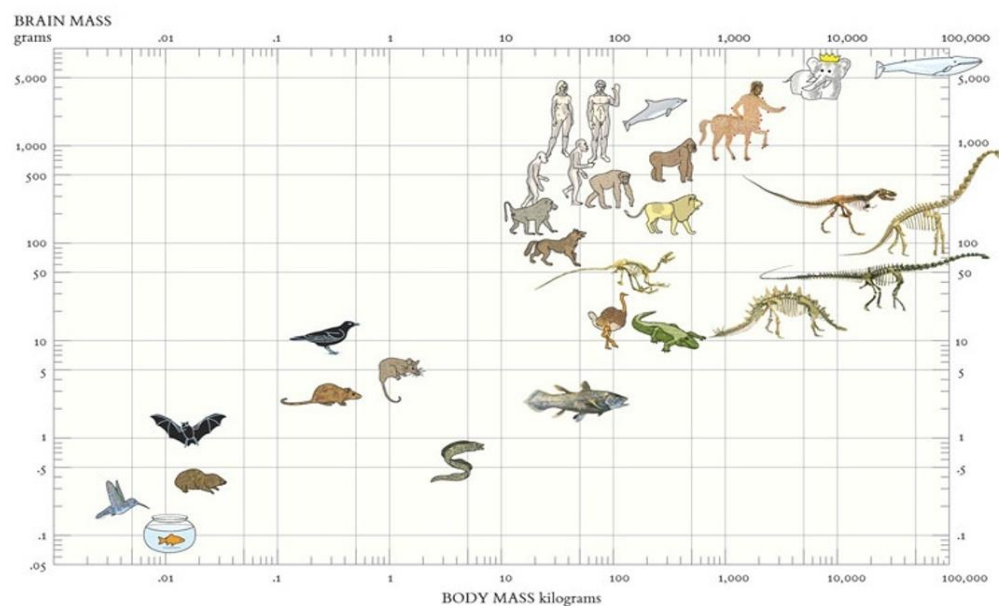
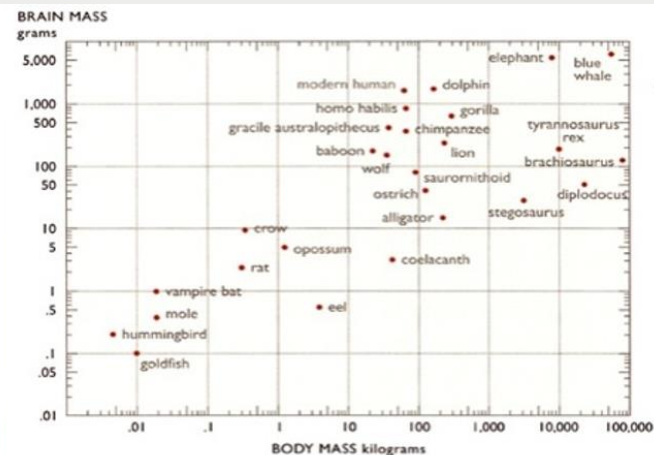
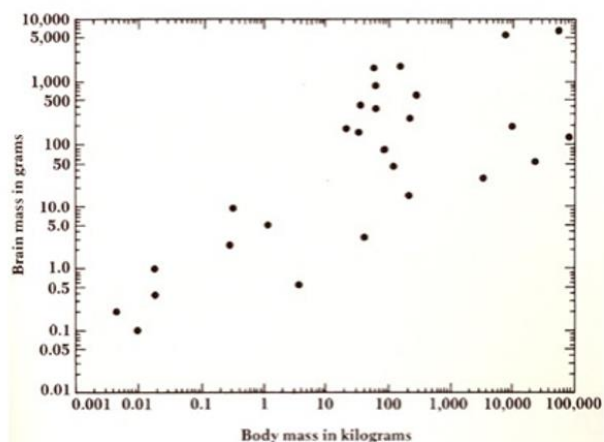
- The ink on a graph that represents data
- Good graphical representations maximize data-ink and erase much non-data-ink as possible
- The data-ink ratio is calculated by 1 minus the proportion of the graph that can be erased without loss of data-information



MAXIMIZE DATA INK

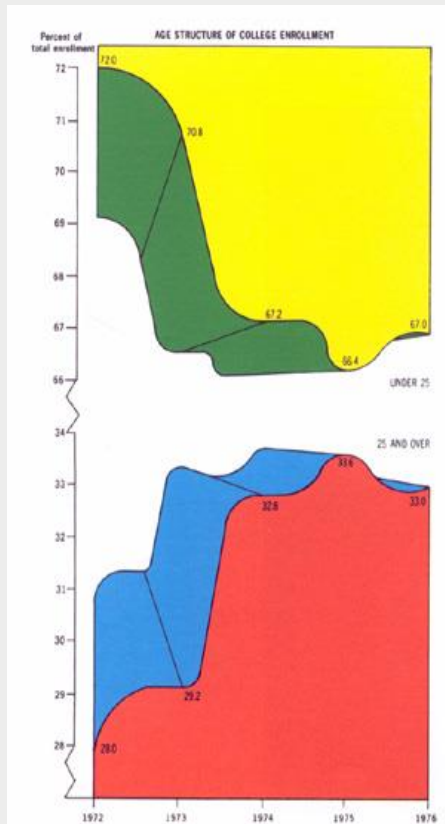


It's an electroencephalogram - a graph that records the electrical activity from the brain. This graph would have a very high data-ink ratio of 1.



AVOID CHART JUNK

- The excessive and unnecessary use of graphical effects in graphs used to demonstrate the graphic ability of the designer rather than display the data



Anatomy of a Winning TED Talk

1%

Sophisticated Visual Aids

We're not sure who puts the D in TED—most of the best presentations favor tepid PowerPoint slide shows (sorry, Brené Brown), Pictionary-quality drawings (really, Simon Sinek?), or no props at all.

5%

Opening Joke

Remember the one about the shoe salesman who went to Africa in the 1900s? That's how Benjamin Zander opened his talk—which turned out to be about classical music.

5%

Spontaneous Moment

Don't overprepare. Tease the guy in the front row ("You could light up a village with this guy's eyes"). Commend the stagehand who handles the human brain you brought.

5%

Statement of Utter Certainty

People come for answers—give 'em what they want, as Shawn Achor did: "By training your brain ... we can reverse the formula for happiness and success."

12%

Snappy Refrain

The TED equivalent of "I have a dream." Example: "People don't buy what you do; they buy why you do it." Repeat 7x.

23%

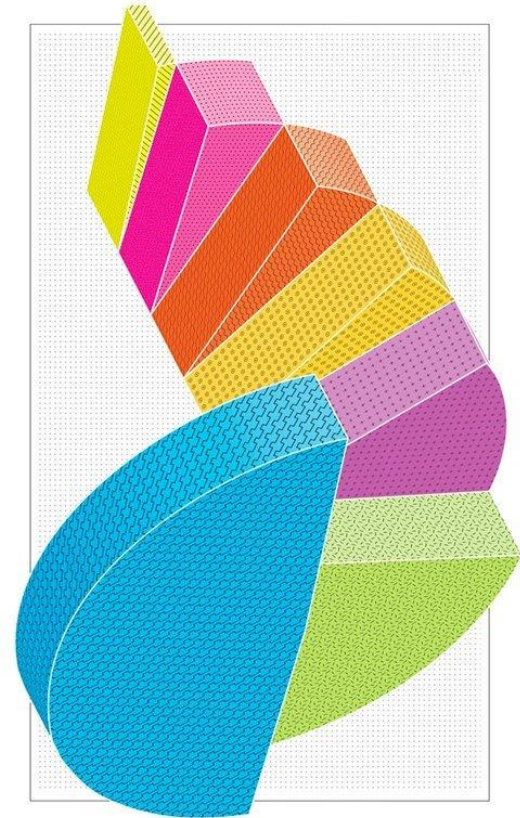
Personal Failure

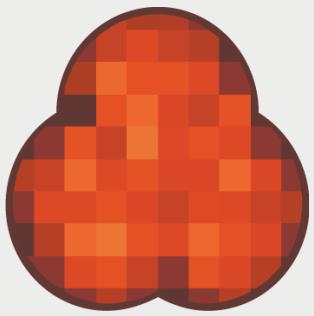
Be relatable. We want to know about that nervous breakdown. Or at least the time you didn't fit in at summer camp.

49%

Contrarian Thesis

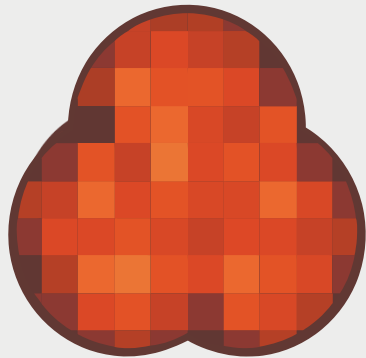
Wait a sec—we should be playing *more* videogames? The more choices we have, the worse off we are? TED is where conventional wisdom goes to die.





CLOSING THOUGHTS

- Take every chance to show a tangible object
- Don't use boxes or 3-D objects
- When presenting - focus on two things - story and credibility
- To clarify - add detail
- Tell the audience what is important
- A number provides information, but it doesn't give context
- You don't need multiple corporate logos on every slide or graphics
- If a summary is tough to write, your content is weak
- Final part is Q&A, press conference style



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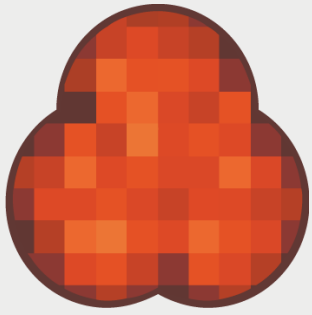
Graphical form



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Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite.

Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui ont été en Russie, le noir ceux qui en sont sortis. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Thiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilow et qui avaient toujours marché avec l'armée.

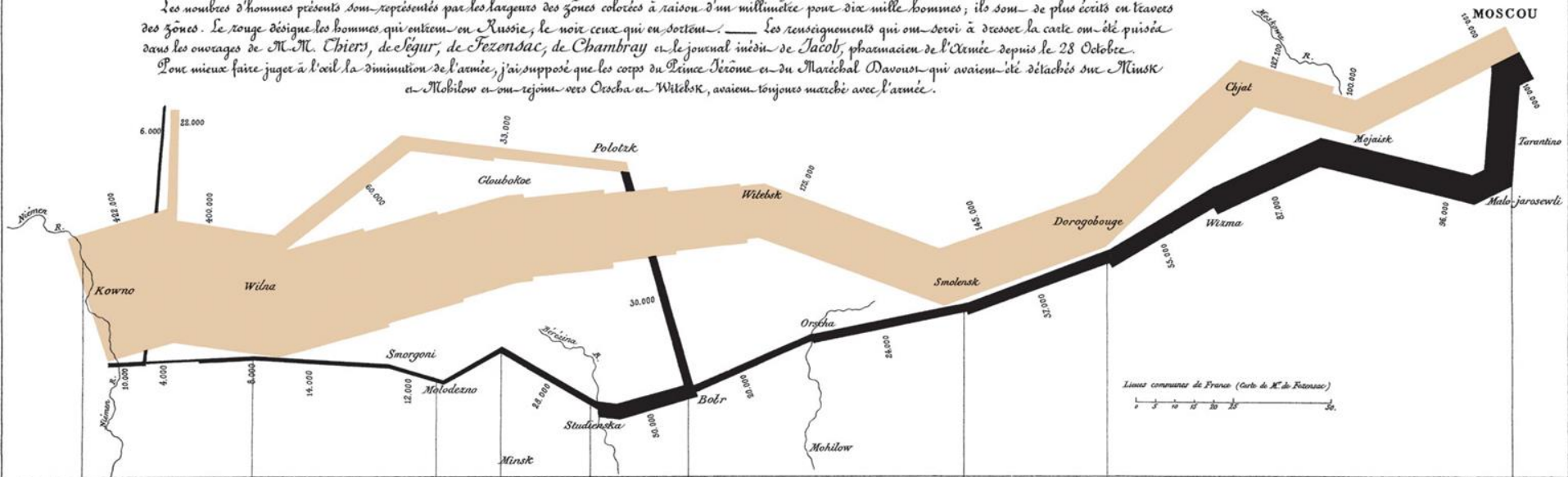
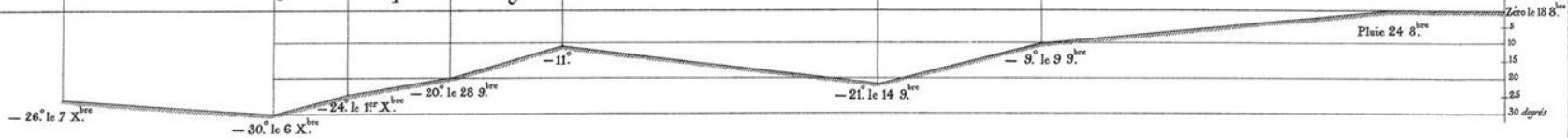
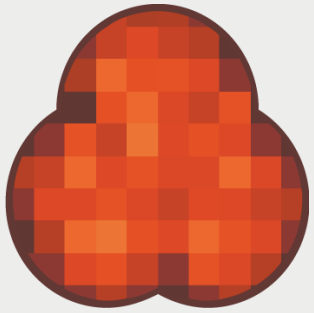


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

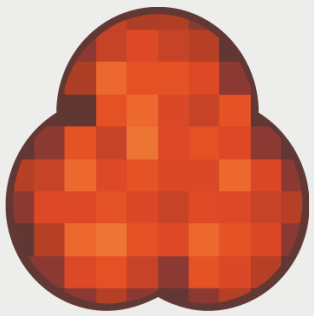


Les Cosaques passent au galop le Niemen gelé.

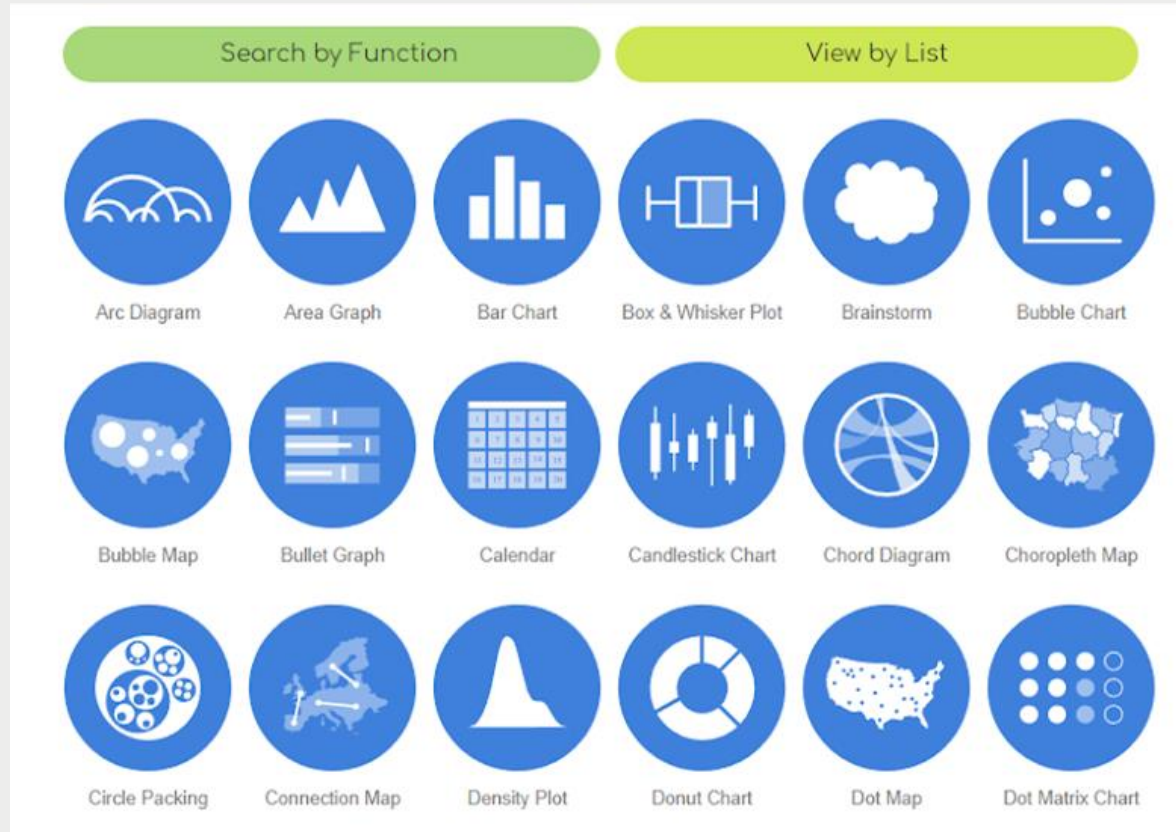


FINDING THE RIGHT GRAPHIC FORM

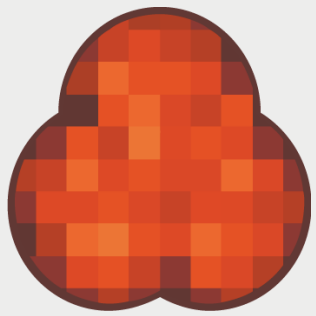
- What do you want to accomplish?
 - compare
 - see change
 - reveal relationships
 - envision temporal or spatial patterns
- Try different graphic forms
- Arrange the components to make it as easy as possible to extract meaning from it
- Test the outcomes



THE DATA VISUALIZATION CATALOGUE

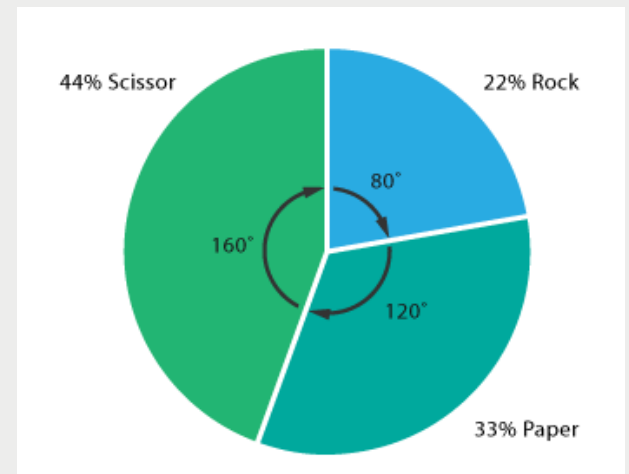


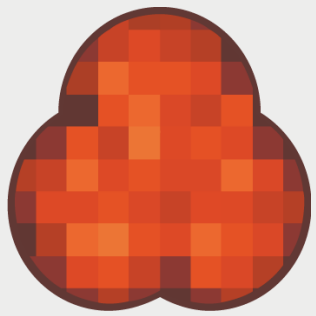
By Severino Ribecca, <https://datavizcatalogue.com/>



PARTS OF A WHOLE & PROPORTIONS

- Pie chart
- Displays part of a whole
- Bad for proportion perception as human vision does not perceive well angle based proportions
- Not suitable for accurate comparison

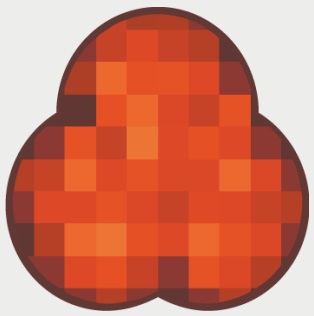




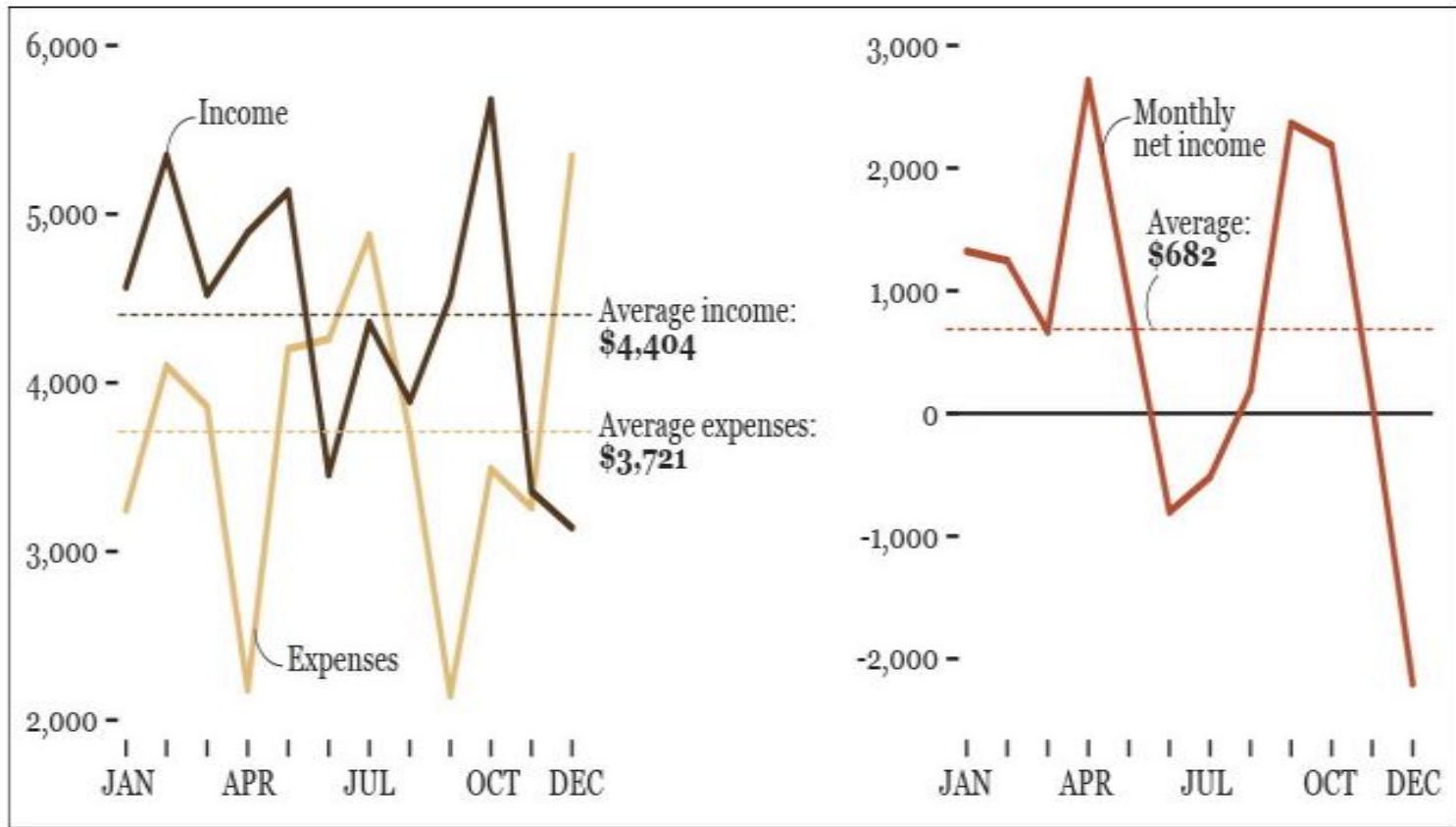
PARTS OF A WHOLE & PROPORTIONS

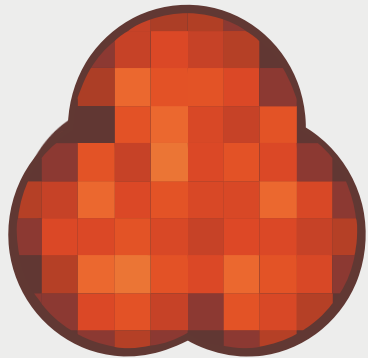
- Treemap
- Can display a hierarchy
- Impractical with too many small segments
- Impractical with too many hierarchy levels





PLOT WHAT YOU WANT TO SHOW!





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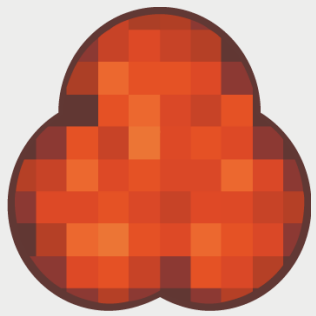
Graphical integrity



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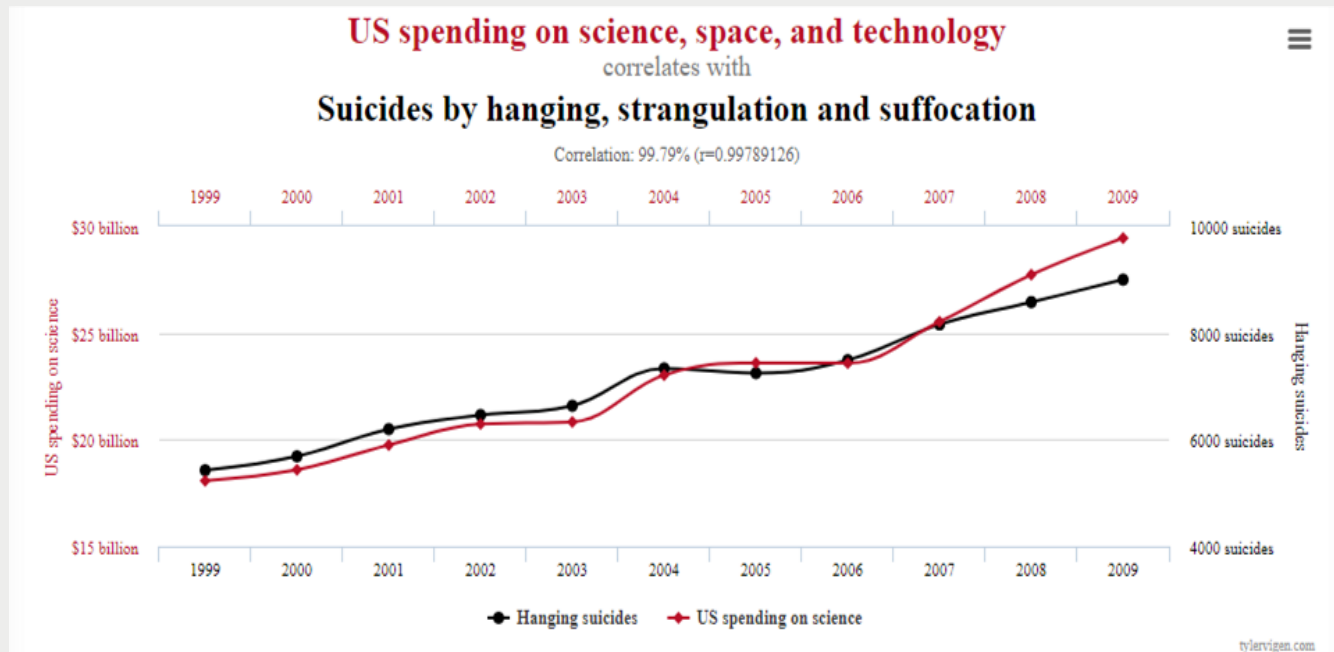


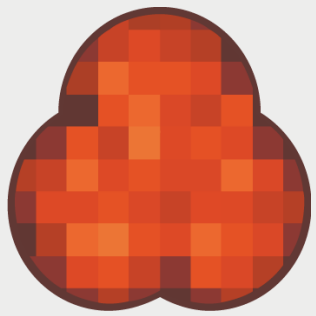
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GIGO ALSO APPLIES TO DATA GRAPHICS!

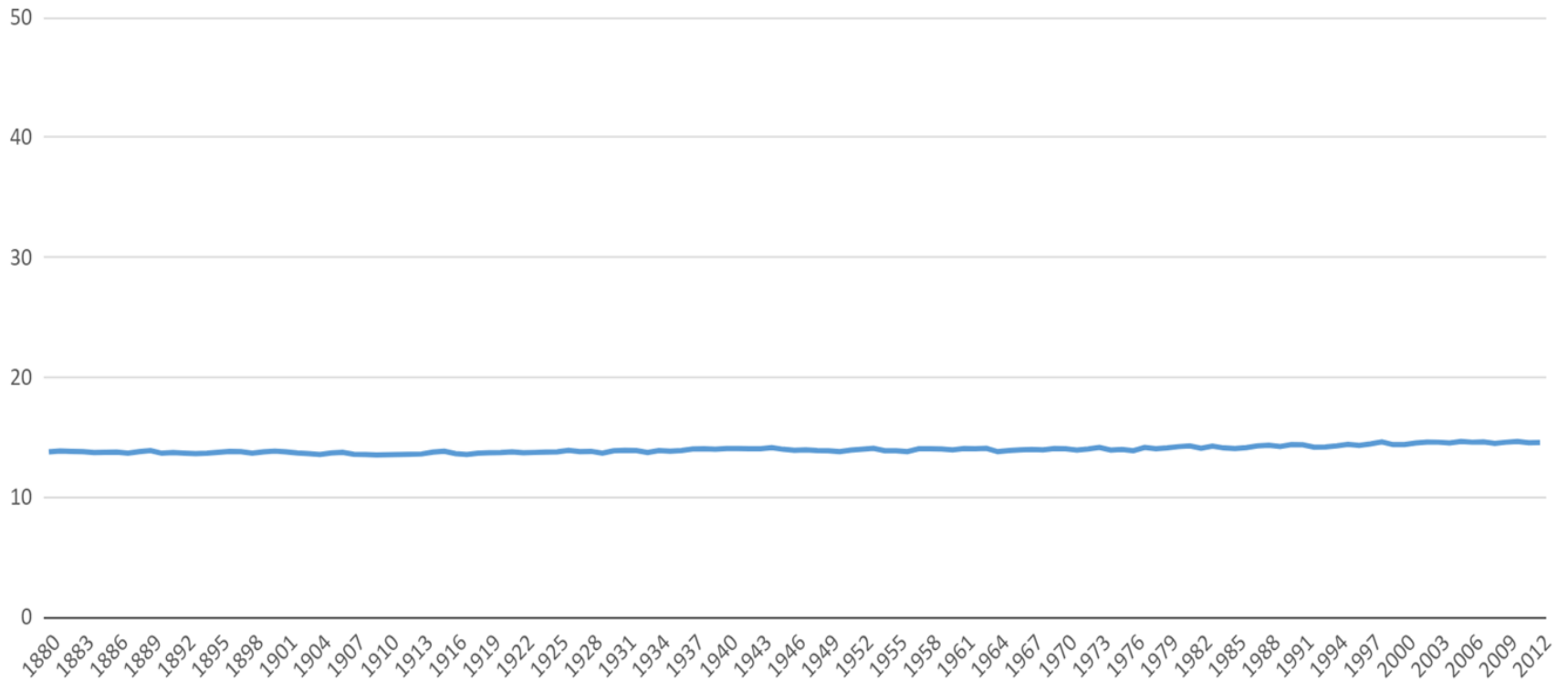
- GIGO - Garbage In, Garbage Out

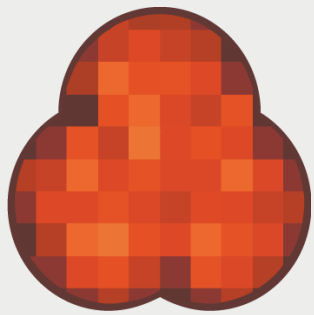




MISLEADING TIME SERIES CHARTS

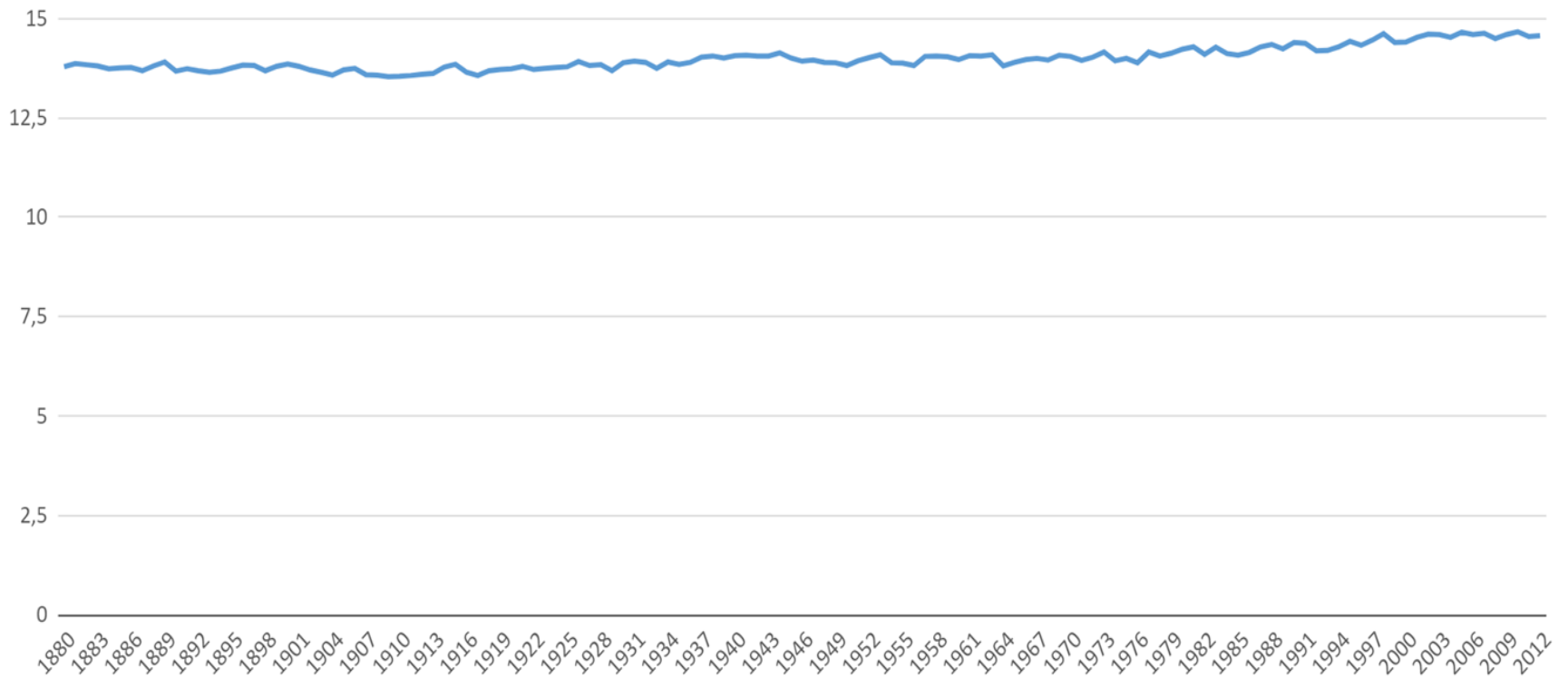
Earth yearly average temperature

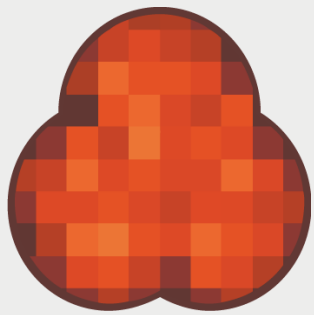




MISLEADING TIME SERIES CHARTS

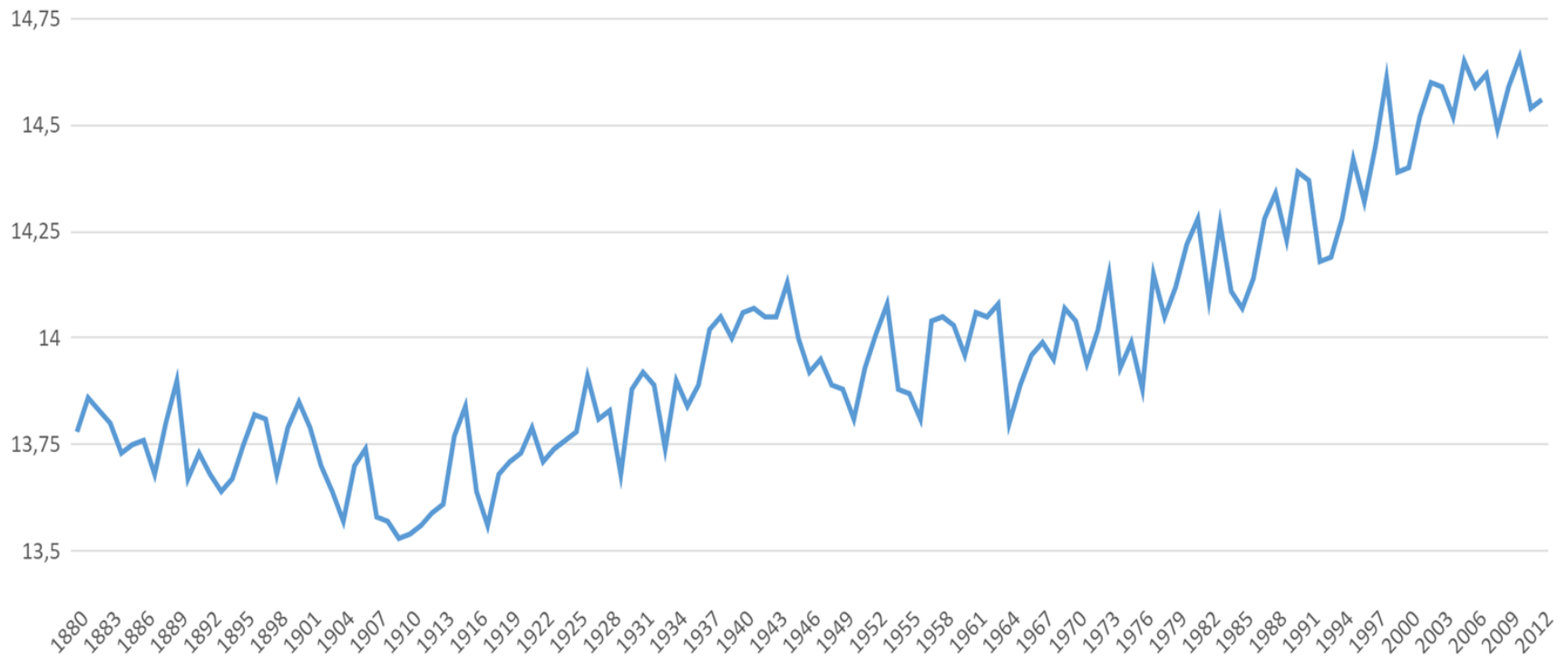
Earth yearly average temperature

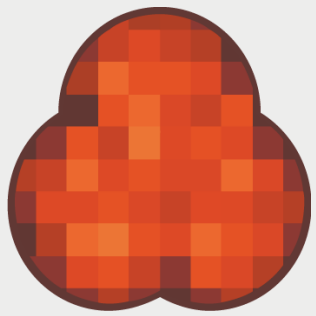




MISLEADING TIME SERIES CHARTS

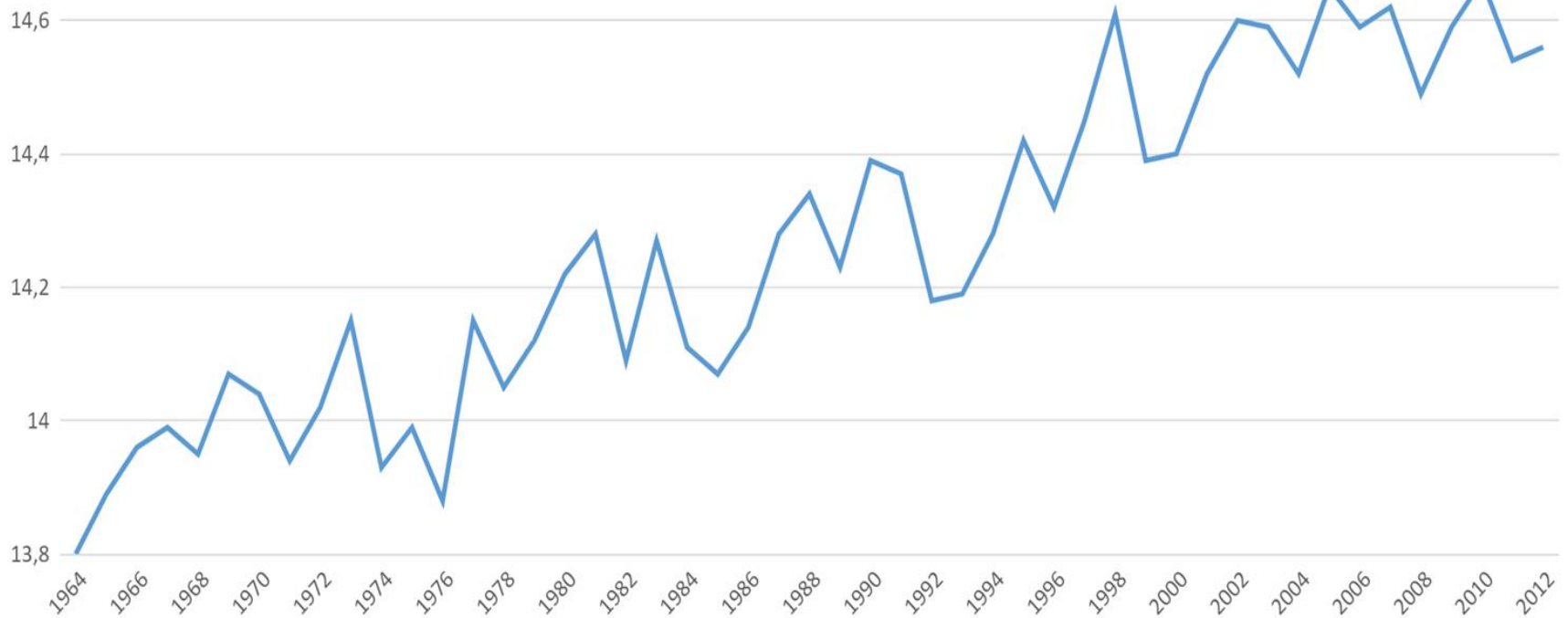
Earth yearly average temperature

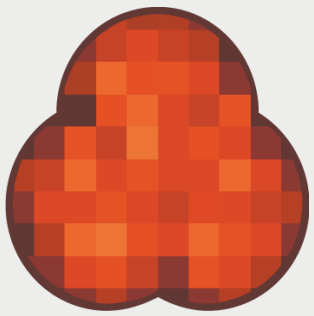




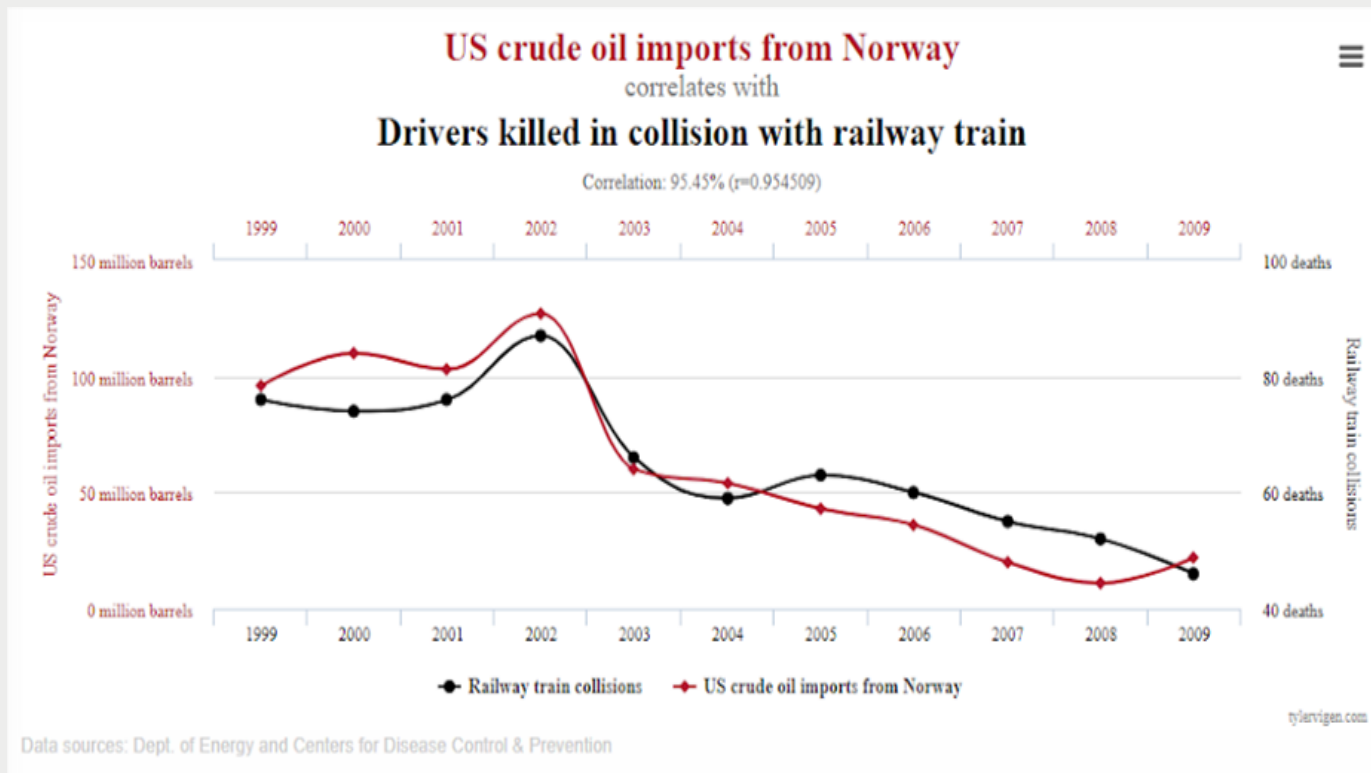
MISLEADING TIME SERIES CHARTS

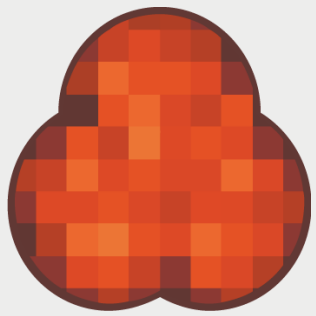
Earth yearly average temperature





CORRELATION DOES NOT IMPLY CAUSATION





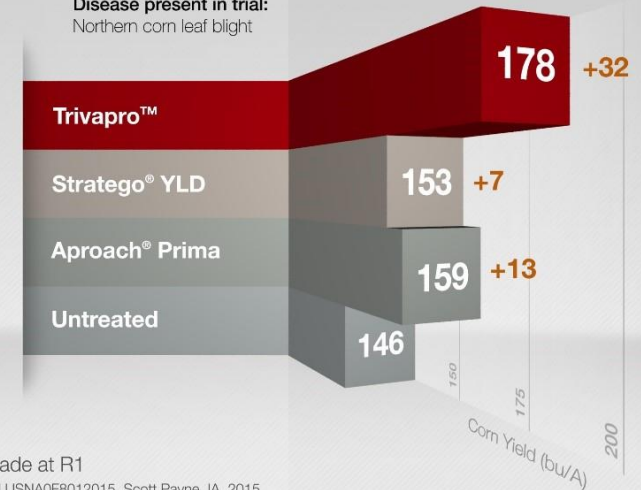
THE DIMENSIONALITY PRINCIPLE

- The number of information carrying dimensions should not exceed the number of dimensions in the data

Trivapro corn yield response

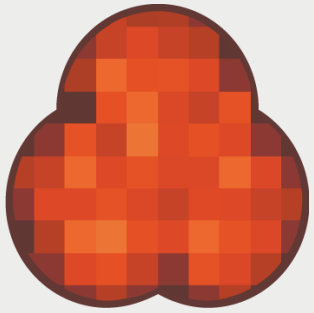
in Boone, IA

Disease present in trial:
Northern corn leaf blight



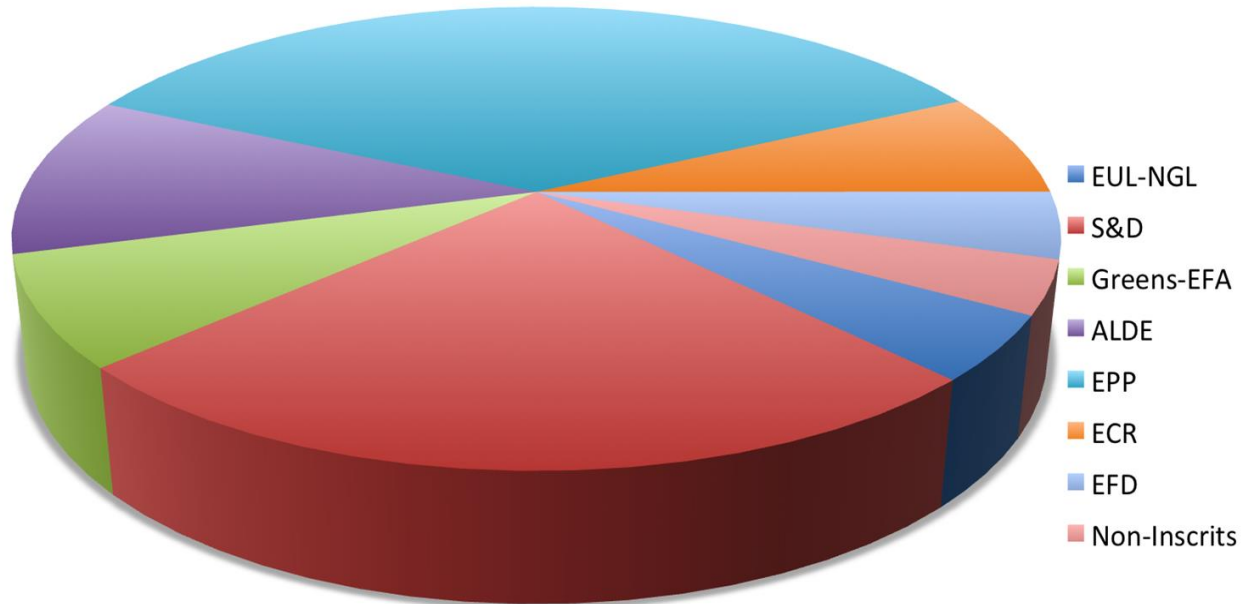
All applications made at R1

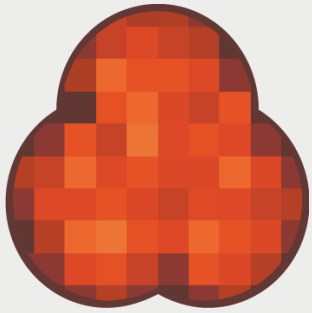
FSF001A4-2015US, Trial USNA0F8012015. Scott Payne. IA. 2015



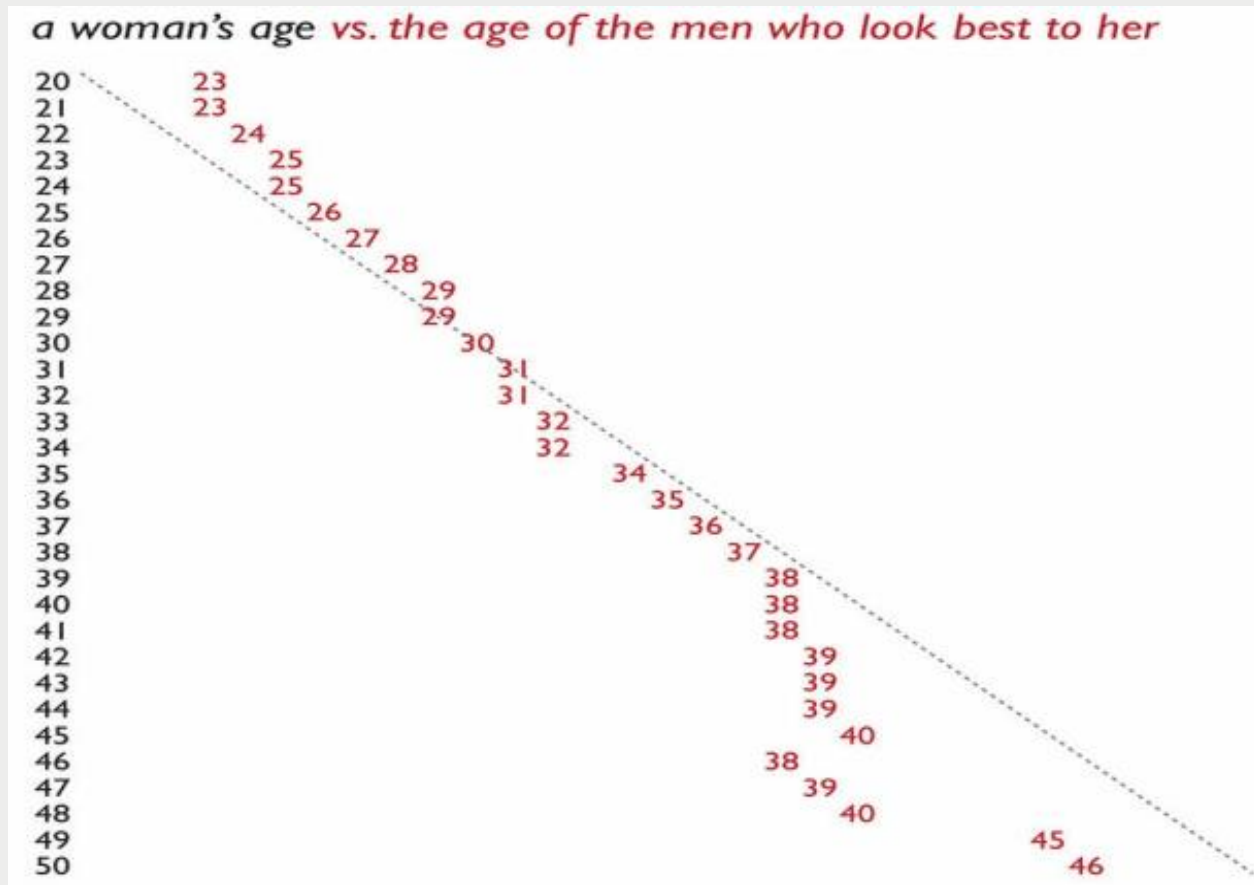
DIMENSIONALITY PRINCIPLE - EXAMPLE

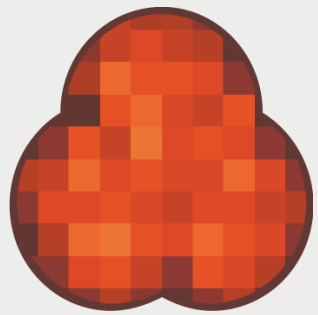
European Parliament Party Breakdown



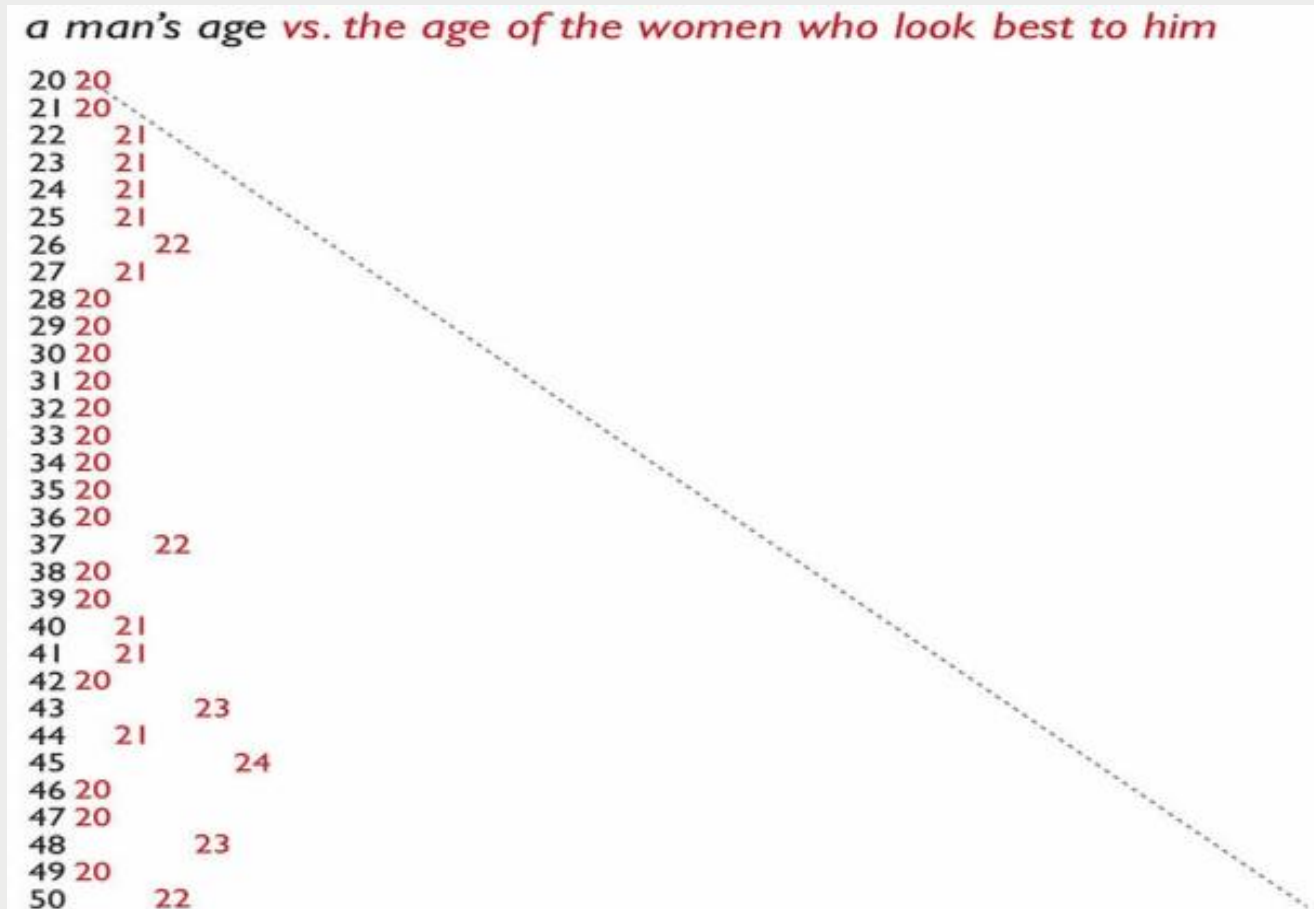


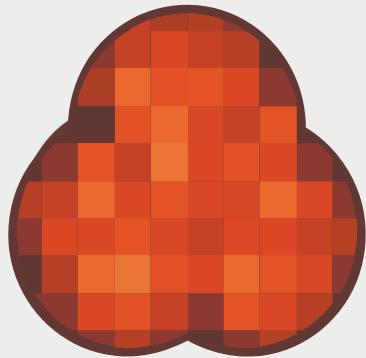
OKCUPID WOMEN VS MEN AGE PREFERENCES





OKCUPID WOMEN VS MEN AGE PREFERENCES





KulenDayz

IT Innovation Conference

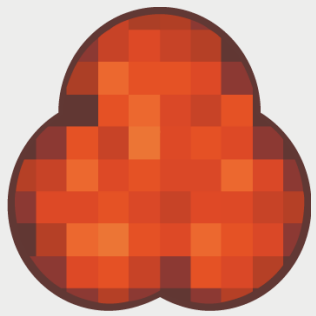
DASHBOARDS



OSIJEK
SOFTWARE
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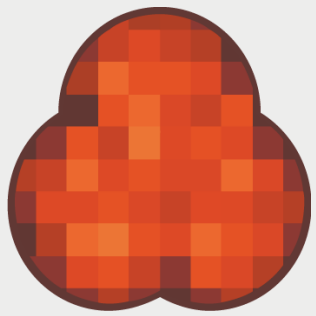


Akademija
za umjetnost
i kulturu u Osijeku

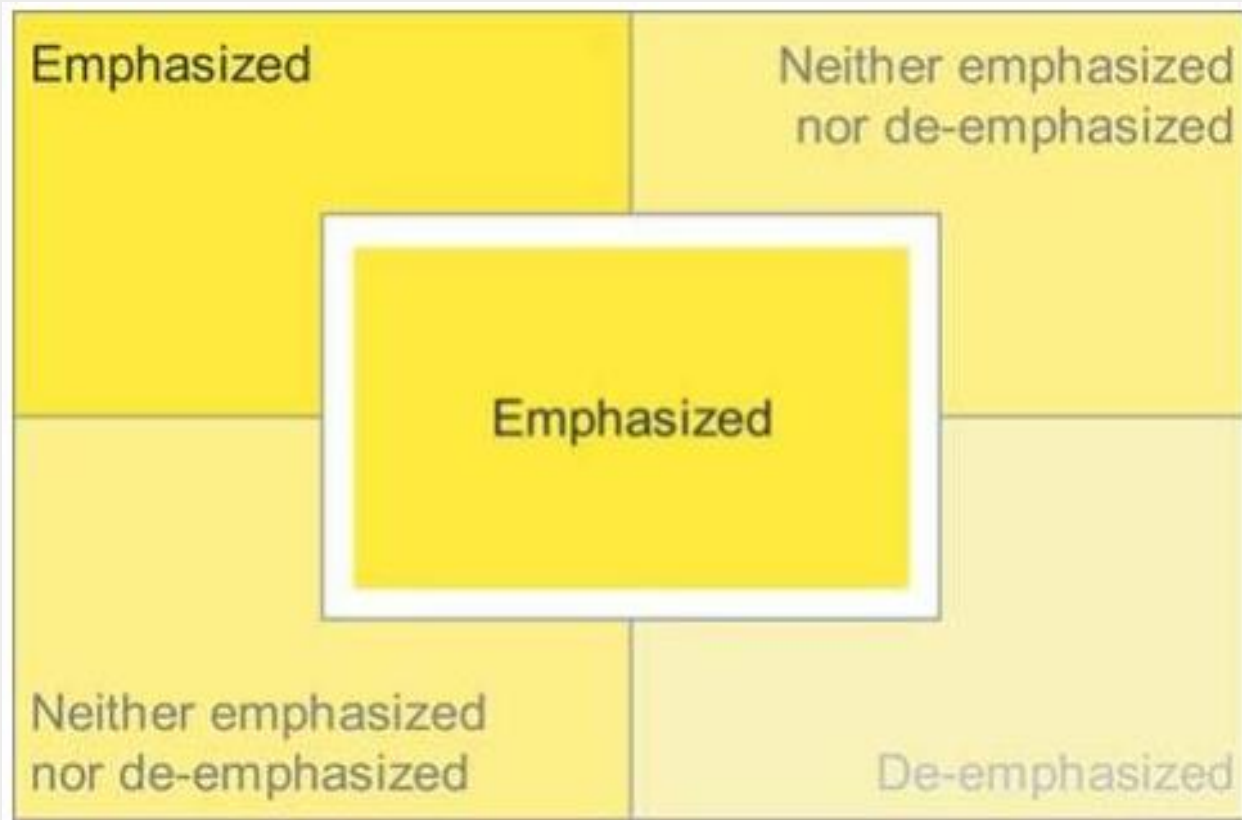


WHAT IS A DASHBOARD?

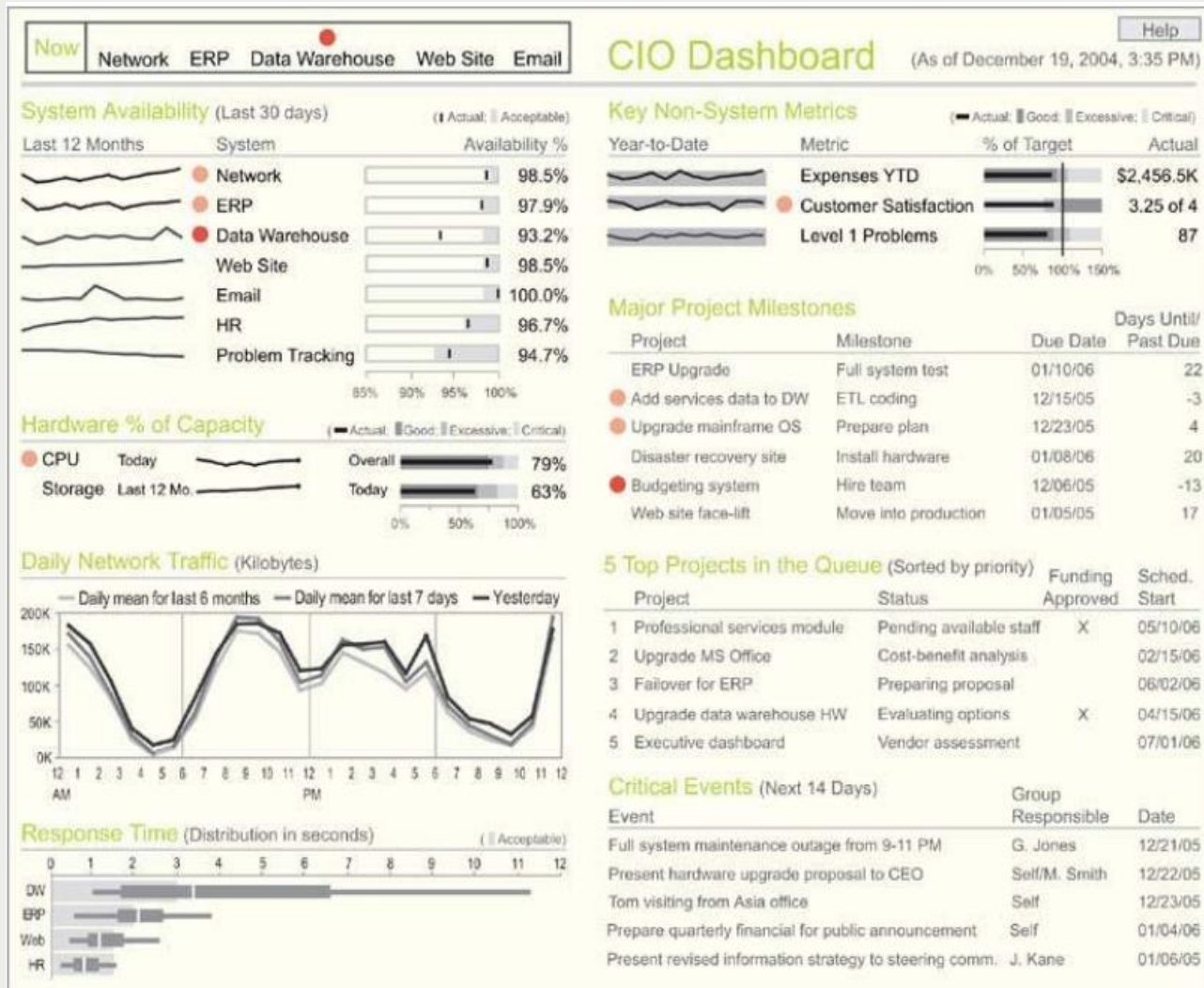
- Dashboards are visual displays
- Dashboards display the information needed to achieve specific objectives
- A dashboard fits on a single computer screen
- Dashboards are used to monitor information at a glance
- Dashboards have small, concise, clear, and intuitive display mechanisms
- Dashboards are customized
- **A dashboard is a type of display, a form of presentation, not a specific type of information or technology**



LOCATION, LOCATION, LOCATION



SAMPLE CIO DASHBOARD



Daily Network Traffic (Kilobytes)

Daily mean for last 6 months

Daily mean for last 7 days

Yesterday

120K

150K

200K

12 AM

1 PM

12 PM

Response Time (Distribution in seconds)

(■ Acceptable)

DW

ERP

Web

HR

0

1

2

3

4

5

6

7

8

9

10

11

12

Key Non-System Metrics

(■ Actual; ■ Good; ■ Excessive; ■ Critical)

Year-to-Date

Metric

% of Target

Actual

Expenses YTD

\$2,456.5K

Customer Satisfaction

3.25 of 4

Level 1 Problems

87

Major Project Milestones

Project

Milestone

Due Date

Days Until/ Past Due

ERP Upgrade

Full system test

01/10/06

22

Add services data to DW

ETL coding

12/15/05

-3

Upgrade mainframe OS

Prepare plan

12/23/05

4

Disaster recovery site

Install hardware

01/08/06

20

Budgeting system

Hire team

12/06/05

-13

Web site face-lift

Move into production

01/05/05

17

5 Top Projects in the Queue (Sorted by priority)

Project

Status

Funding Approved

Sched. Start

1 Professional services module

Pending available staff

X

05/10/06

2 Upgrade MS Office

Cost-benefit analysis

02/15/06

3 Failover for ERP

Preparing proposal

06/02/06

4 Upgrade data warehouse HW

Evaluating options

X

04/15/06

5 Executive dashboard

Vendor assessment

07/01/06

Critical Events (Next 14 Days)

Event

Group Responsible

Date

Full system maintenance outage from 9-11 PM

G. Jones

12/21/05

Present hardware upgrade proposal to CEO

Self/M. Smith

12/22/05

Tom visiting from Asia office

Self

12/23/05

Prepare quarterly financial for public announcement

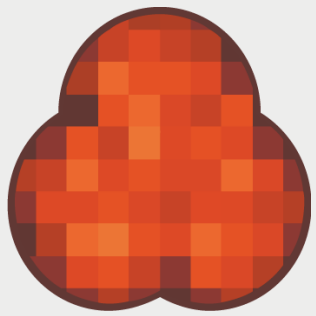
Self

01/04/06

Present revised information strategy to steering comm.

J. Kane

01/06/05



LITERATURE

- Edward R. Tufte - The Visual Display of Quantitative Information, 2nd Edition. Graphics Press, 2001.
- Alberto Cairo - The Truthful Art. New Riders, 2016.
- Stephen Few - Information Dashboard Design - The Effective Visual Communication of Data. O'Reilly, 2006.