Data Visualization W12-2

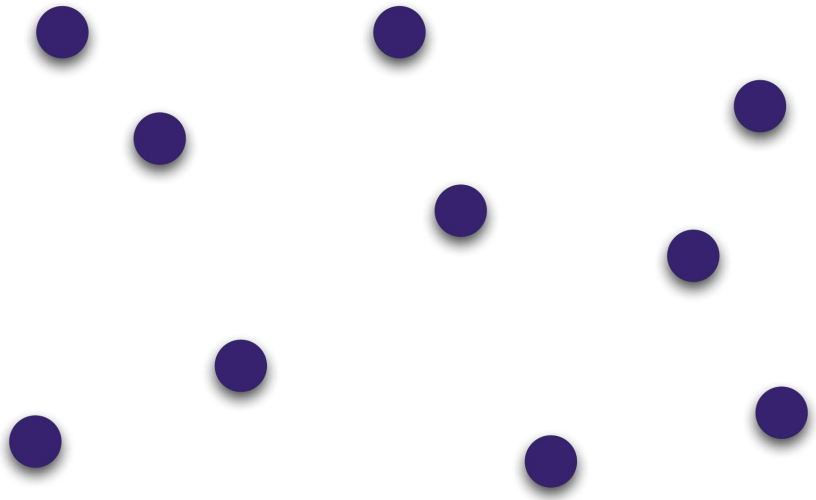
Final exam

- 14 Nov (Tue) in class - 70 mins (last submission: 6:10pm)
- 2 students per desk
- Closed book & **NO** cheatsheet
- Coverage: All modules
- Using Lockdown browser on Canvas
  - Please test your device before the exam and resolve potential technical issues
  - https://kb.iu.edu/d/betv
  - https://kb.iu.edu/d/abxl#iub (IUB IT support)
- Separate sheet of paper for drawing visualizations
- T/F, MCQ (& multi select), essay questions, matching questions

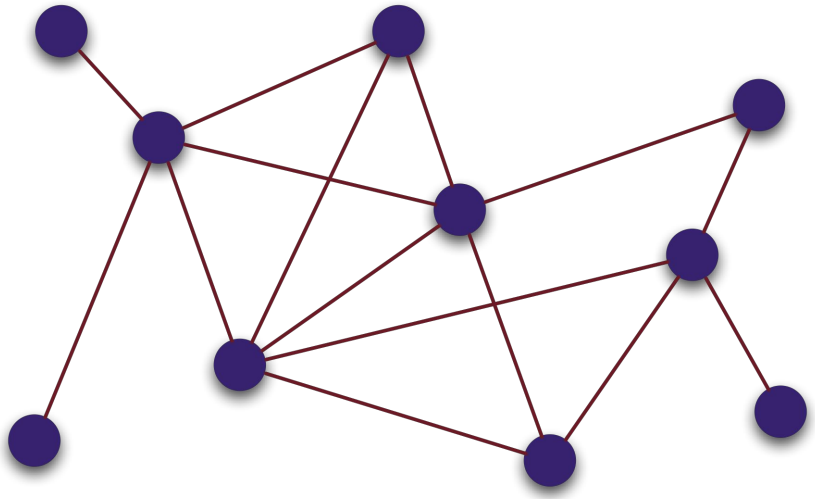
Quiz

- What do you find interesting in today’s VotW?
- Why is 'word' the most common unit in text visualization?
- What is the “bag of words” (BoW) model? What are the key assumptions?

Networks



Nodes



Links (edges) between nodes

Can you think of networks around us?


facebook
December 2010

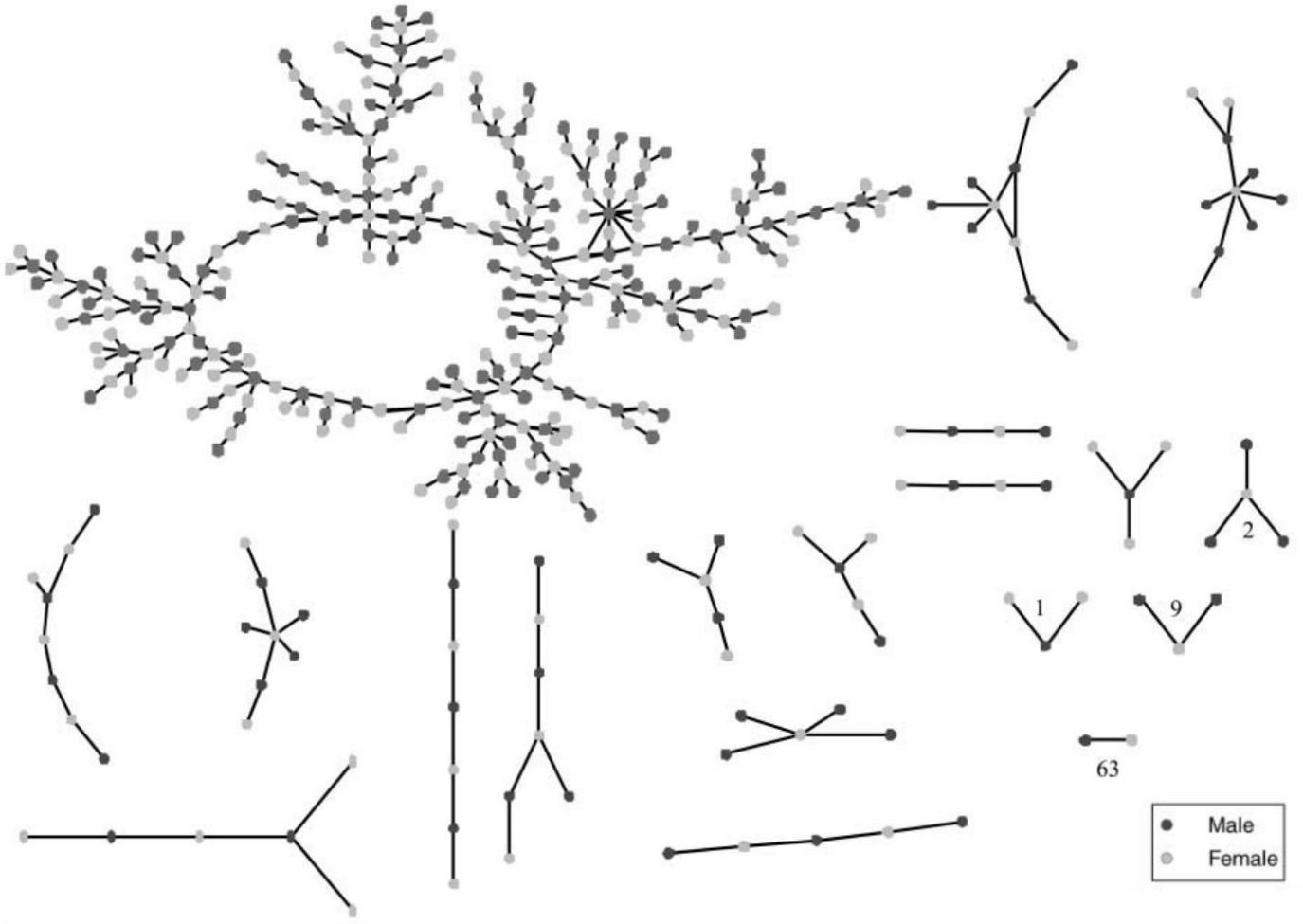
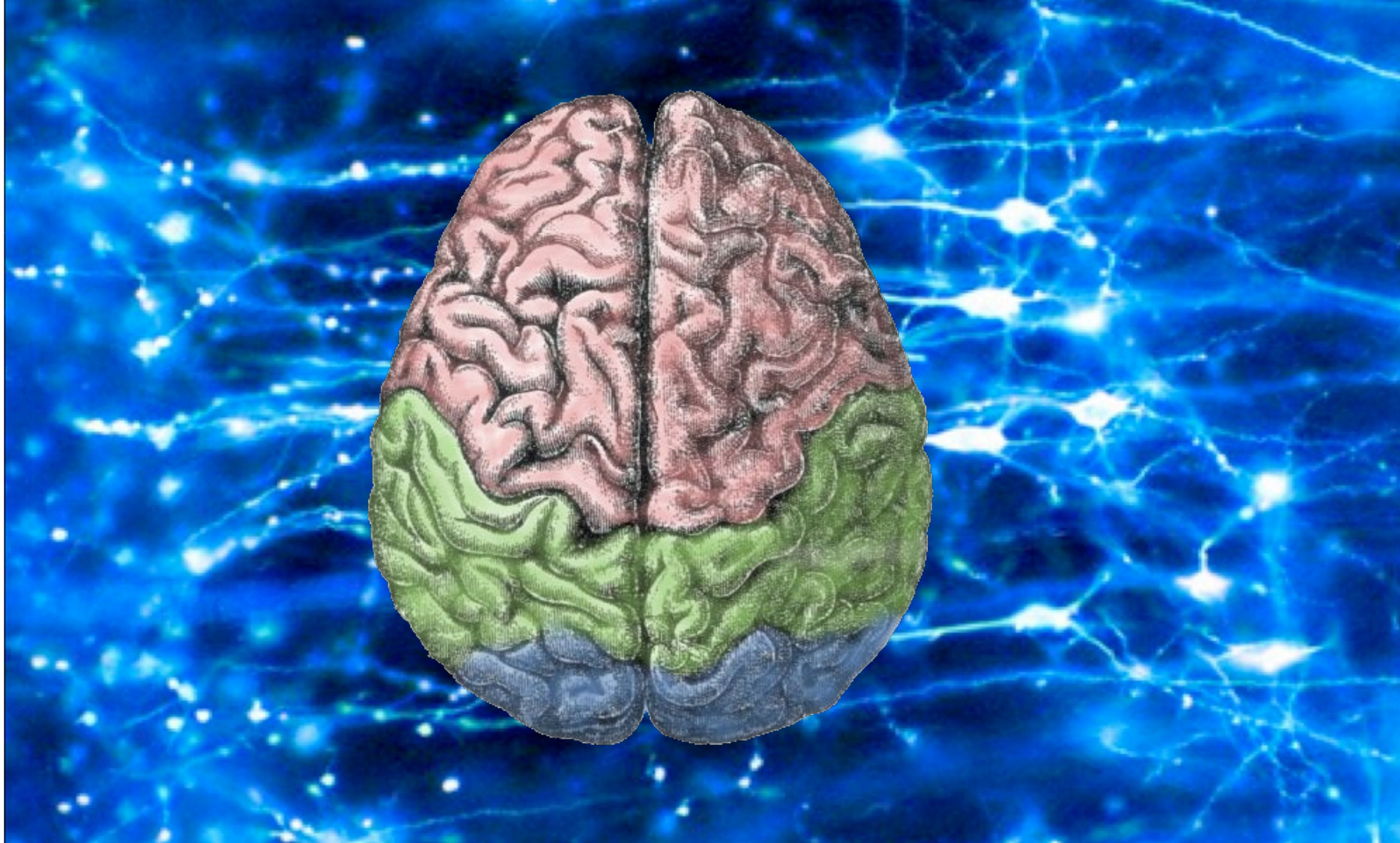
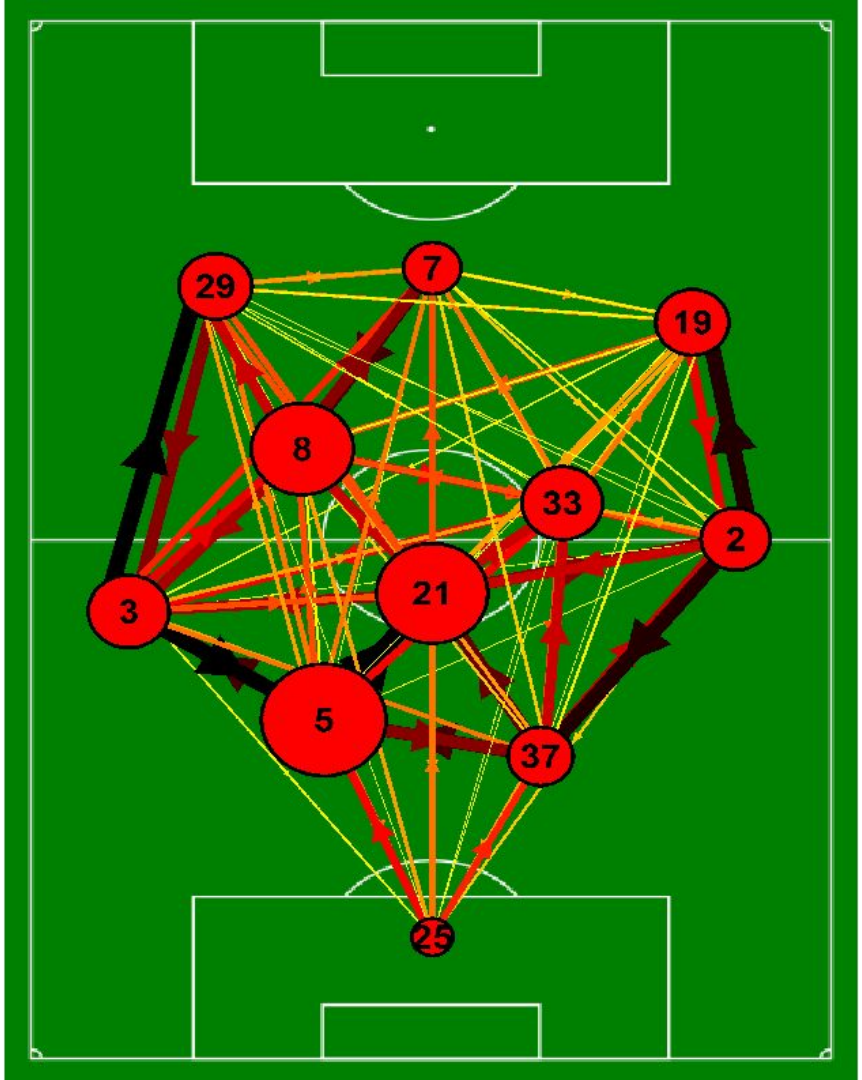
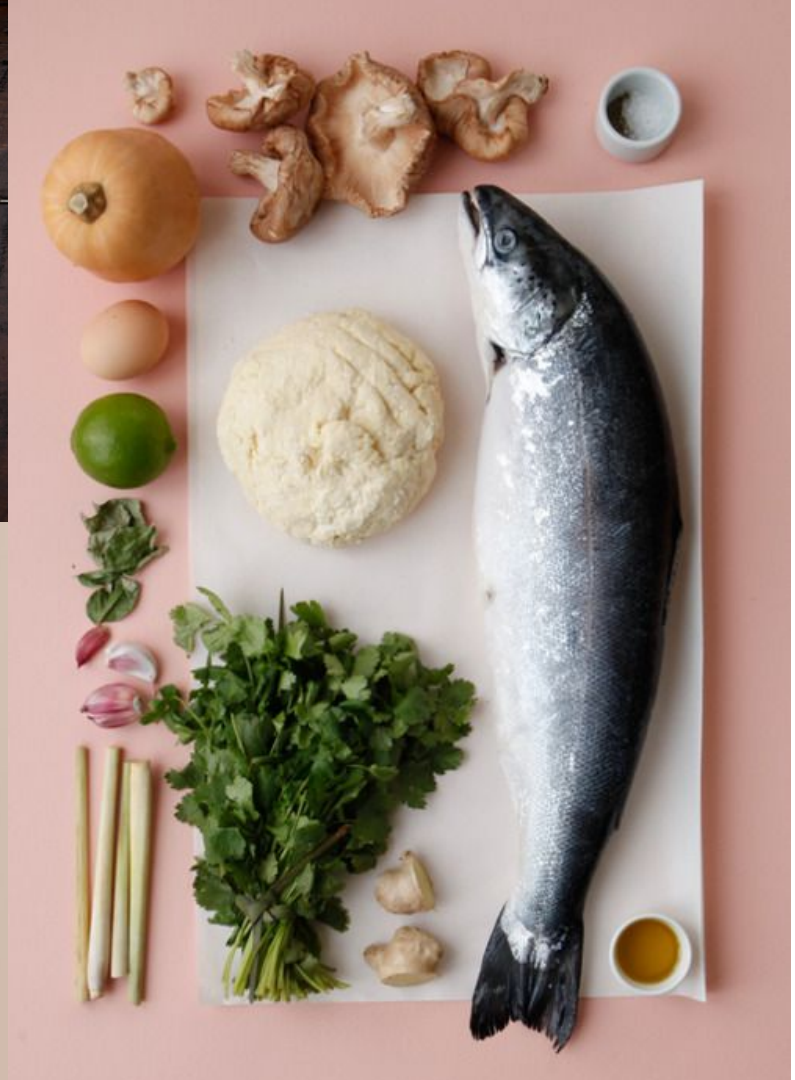


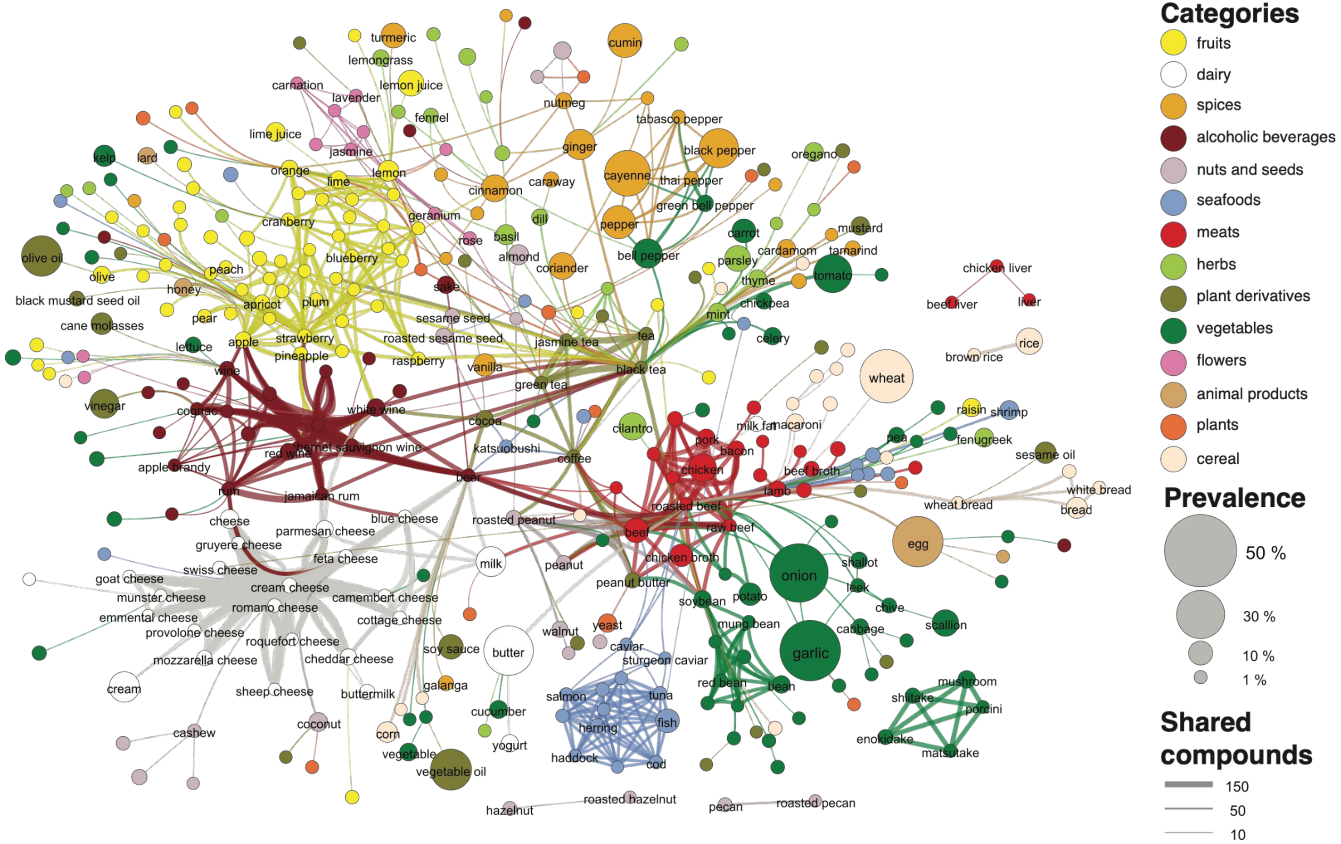
FIG. 2.—The direct relationship structure at Jefferson High



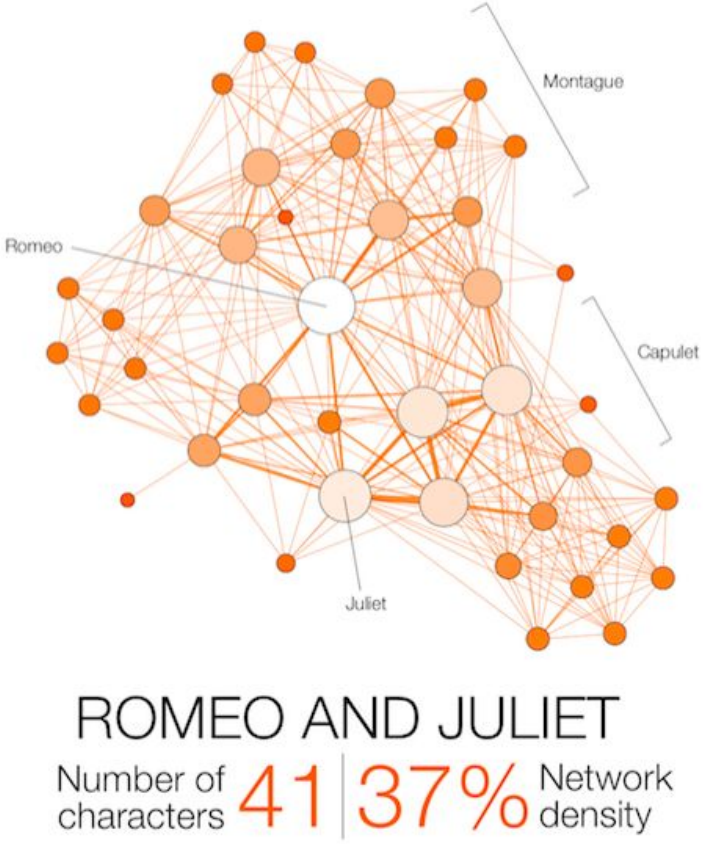
Liverpool
25: Reina
2: Johnson
3: Enrique
5: Agger
37: Skrtel
21: Lucas
33: Shelvey
8: Gerrard
19: Downing
7: Suarez
29: Borini







Y.-Y. Ahn, S. Ahnert, J. P. Bagrow, A.-L. Barabási, *Sci. Rep.* 2011



Node-link Diagram

Should be easy right?

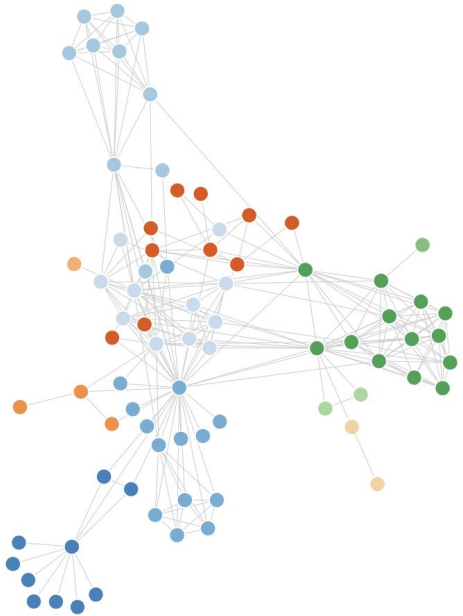
What are the basic constraints?

- Connected pairs should be close.
- Nodes should not overlap with each other.
- Everything should stay in a confined area (screen).

https://vega.github.io/vega/examples/force-directed-layout/

Force Directed Layout Example

Network layout by force-directed placement. Uses Vega's force transform to simulate physical forces such as charge repulsion and edge constraint. Drag nodes to reposition them.



nodeRadius 8
nodeCharge -30
linkDistance 30
static

Can you design an algorithm?

“Force-directed layouts”

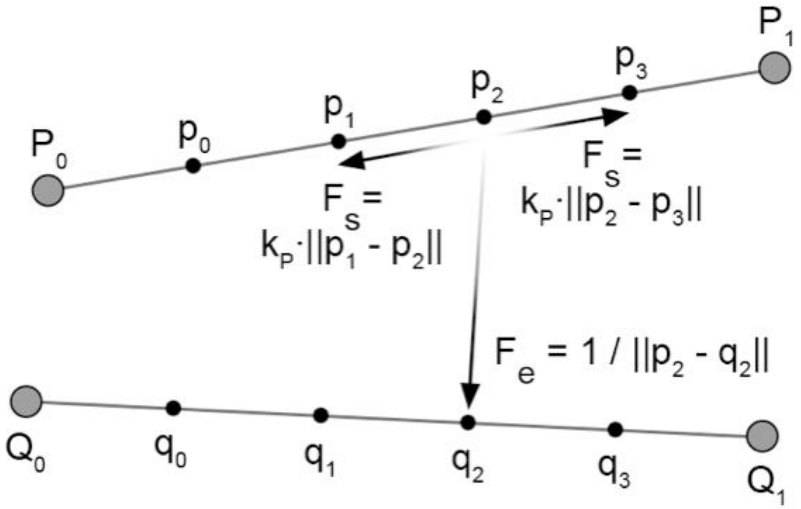
1. Each link is a spring (pulls two nodes together).
2. Each node pushes other nodes.
3. There is gravity towards the center of the screen.

https://observablehq.com/@d3/force-directed-graph-component

Force-directed edge bundling

http://www.win.tue.nl/~dholten/papers/forcebundles_eurovis.pdf

Spring and electrostatic force again



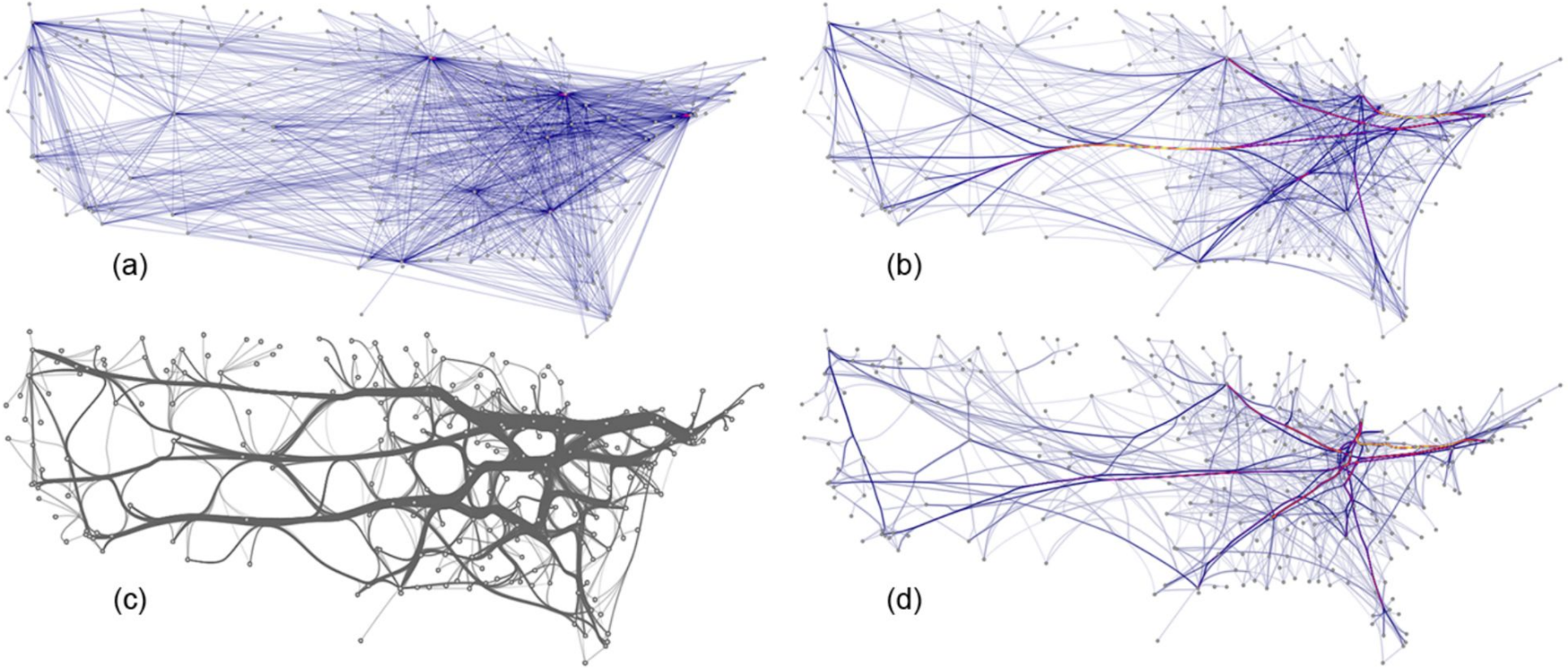
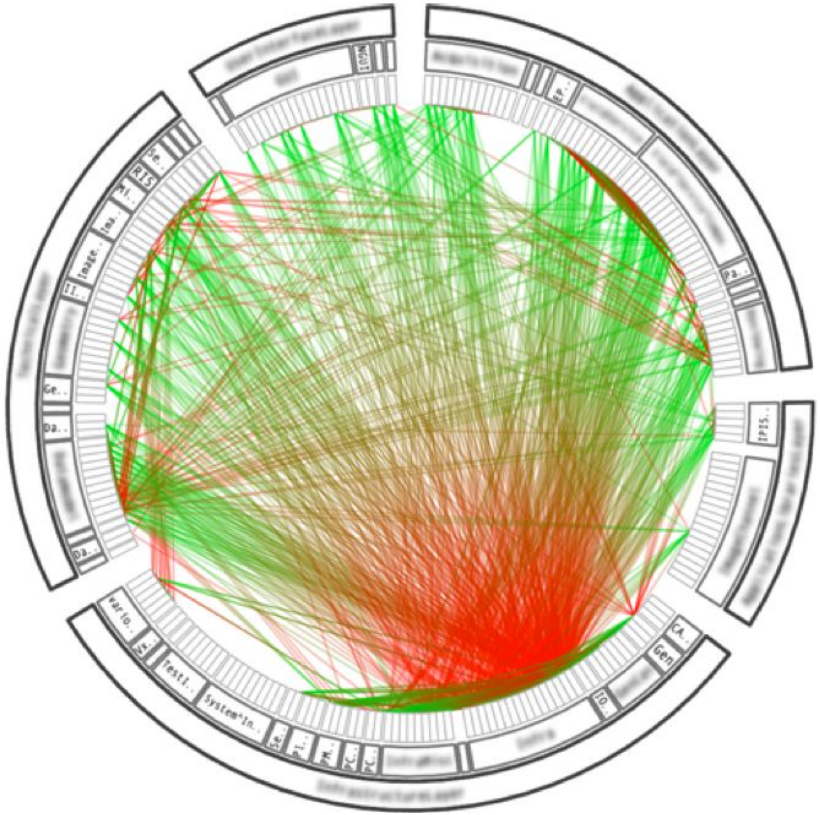
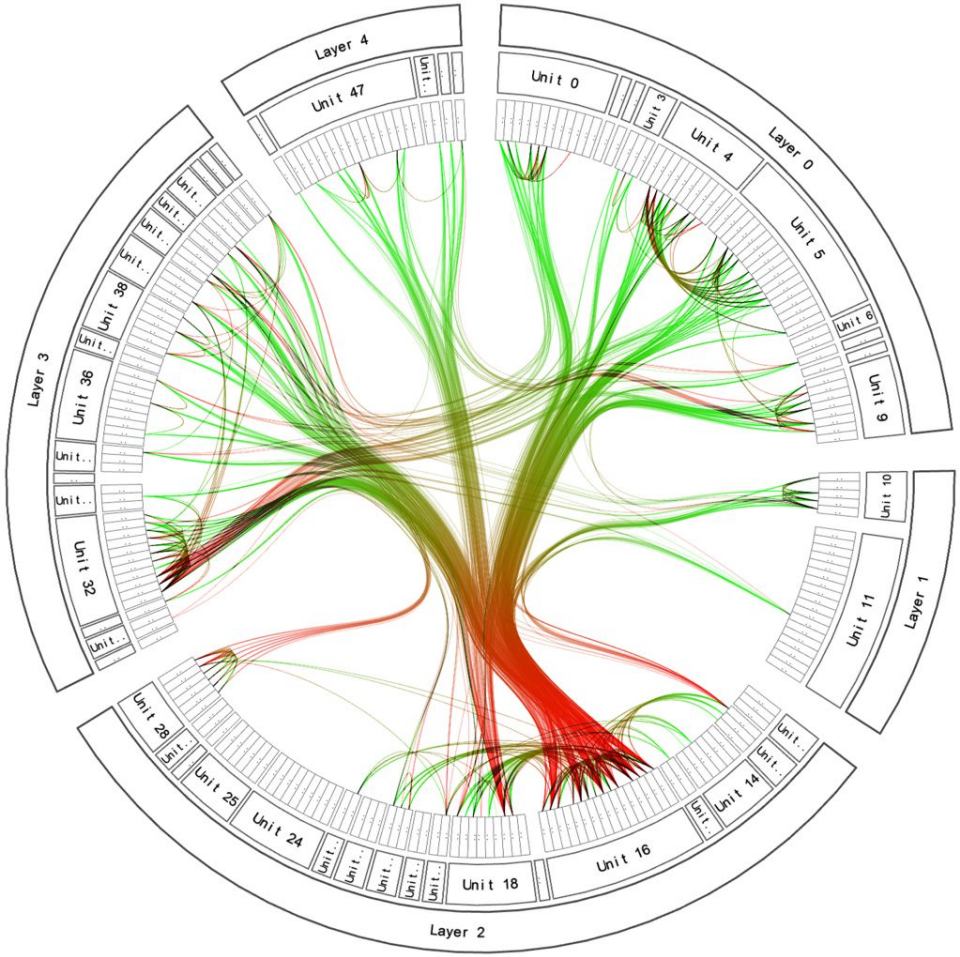


Figure 7: *US airlines graph (235 nodes, 2101 edges) (a) not bundled and bundled using (b) FDEB with inverse-linear model, (c) GBEB, and (d) FDEB with inverse-quadratic model.*




Layer 4
Unit 47
Unit 0
Unit 4
Layer 0
Unit 5
Unit 9
Layer 3
Unit 36
Unit 38
Unit 32
Unit 10
Unit 11
Layer 1
Unit 28
Unit 25
Unit 24
Unit 14
Unit 16
Unit 18
Layer 2

Tree: a special type of network

What is it?

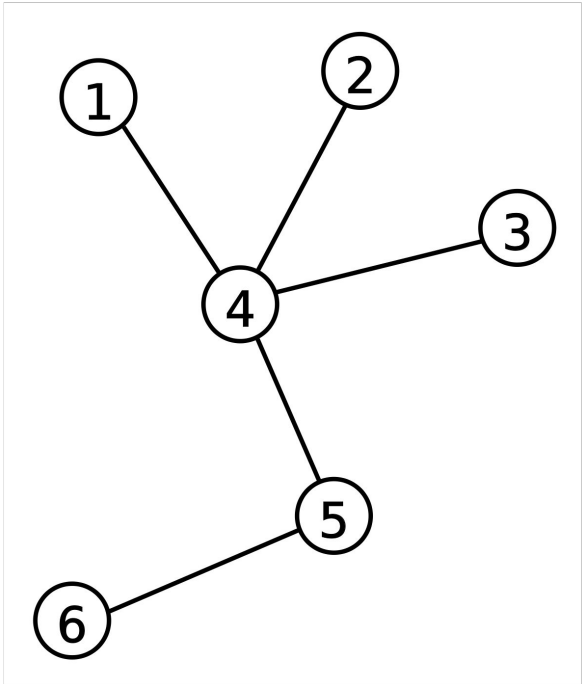
A graph with no loops.

Only one path that connects two nodes exists.

Why are trees special?

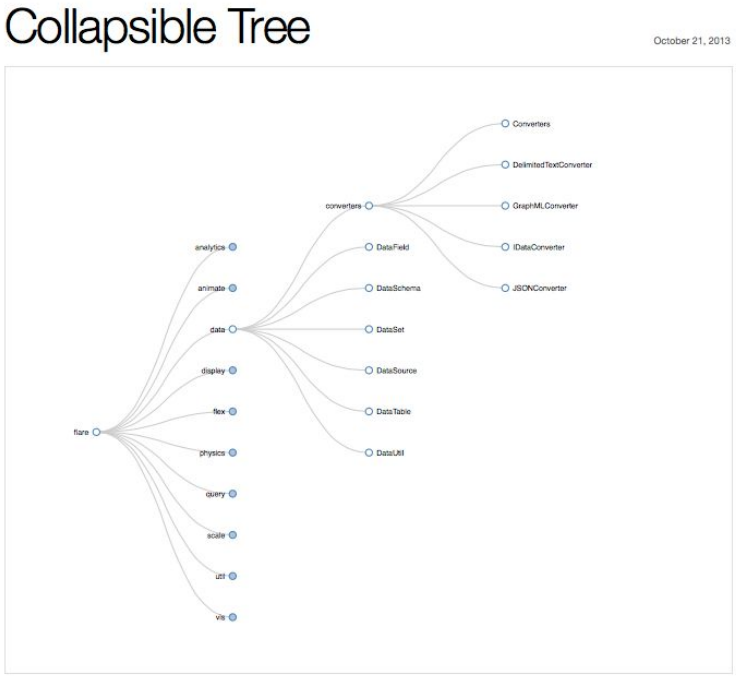
Euler's formula $v - e + f = 2.$

A tree is a “planar graph”



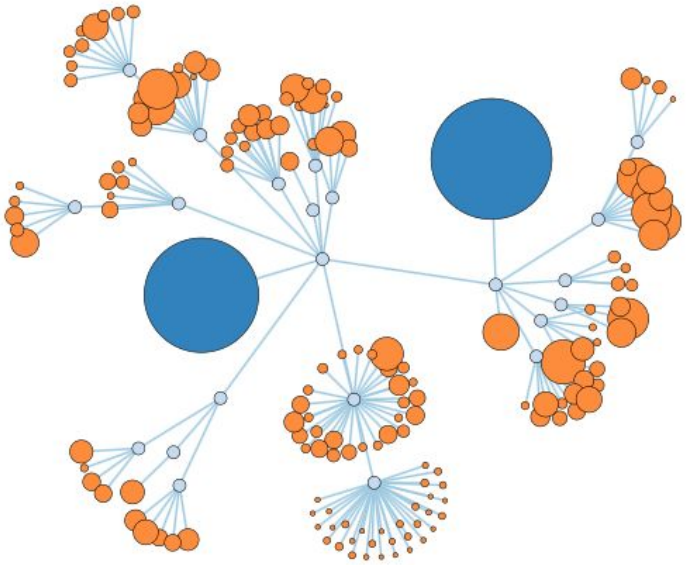
Can be embedded in 2D without any crossings

Trees are hierarchical



https://blocks.roadtolarissa.com/mbostock/4339083

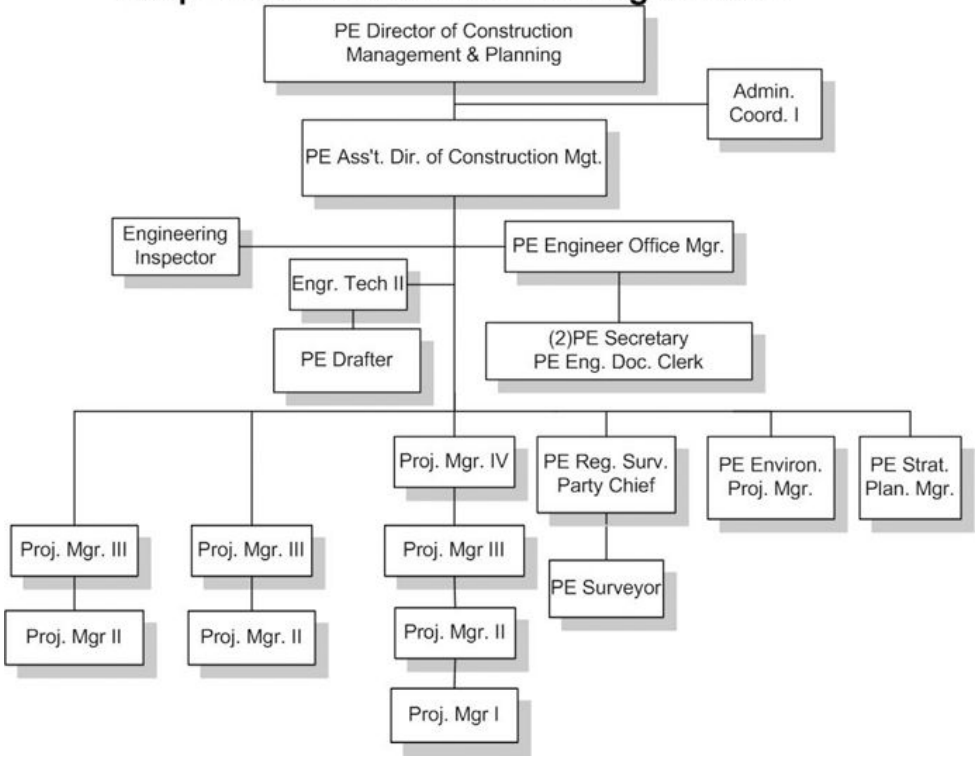
http://mbostock.github.io/d3/talk/20111116/force-collapsible.html

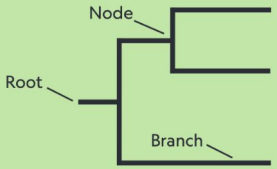


Trees are:

1. easy to draw in 2D (planar)
2. hierarchical (can hide details)
3. *divide-and-conquer*able

Public Works & Transportation Department
Seaport Construction & Planning Division





THE TREE OF LIFE

A phylogenetic tree shows the evolutionary relationships among different organisms. The branches of the tree show where genetic or physical similarities and differences between organisms begin or end.

A phylogenetic tree is like a family tree. The root of the tree represents a distant ancestor of the species that appear at the ends of the branches. The branches separate at nodes, or points where ancestral lines split into new lines of evolution.

Deuterostomia

Protostomia

Chordata
(vertebrates, mammals, humans)
~60,000 species

Echinodermata
(starfishes, sea urchins)
~7,000 species

Arthropoda
(insects, crustaceans, spiders, ticks)
~1,500,000 species

Nematoda
(roundworms)
~20,000 species

Tardigrada
(water bears)
~1,200 species

Mollusca
(clams, snails, squids)
~8,500 species

Annelida
(earthworms, leeches)
~12,000 species

Brachiopoda
(lamp shells)
~300 species

Platyhelmintha
(flatworms)
~13,000 species

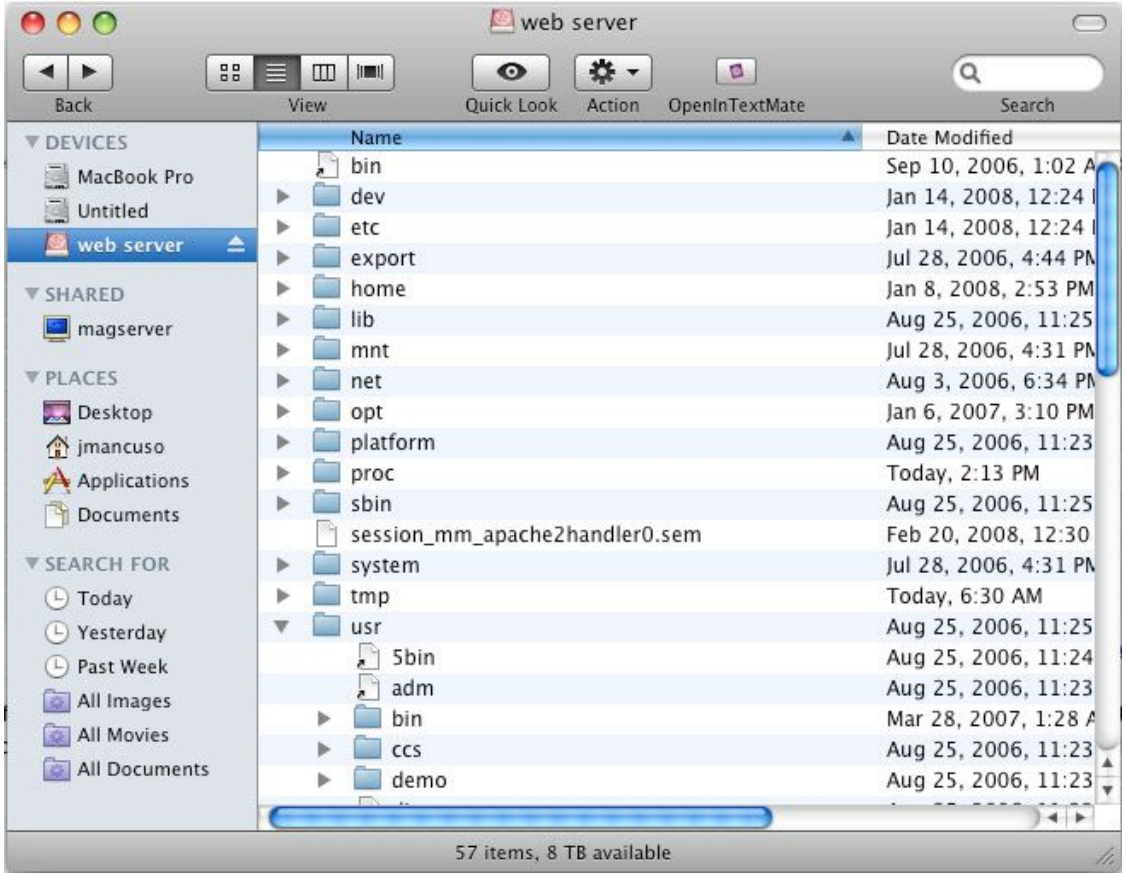
~700 million years ago

Porifera
(sponges)
~5,000 species

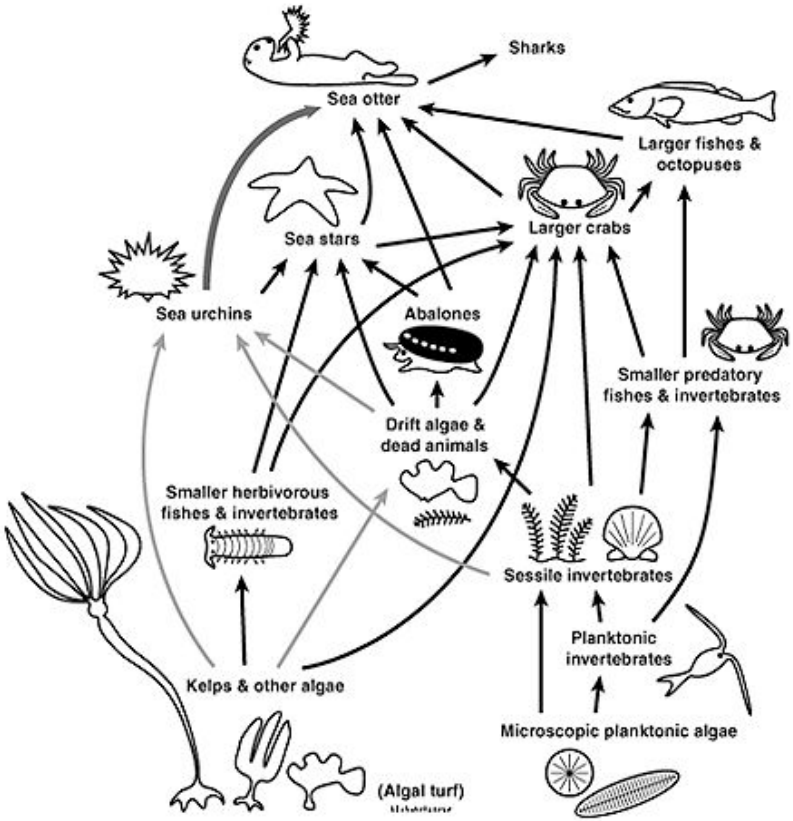
Cnidaria
(sea anemones, corals, hydra, jellyfishes)
~9,000 species

This tree of life shows the relationships among common groups of animals. The main branch in this tree, which separates the animals into two distinct groups, *Deuterostomia* and *Protostomia*, split about seven hundred million years ago. This tree shows how today's animal species have diverged over time from common ancestors.

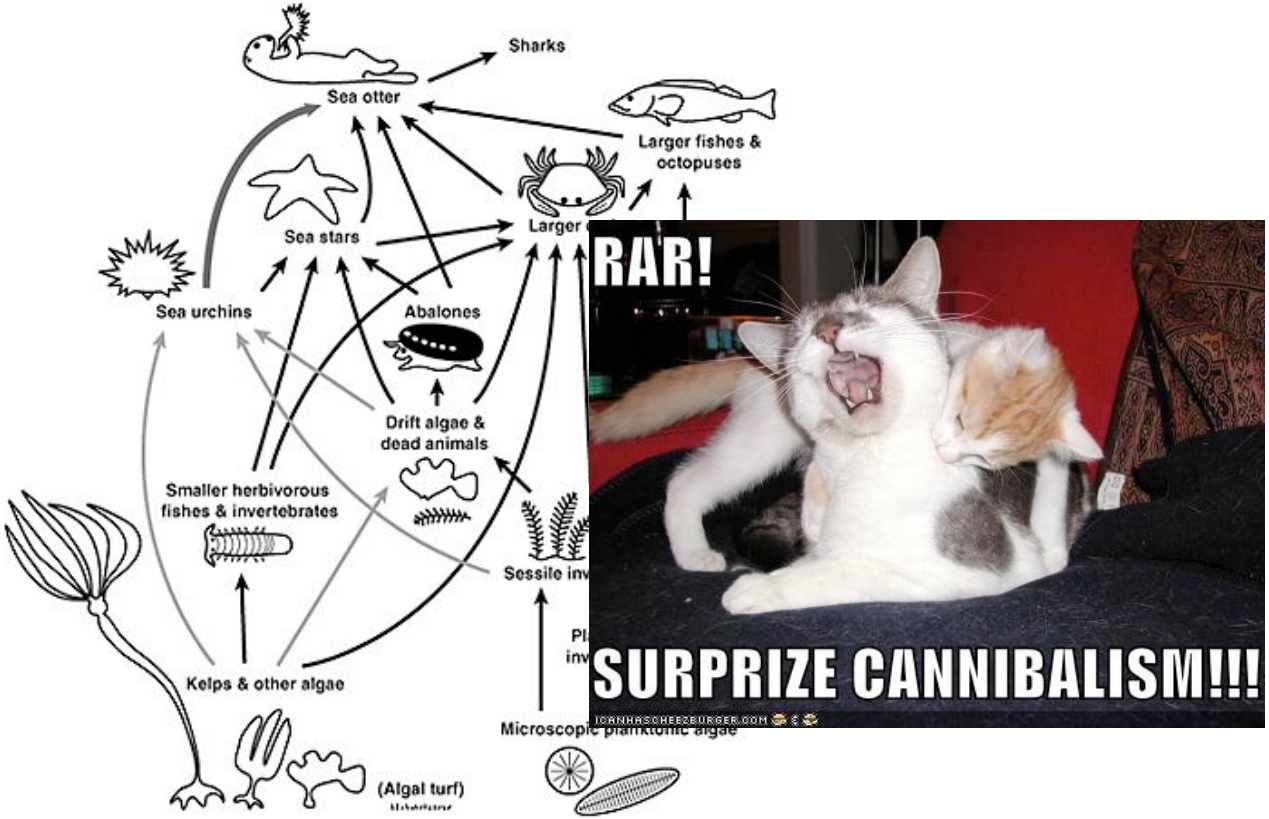
NATIONAL GEOGRAPHIC


web server
Back
View
Quick Look
Action
OpenInTextMate
Search
DEVICES
MacBook Pro
Untitled
web server
SHARED
magserver
PLACES
Desktop
jmancuso
Applications
Documents
SEARCH FOR
Today
Yesterday
Past Week
All Images
All Movies
All Documents
Name
Date Modified
bin
dev
etc
export
home
lib
mnt
net
opt
platform
proc
sbin
session_mm_apache2handler0.sem
system
tmp
usr
5bin
adm
bin
ccs
demo
57 items, 8 TB available

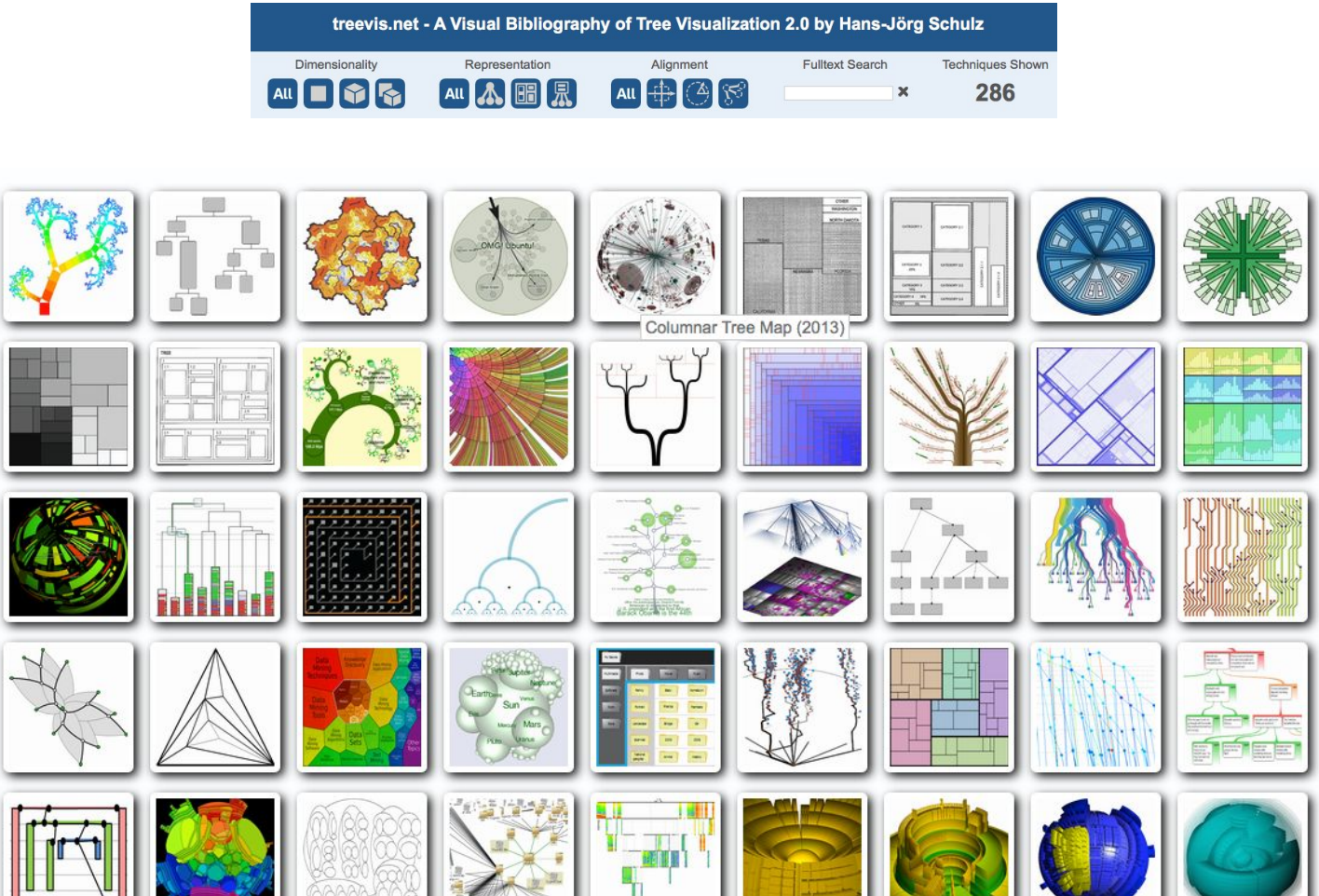
A. With sea otters, kelp forest food web



A. With sea otters, kelp forest food web

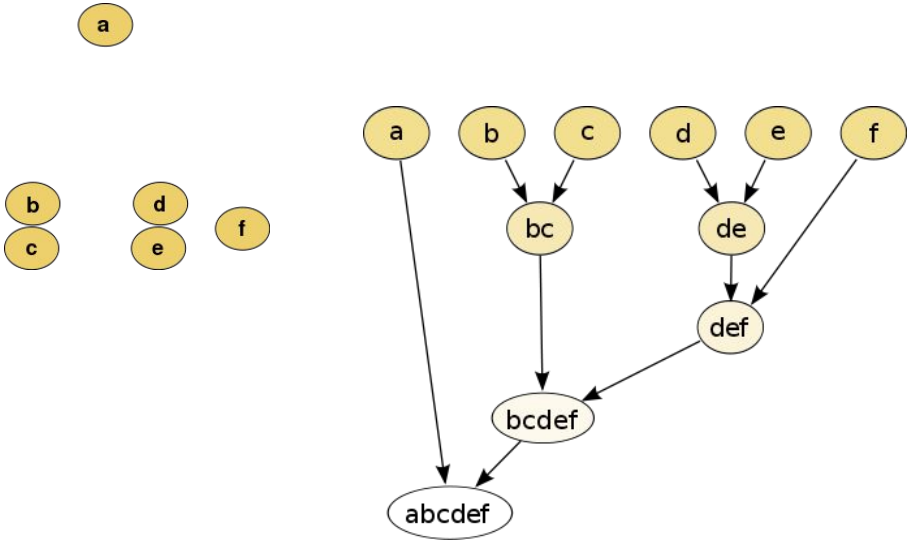


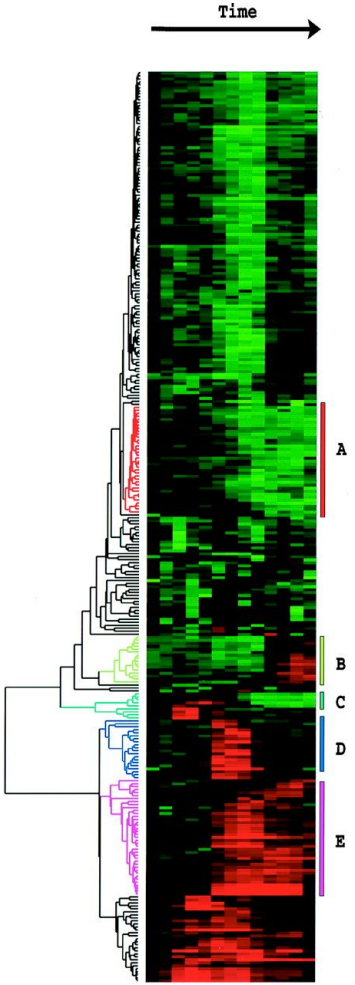
http://vcg.informatik.uni-rostock.de/~hs162/treeposter/poster.html



Common ways to visualize trees

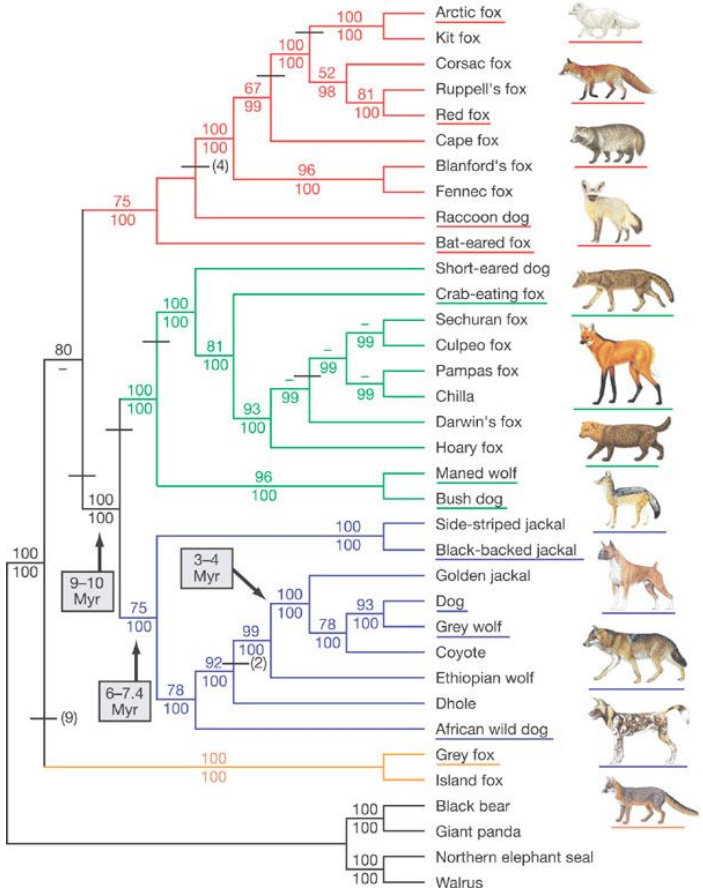
Dendrogram

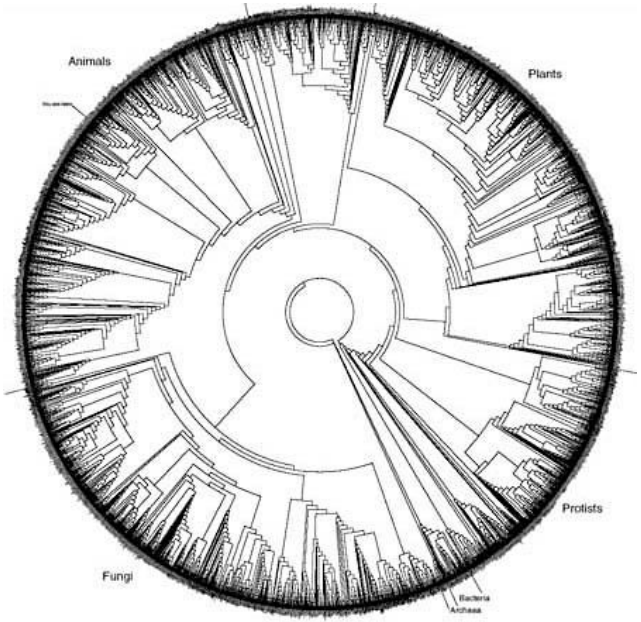




http://en.wikipedia.org/wiki/Dendrogram

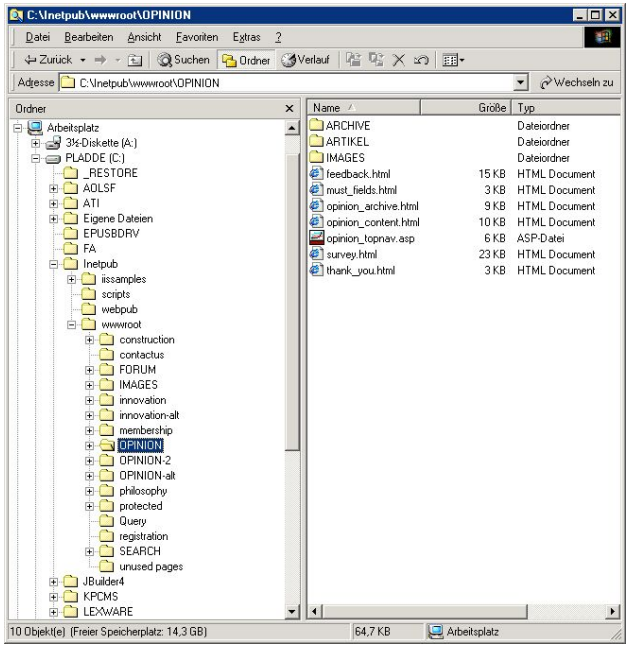
http://www.pnas.org/content/95/25/14863/F1.expansion.html

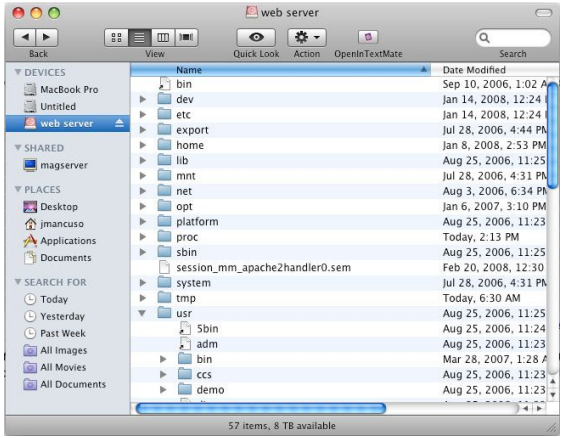

Arctic fox
Kit fox
Corsac fox
Ruppell's fox
Red fox
Cape fox
Blanford's fox
Fennec fox
Raccoon dog
Bat-eared fox
Short-eared dog
Crab-eating fox
Sechuran fox
Culpeo fox
Pampas fox
Chilla
Darwin's fox
Hoary fox
Maned wolf
Bush dog
Side-striped jackal
Black-backed jackal
Golden jackal
Dog
Grey wolf
Coyote
Ethiopian wolf
Dhole
African wild dog
Grey fox
Island fox
Black bear
Giant panda
Northern elephant seal
Walrus
9–10 Myr
3–4 Myr
6–7.4 Myr

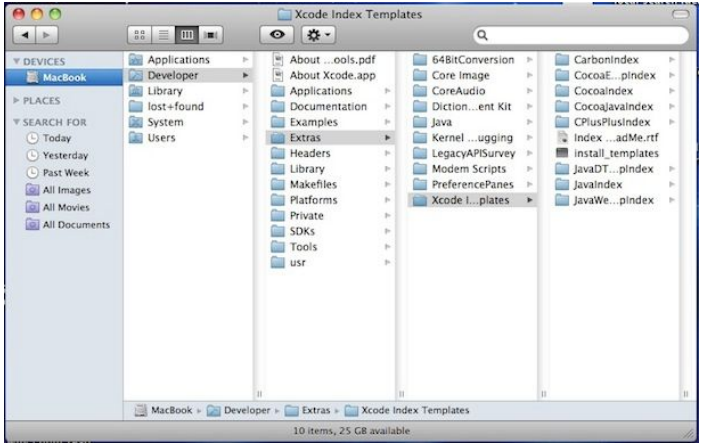

Animals
Plants
Protists
Fungi
Bacteria
Archaea

Sunburst

Indentation





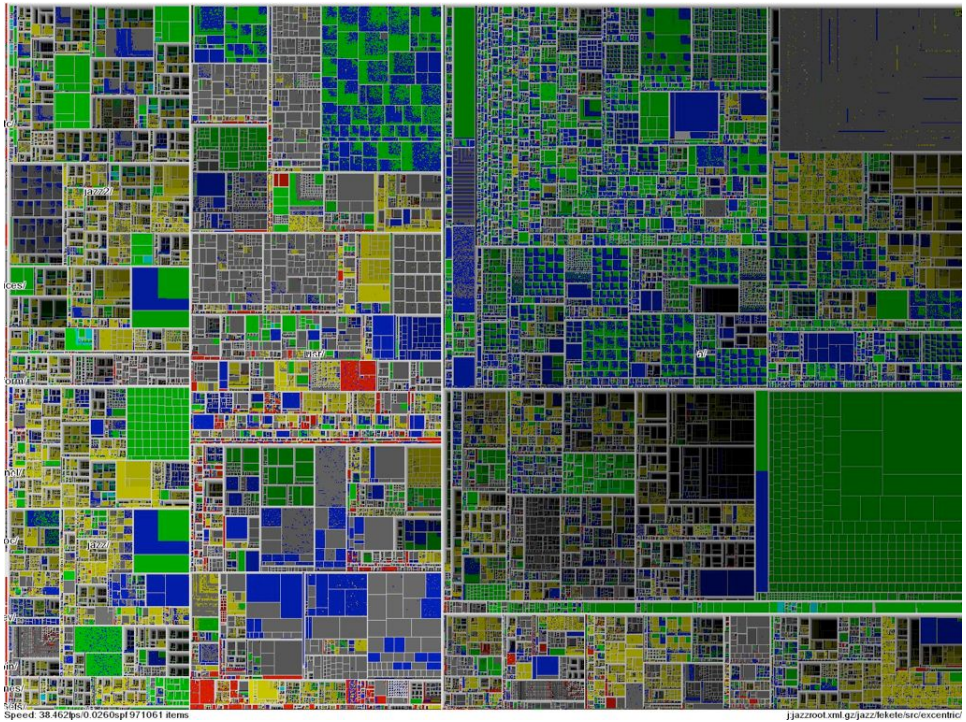


http://www.sapdesignguild.org/community/design/print_hierarchies3.asp

Sometimes, there are quantities associated with each hierarchical level of a tree.

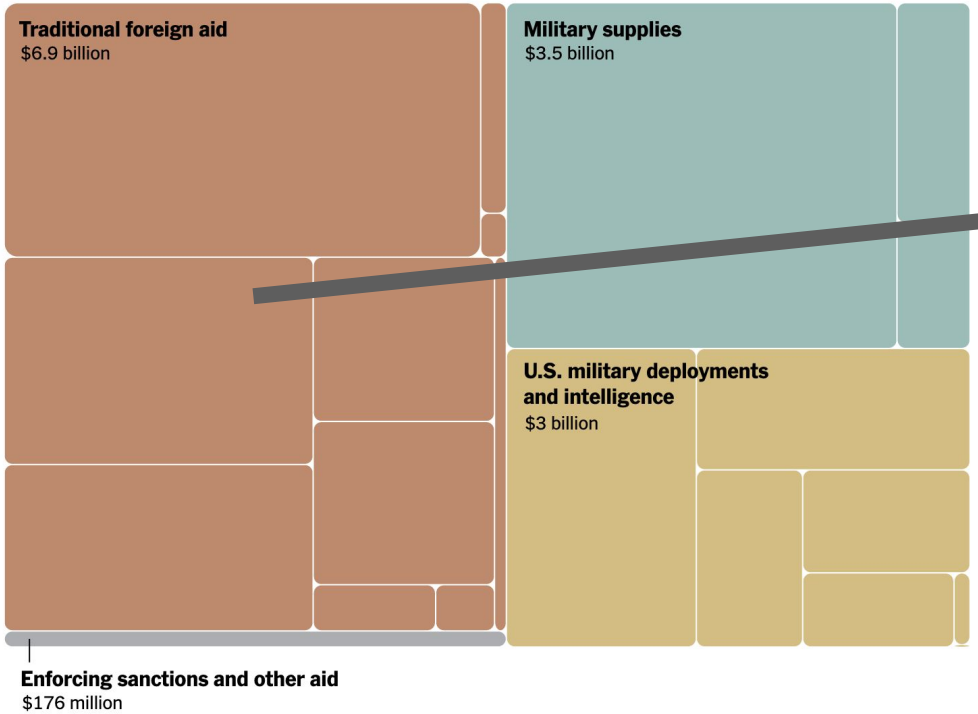
(US Budget)

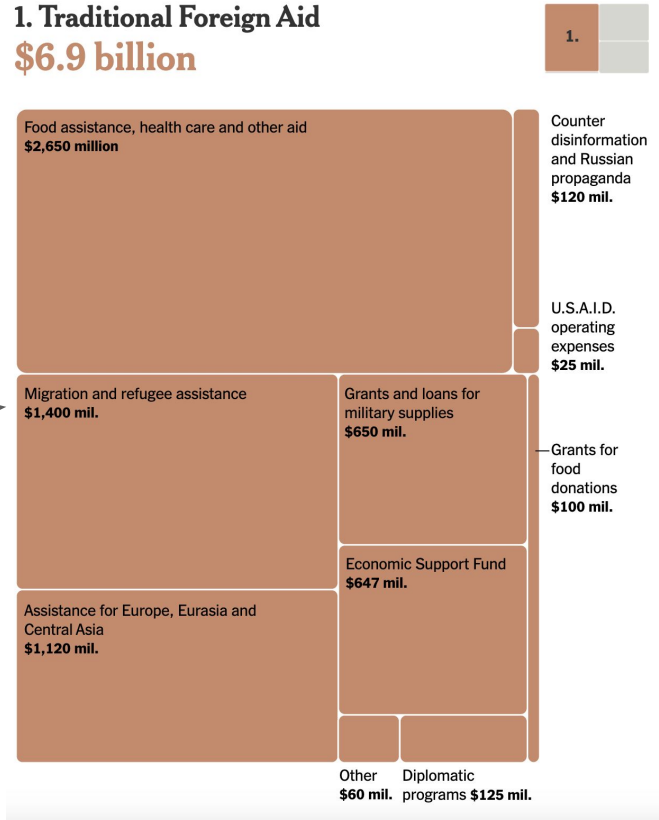
Treemap


Speed: 38.462fps/0.0260spf 971061 items
jjazzroot.xml.gz/jazz/fekete/src/excentric/

Visualizing the $13.6 Billion in U.S. Spending on Ukraine

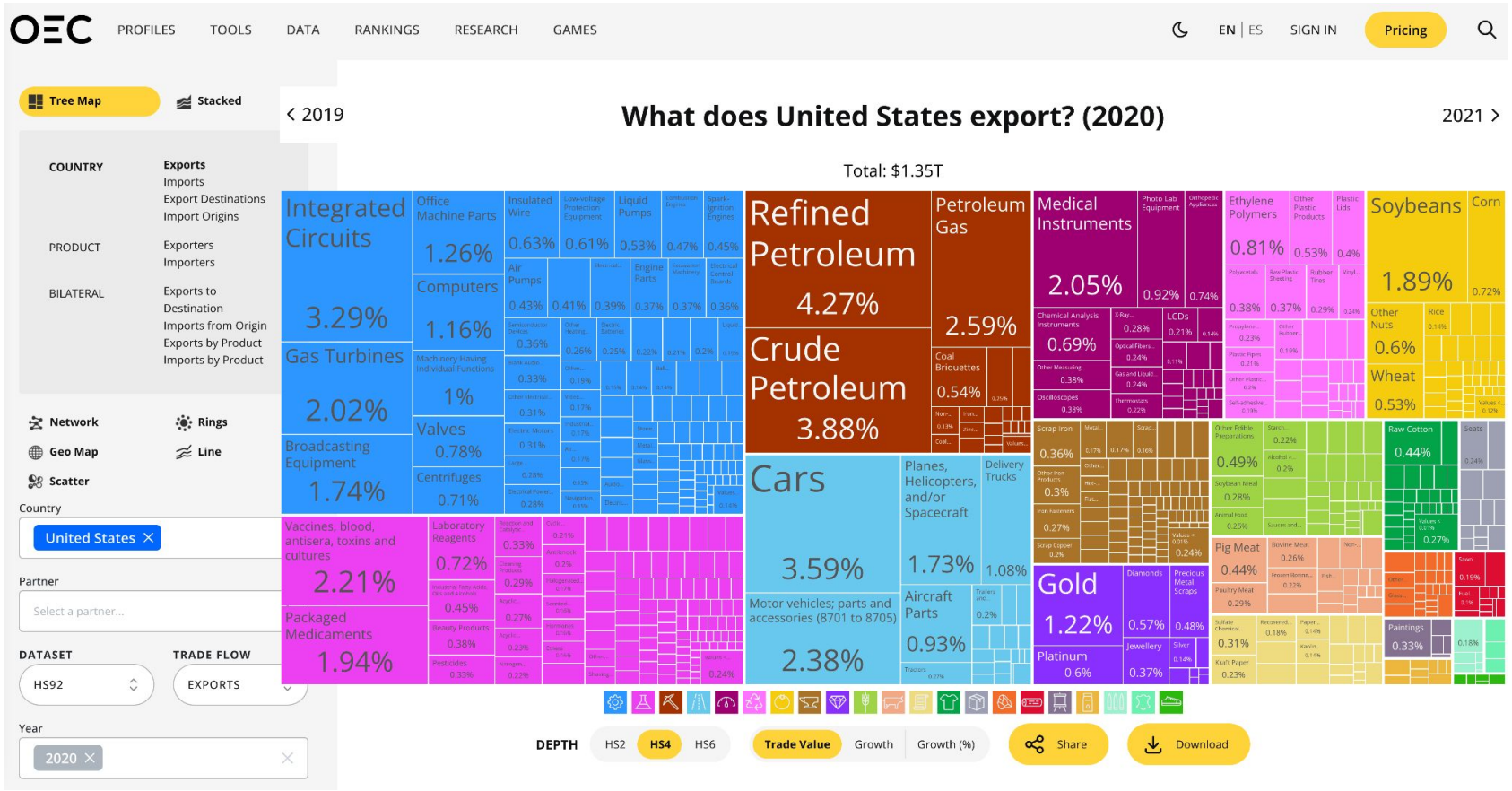
By Bianca Pallaro and Alicia Parlapiano March 18, 2022





https://www.nytimes.com/interactive/2022/03/18/upshot/ukraine-aid-details.html

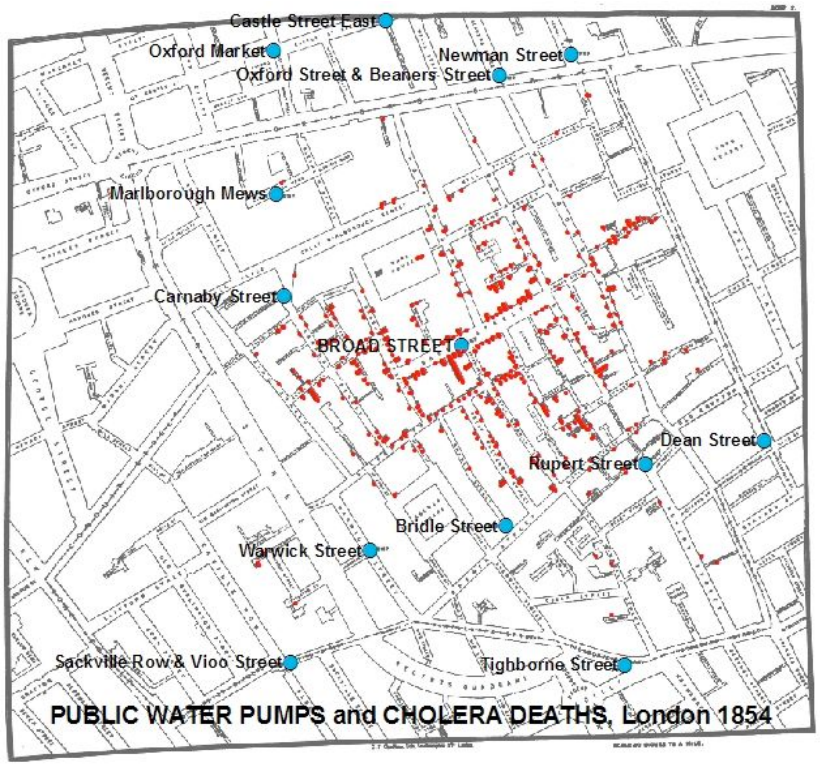
https://oec.world/en/visualize/tree_map/hs92/export/usa/all/show/2020



What’s nice about treemap?
Any drawbacks?

Review

Power


Castle Street East
Oxford Market
Newman Street
Oxford Street & Beaners Street
Marlborough Mews
Carnaby Street
BROAD STREET
Dean Street
Rupert Street
Bridle Street
Warwick Street
Sackville Row & Vioo Street
Tighborne Street
PUBLIC WATER PUMPS and CHOLERA DEATHS, London 1854

Power

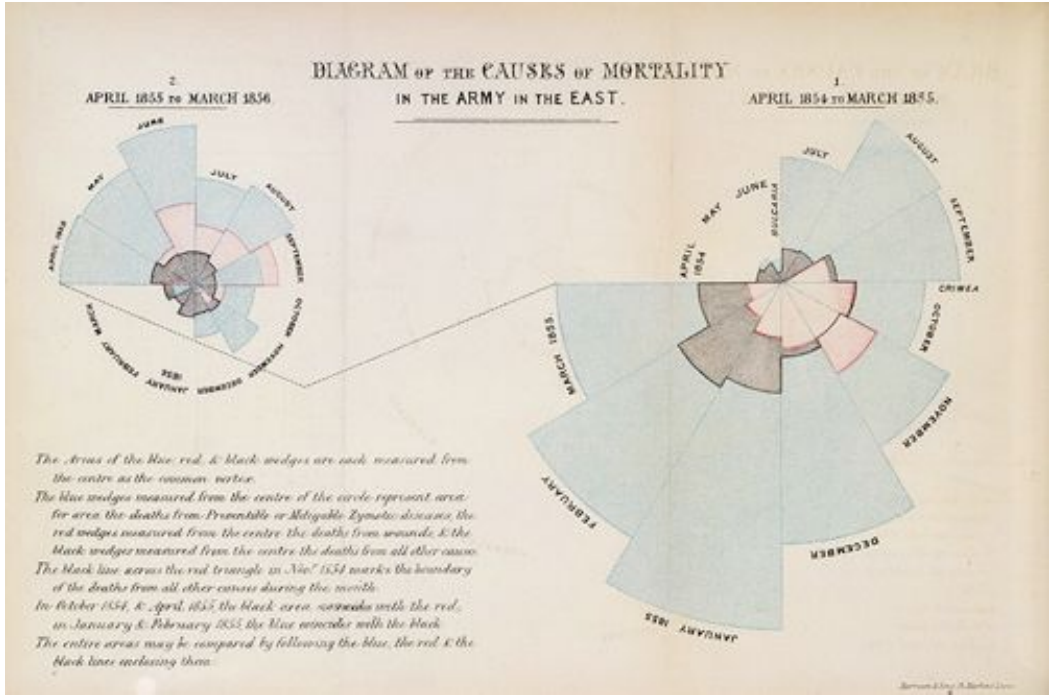


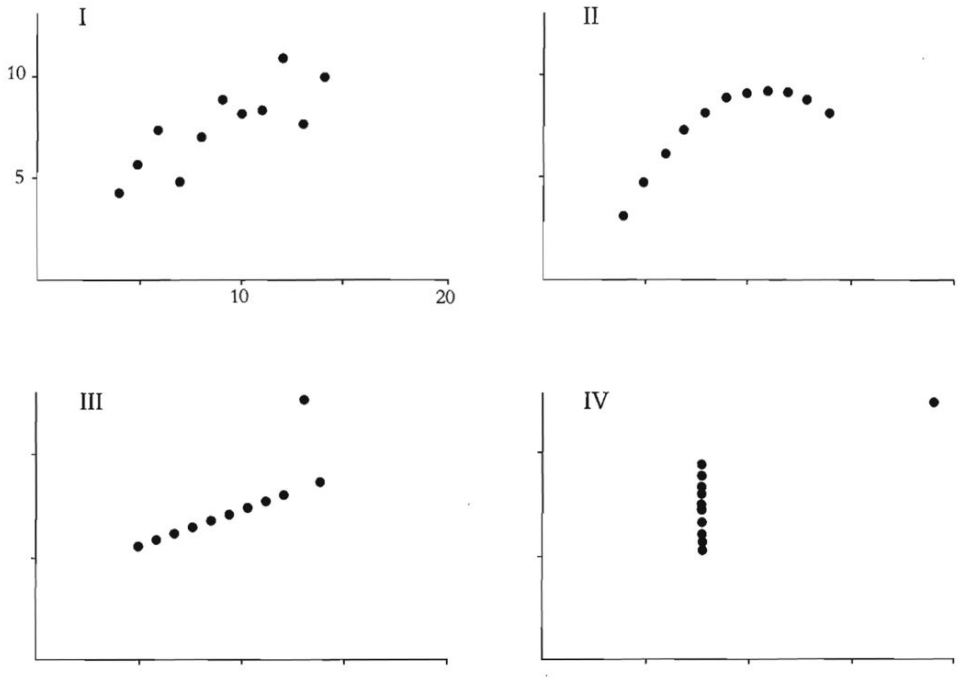
DIAGRAM OF THE CAUSES OF MORTALITY
IN THE ARMY IN THE EAST.
2.
APRIL 1855 TO MARCH 1856
1.
APRIL 1854 TO MARCH 1855.
APRIL 1854
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY 1855
FEBRUARY
MARCH 1855
CRIMEA
The Areas of the blue, red, & black wedges are each measured from the centre as the common vertex.
The blue wedges measured from the centre of the circle represent area for area the deaths from Preventible or Mitigable Zymotic diseases, the red wedges measured from the centre the deaths from wounds, & the black wedges measured from the centre the deaths from all other causes.
The black line across the red triangle in Nov.r 1854 marks the boundary of the deaths from all other causes during the month.
In October 1854, & April 1855 the black area coincides with the red, in January & February 1855 the blue coincides with the black.
The entire areas may be compared by following the blue, the red, & the black lines enclosing them.

Power

I		II		III		IV	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

$N = 11$
mean of X's $= 9.0$
mean of Y's $= 7.5$
equation of regression line: $Y = 3 + 0.5X$
standard error of estimate of slope $= 0.118$
$t = 4.24$
sum of squares $X - \overline{X} = 110.0$
regression sum of squares $= 27.50$
residual sum of squares of $Y = 13.75$
correlation coefficient $= .82$
$r^2 = .67$

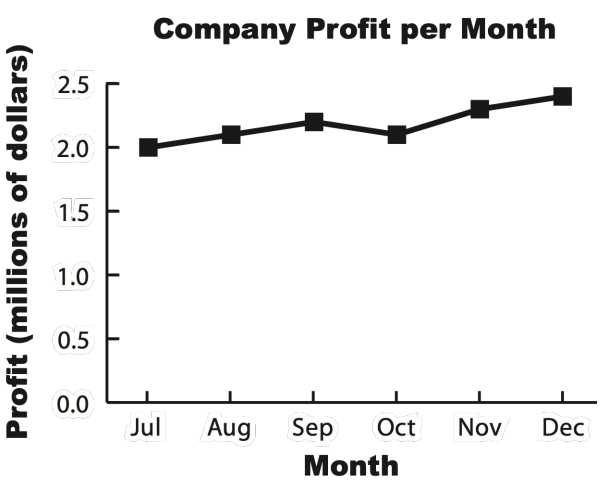
Power

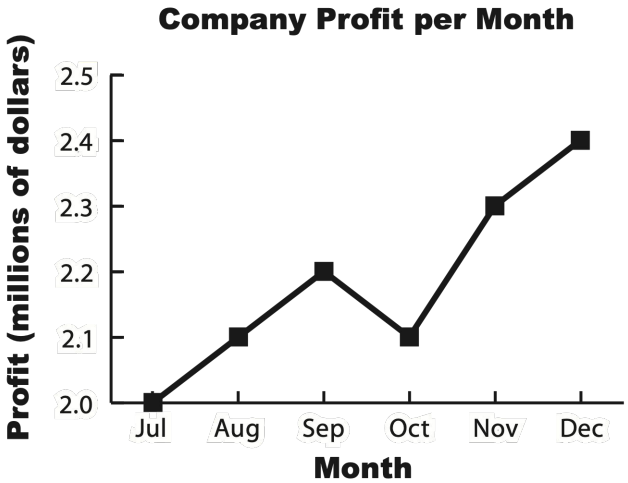


Lies and Integrities

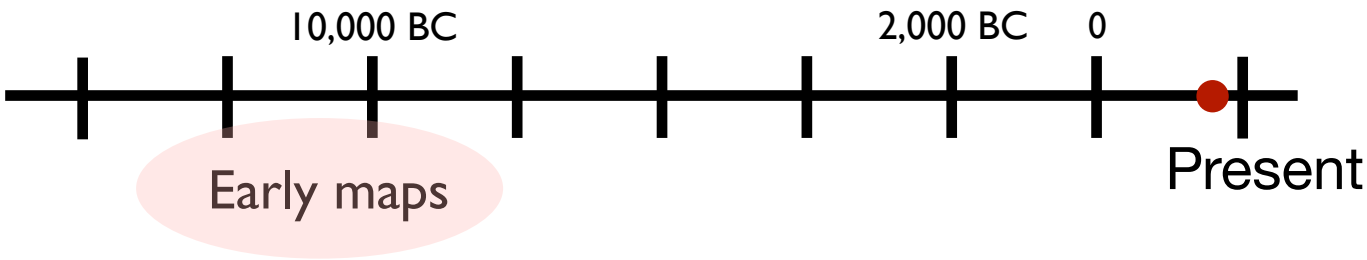
Lies and Integrities

Lies and Integrities

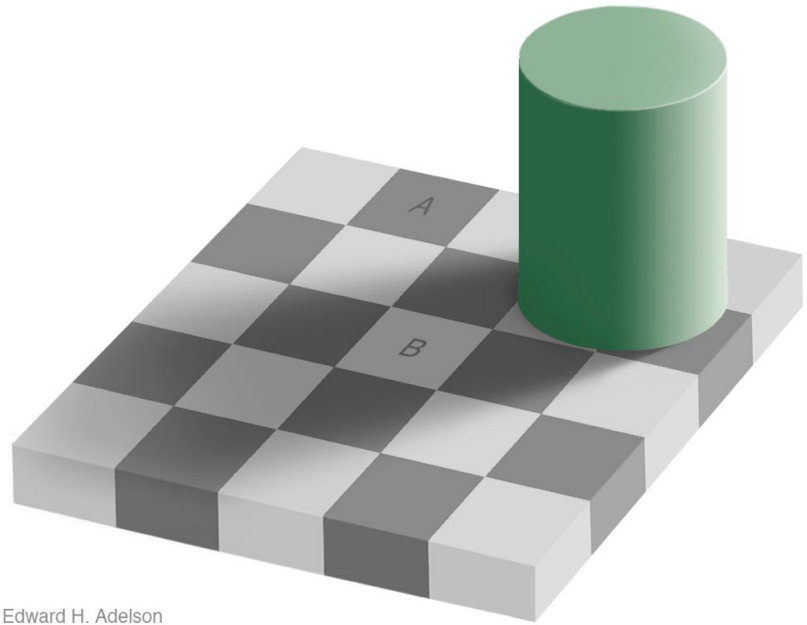




History

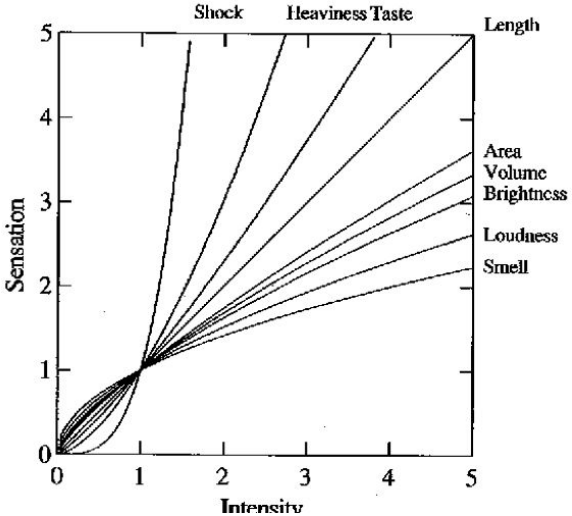


Perception



Edward H. Adelson

Perception



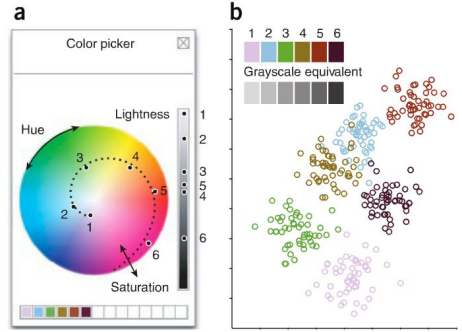
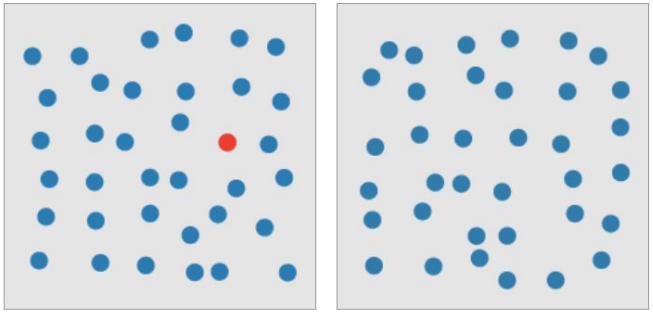
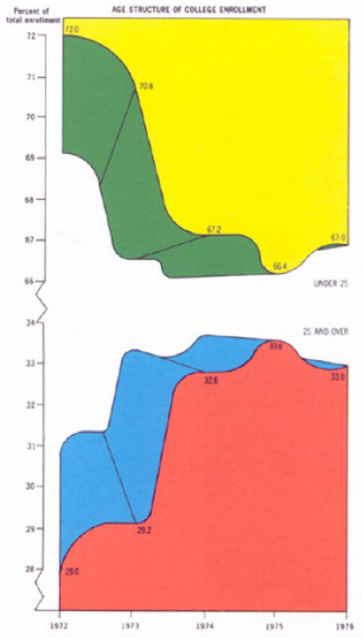


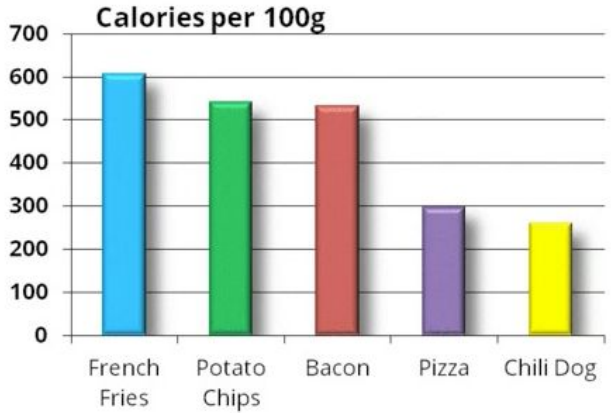
Figure 2 | Color has hue, saturation and brightness. (**a**,**b**) Colors can be tuned using a color picker (**a**). Spiraling through hue and saturation while varying lightness can generate a discernible color set distinguishable even in grayscale (points labeled 1–6).



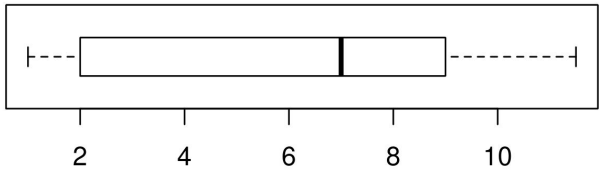
Design principles

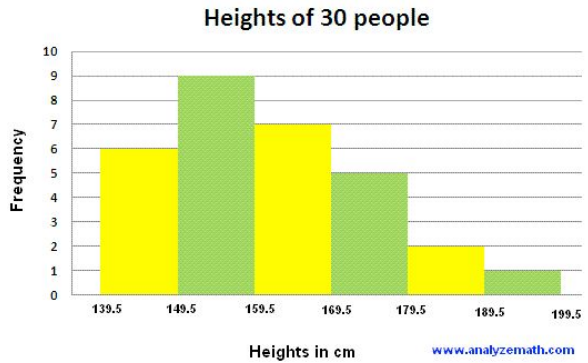


Reduce colors



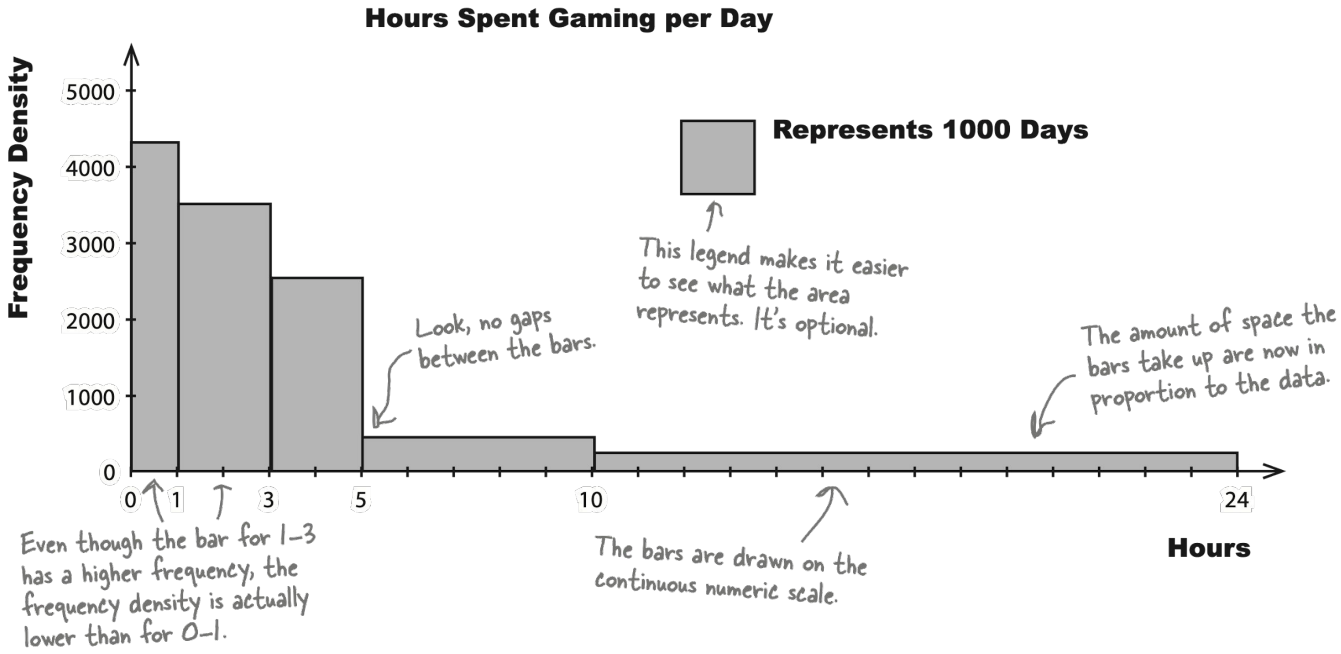
Data & Fundamental Methods



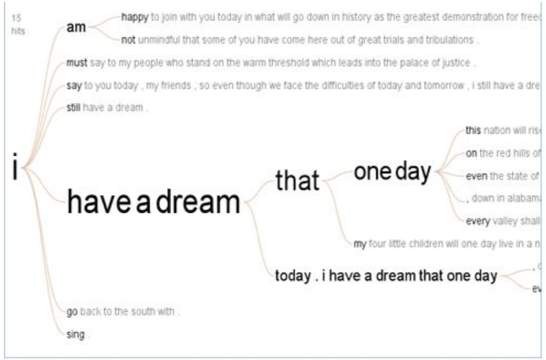


Segmentation
vs.
Summarization

Data & Fundamental Methods

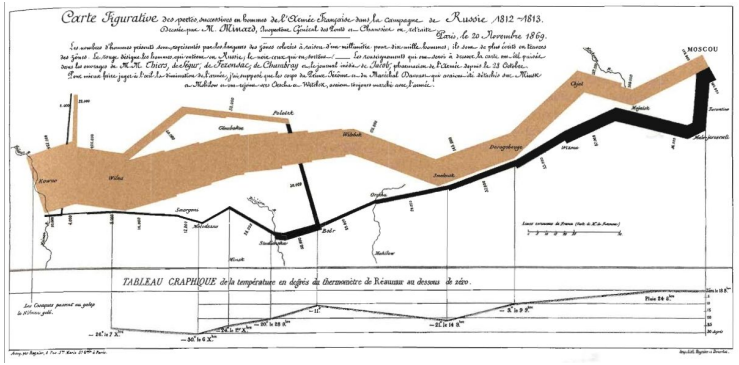


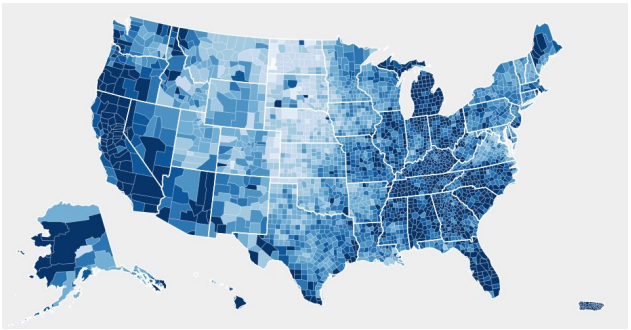
Text


15 hits
i
am
happy to join with you today in what will go down in history as the greatest demonstration for free
not unmindful that some of you have come here out of great trials and tribulations .
must say to my people who stand on the warm threshold which leads into the palace of justice .
say to you today , my friends , so even though we face the difficulties of today and tomorrow , i still have a dre
still have a dream .
have a dream
that
one day
this nation will ris
on the red hills of
even the state of
, down in alabam
every valley shall
my four little children will one day live in a n
today . i have a dream that one day
go back to the south with .
sing

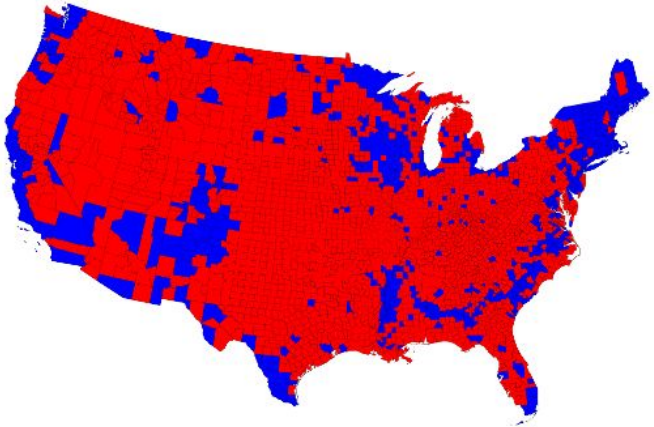

new
people
work
years
jobs
american
america
government
make
just
now
one
time
future
business
americans
tonight
want
year
last
know
need
take
come
education
congress
nation
innovation
energy
deficit
dream
republicans
spending
students
tax
two
world
success
first
every
get

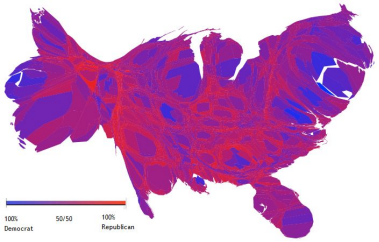
Maps


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



Maps





Trees and Networks