

# Information Visualization

## Introduction

Ming-Te Chi

moodle

Slide: <https://goolink.cc/robkC>



# Outline

- Vis Examples
- Syllabus
- News Vis
- Chapter 1

# Facebook Friendship in 2010

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ten million pairs of friends

# Covid 19 Dashboard

COVID-19 (Wuhan\_Coronavirus) Dashboard

故事地圖 [Facebook](#) [Twitter](#) [Email](#) 

全球儀表版(JHU CSSE) 全球即時案例 ICAO儀表版 美國儀表版 臺灣儀表版 日本儀表版 韓國儀表版 香港儀表版 菲律賓儀表版 世界衛生組織儀表版

JOHNS HOPKINS UNIVERSITY & MEDICINE CORONAVIRUS RESOURCE CENTER Home Tracking Testing Tracing Vaccines By Region Events & News About

Tracking Home Critical Trends Global Map U.S. Map Data in Motion

COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)

Global Cases **111,824,687**

Cases by Country/Region/Sovereignty

- 28,191,213 US
- 11,016,434 India
- 10,195,160 Brazil
- 4,142,126 Russia
- 4,138,233 United Kingdom
- 3,669,562 France
- 3,153,971 Spain
- 2,818,863 Italy
- 2,646,526 Turkey
- 2,401,212 Germany
- 2,229,663 Colombia
- 2,069,751 Argentina
- 2,043,632 Mexico
- 1,648,962 Poland

Last Updated at (M/D/YYYY)  
2/23/2021 9:23 下午

192 countries/regions

Global Deaths **2,476,668**

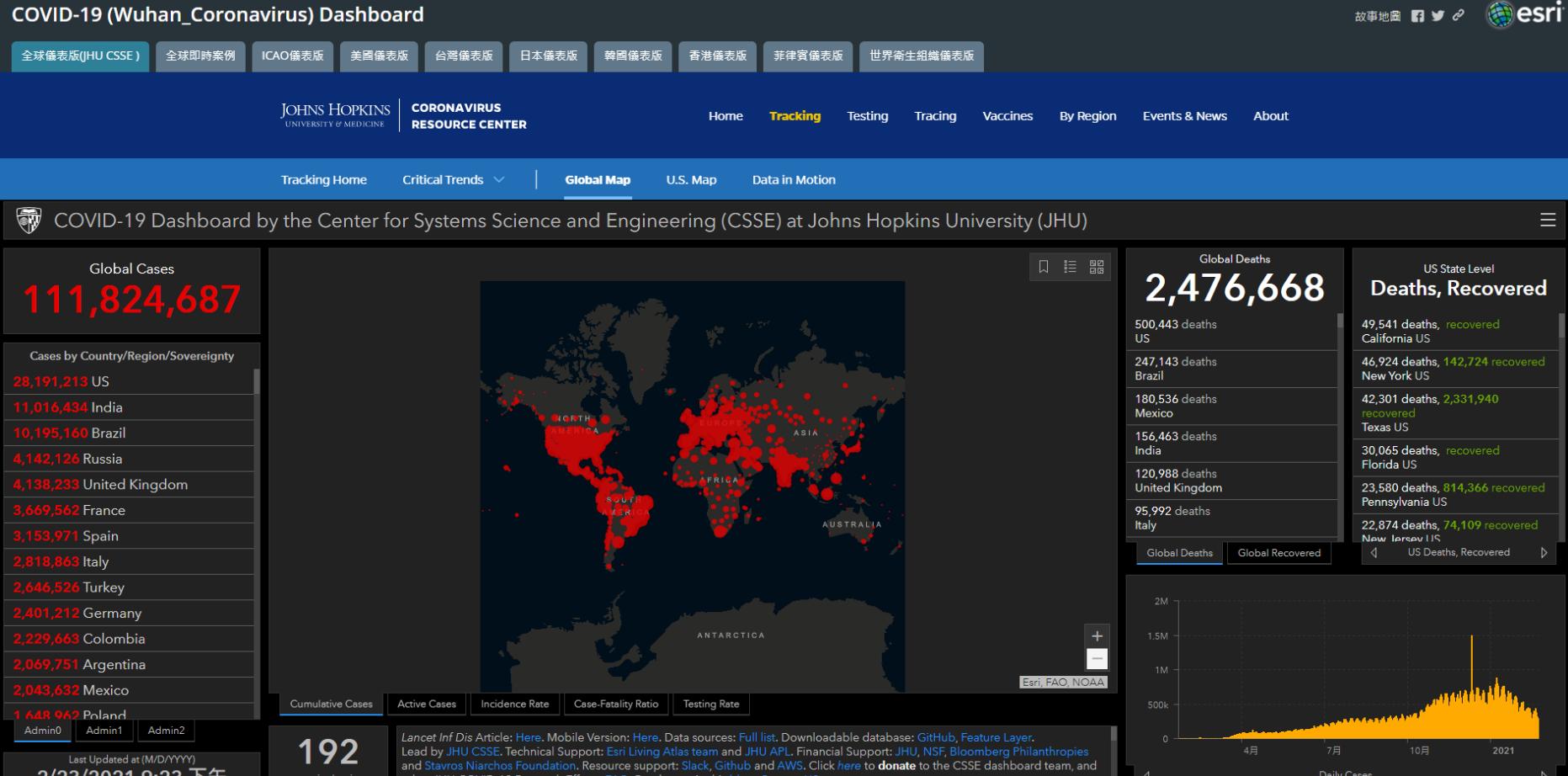
US State Level Deaths, Recovered

- 49,541 deaths, recovered California US
- 46,924 deaths, 142,724 recovered New York US
- 42,301 deaths, 2,331,940 recovered Texas US
- 30,065 deaths, recovered Florida US
- 23,580 deaths, 814,366 recovered Pennsylvania US
- 22,874 deaths, 74,109 recovered New Jersey US

Global Deaths Global Recovered

Daily Cases

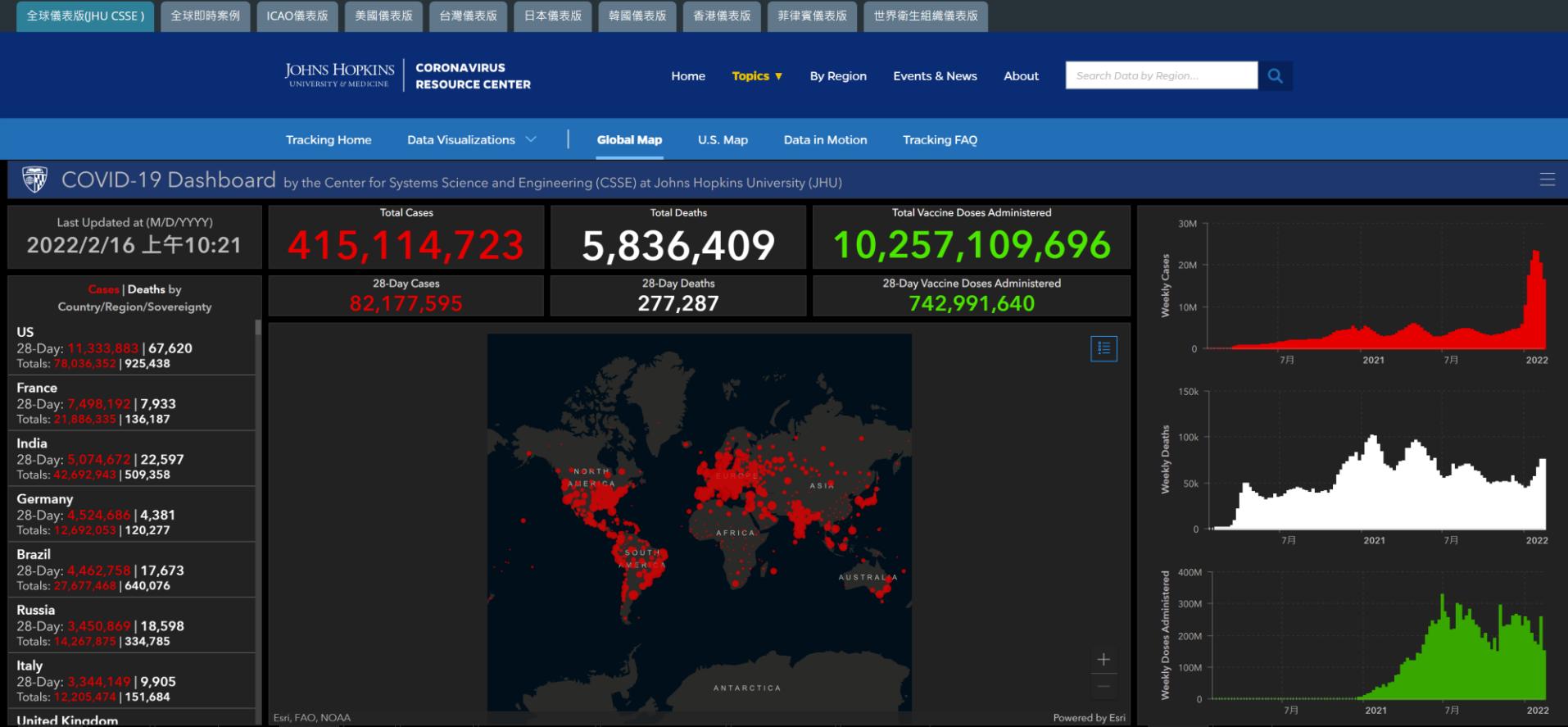
Lancet Inf Dis Article: [Here](#). Mobile Version: [Here](#). Data sources: [Full list](#). Downloadable database: GitHub, Feature Layer. Lead by JHU CSSE. Technical Support: Esri Living Atlas team and JHU APL. Financial Support: JHU, NSF, Bloomberg Philanthropies and Stavros Niarchos Foundation. Resource support: Slack, Github and AWS. Click [here](#) to donate to the CSSE dashboard team, and other JHU COVID-19 Research Efforts. [FAQ](#). Read more in this blog. [Contact US](#).



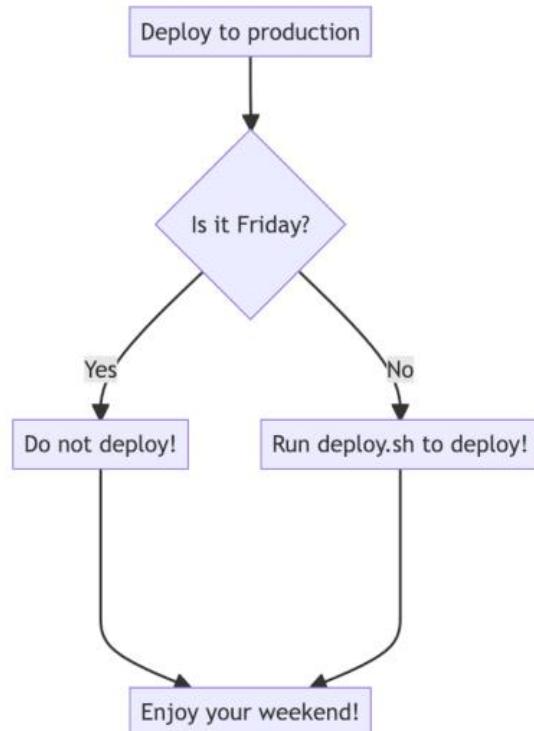
# Covid 19 Dashboard

## COVID-19 (Wuhan\_Coronavirus) Dashboard

故事地圖   



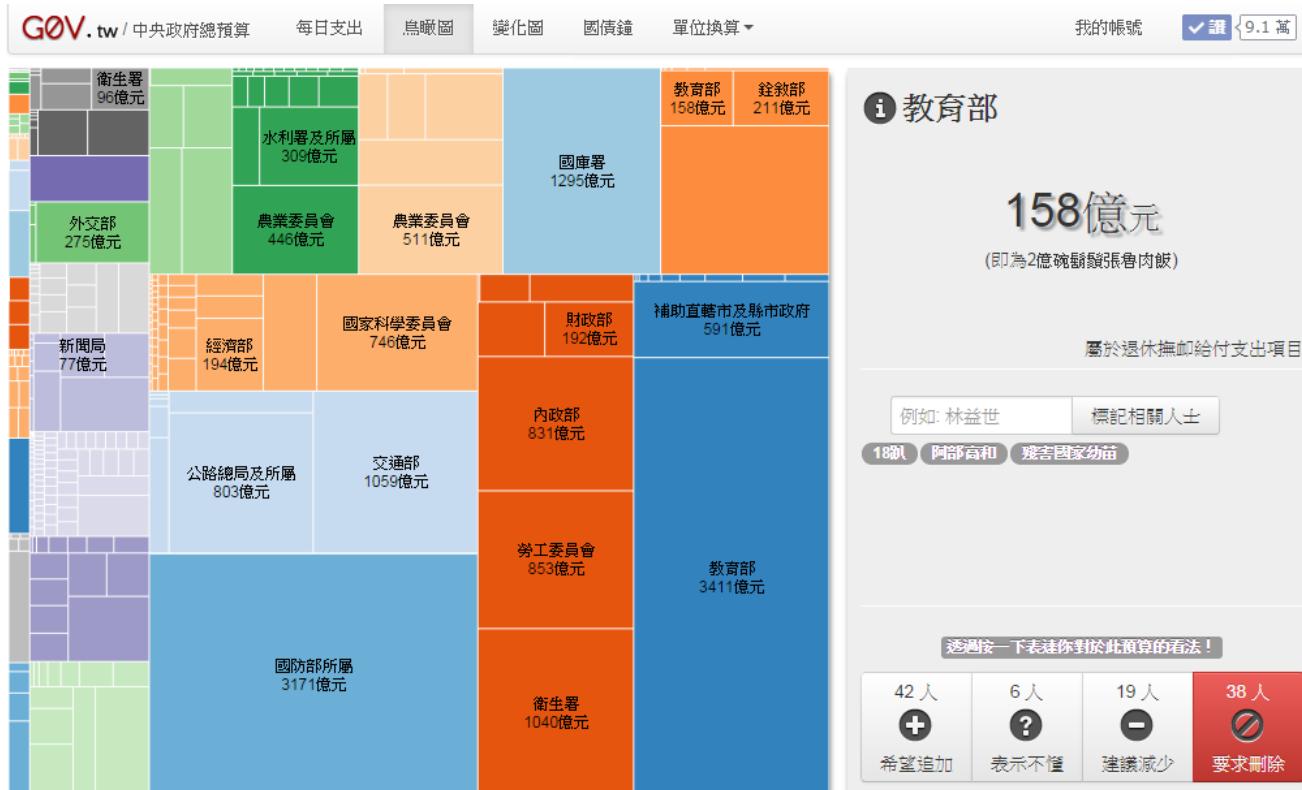
# Diagrams



<> Edit file Preview

```
1  ## How to deploy
2
3  ````mermaid
4  flowchart TD
5  A[Deploy to production] --> B{Is it Friday?};
6  B -- Yes --> C[Do not deploy!];
7  B -- No --> D[Run deploy.sh to deploy!];
8  C ----> E[Enjoy your weekend!];
9  D ----> E[Enjoy your weekend!];
10 ...
11
```

# g0v 中央政府總預算



# g0v全國重度級急救責任醫院急診即時訊息

全國急診即時看版

關於本司 組織架構

2014/09/9 14:25:28

全文檢索 檢索 進階

現在位置：醫事司／全國重度級急救責任醫院

建檔日期：2014/09/09  
更新時間：2014/09/09

全國重度級急救責任醫院

資料來源：醫事司

瀏覽人數：702103

縣市別

宜蘭縣

基隆市

台北市

台北市

台北市

Gov 零時政府開發中

全國重度級急救責任醫院急診即時訊息

JHNG: hospital : 060160016

Zoom Out 12 hours ago to a few seconds ago refreshed every 15m

等待住院病人數

自訂更新頻率

依照類型顯示

依照醫院顯示

滿床通報

資料來源：衛服部網站暨各醫院 <http://bit.ly/1q361pB>

資料來源：衛服部網站暨各醫院 <http://bit.ly/1q361pB> 鐘會自動更新

附設醫院校和醫院 | English | 圖書館 | 員工信箱 | 員工園區

責任醫院急診即時資訊

情危急程度看診，不完全以掛號時間順序

候就診時請勿喧囂，以維持診間安靜。  
請口置。  
幾、飲水機，急診大廳外有公用電話可供使用。  
、便盆或尿壺請洽護理站或服務台。  
作人員，我們將為您服務。  
您無法繼續留院觀察，請依醫護人員指示辦理離院。

三軍總醫院附設民眾診療服務處

# g0v 政治獻金

政治獻金會計報告書查詢閱制度電腦系統查詢結果列印清單						
專戶名稱：第1屆新北市市長候選人朱立倫政治獻金專戶						
列印日期：103年05月22日 144523:09:24G 第 1 頁 / 共 23 頁						
序號	交易日期	收支科目	捐贈者/支出對象	身分證/統一編號	收入金額	支出金額
1	099/11/30	人事費用支出	邱○欽		500	是 ****
2	099/11/30	人事費用支出	張○玉		500	是 ****
3	099/11/30	人事費用支出	陳○穎		500	是 ****
4	099/11/30	人事費用支出	黃○玲		500	是 ****
5	099/11/30	人事費用支出	陳○威玉		500	是 ****
6	099/11/30	人事費用支出	吳○金蘭		500	是 ****
7	099/11/30	人事費用支出	陳○誠		500	是 ****
8	099/11/30	人事費用支出	黃○樹		500	是 ****
9	099/11/30	人事費用支出	林○仰		500	是 ****
10	099/11/30	人事費用支出	王○桂		500	是 ****
11	099/11/30	人事費用支出	陳○榕		500	是 ****
12	099/11/30	人事費用支出	張○望		500	是 ****
13	099/11/30	人事費用支出	邱○曉		500	是 ****
14	099/11/30	人事費用支出	李○智		500	是 ****
15	099/11/30	人事費用支出	張○明		500	是 ****
16	099/11/30	人事費用支出	張○宜		500	是 ****
17	099/11/30	人事費用支出	李○玉		500	是 ****
18	099/11/30	人事費用支出	黃○和		500	是 ****
19	099/11/30	人事費用支出	王○月		500	是 ****
20	099/11/30	人事費用支出	石○東		500	是 ****

本件資料係依申報人網路申報資料或其中報之紙本資料建檔產生，如有錯誤，以中報人申報之資料為準。

本政治獻金資料僅供學術交流使用，嚴禁營利、徵信，或其他不正當目的之使用

24 小時內，2,637 份文件 = 309,666 筆政治獻金辨識完成  
感謝各位鄉民踴躍參與 Otaku Character Recognition !

## 政治獻金數位化

鄉民一起來

目前資料已經有 309666 筆

## API

取得指定頁所有欄位的值

<http://campaign-finance.g0v.ctim1.tw/api/getcells/1100>

取得單一欄位的值

<http://campaign-finance.g0v.ctim1.tw/api/getcellvalue/1100/1>

取得已經處理完成的頁面列表(2637 / 2637)

<http://campaign-finance.g0v.ctim1.tw/api/getdonepages>

請填入圖片中的數字、文字或日期

阿波快速輸入

第 2049 頁 (16, 5) 已經有 1 人填寫標題了。目前答案：[09148861](#) | 請答案須額



資料要開放 監督才透明！

鄉民要團結 OCR真有力！

g0v

# g0v 政治獻金視覺化 (2014)

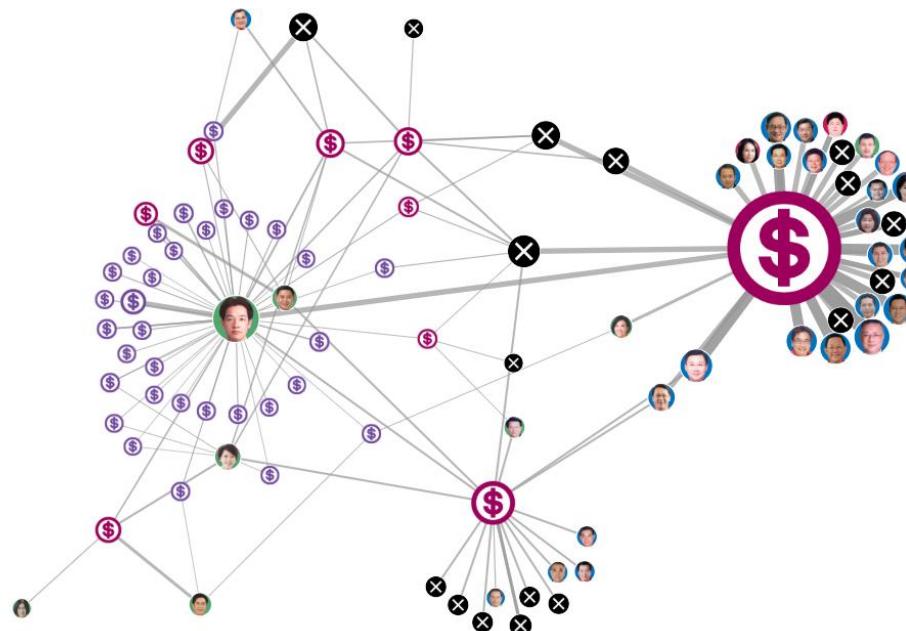


# 數讀政治獻金2.0 (2018)

第 L/四

READr

## 營利事業捐贈關係圖



- 民主進步黨
- 中國國民黨
- 無黨團結聯盟
- 未當選立委
- 金流多寡
- 總額多寡
- 集團
- 公司

搜尋候選人、集團、公司名稱

### 賴清德的營利事業捐贈排名

1. 亞利通運	\$1,000,000
2. 遠東集團 ►	\$1,000,000
3. 威京集團 ►	\$300,000
4. 大億企業集團 ►	\$300,000
5. 台南企業集團 ►	\$300,000
6. 丞寬企業	\$200,000
7. 台南幫集團 ►	\$200,000
8. 東陽事業集團 ►	\$200,000
9. 錦慶鋁業	\$200,000
10. 北海道超商	\$200,000
11. 寶隆建設	\$100,000
12. 儀大 ►	\$100,000
... 共 12 家	...

賴清德 (61 歲)

民主進步黨 連任



總收入 3,205.5 萬元

營利事業收入 571.1 萬元

捐贈公司數 41 家

### 政治獻金收入組成



### 誰跟賴清德的政商關係最接近

1. 陳亭妃	重複 6 家子公司
2. 王昱婷	重複 4 家子公司
3. 李俊毅	重複 4 家子公司
4. 黃偉哲	重複 2 家子公司
5. 高思博	重複 2 家子公司
6. 郭玟成	重複 2 家子公司
7. 林益世	重複 1 家子公司
8. 葉宜津	重複 1 家子公司
9. 余政憲	重複 1 家子公司
10. 林郁方	重複 1 家子公司
11. 鍾紹和	重複 1 家子公司
12. 吳光訓	重複 1 家子公司

### 營利事業產業組成

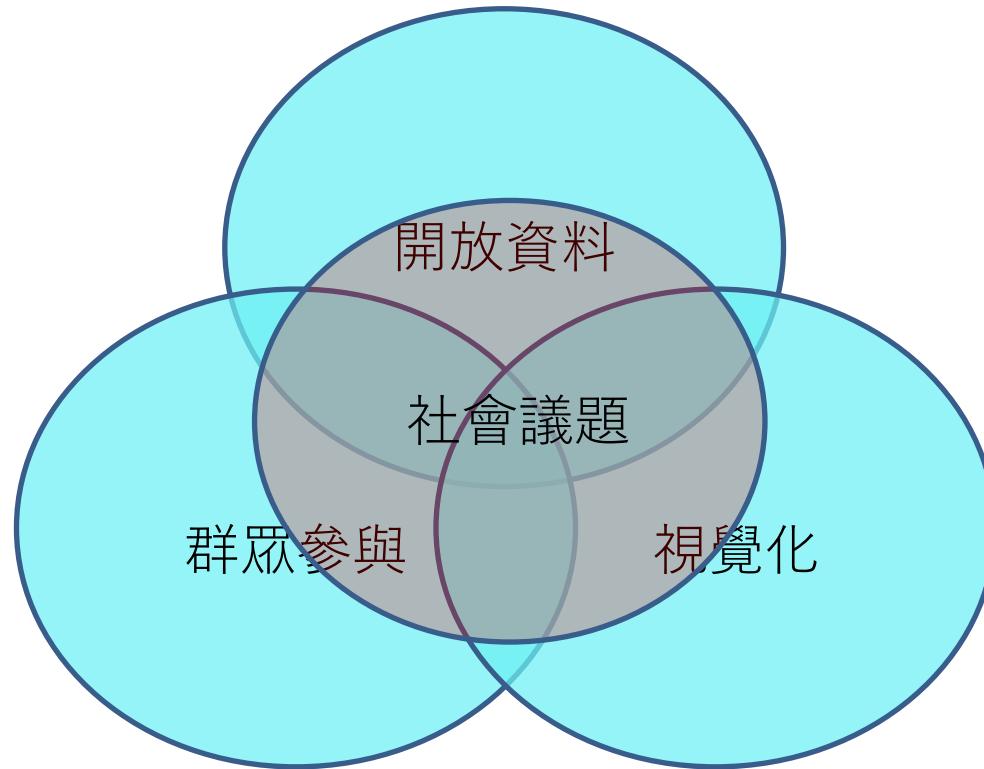


### 營利事業選區內 / 選區外



### 營利事業選區縣市 / 外縣市





# Neural Network Visualization



Epoch  
000,000

Learning rate  
0.03

Activation  
Tanh

Regularization  
None

Regularization rate  
0

Problem type  
Classification

## DATA

Which dataset do you want to use?



Ratio of training to test data: 50%

Noise: 0

Batch size: 10

**REGENERATE**

## FEATURES

Which properties do you want to feed in?

- $X_1$
- $X_2$
- $X_1^2$
- $X_2^2$
- $X_1 X_2$
- $\sin(X_1)$
- $\sin(X_2)$

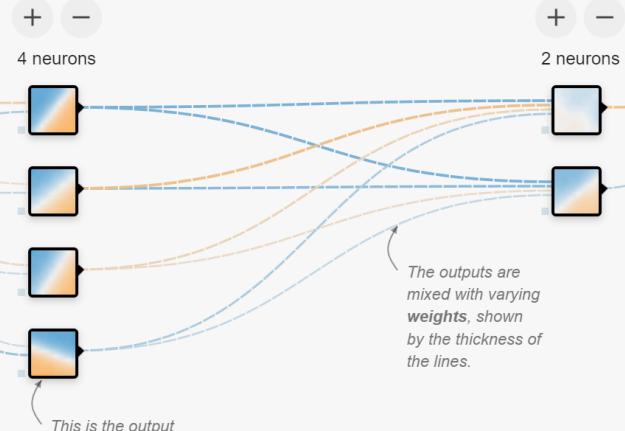


2 HIDDEN LAYERS



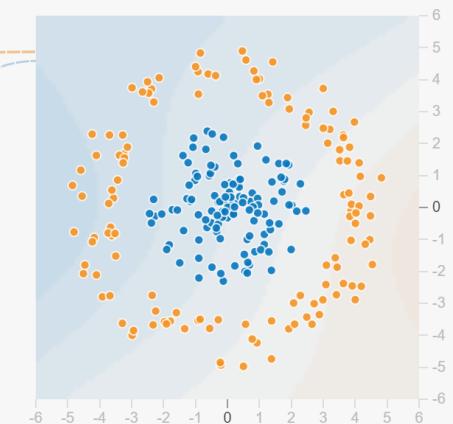
4 neurons

2 neurons



## OUTPUT

Test loss 0.501  
Training loss 0.503



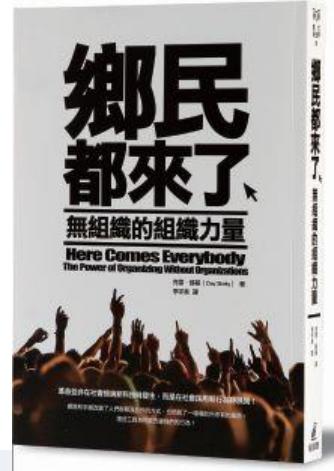
Colors shows data, neuron and weight values.

Show test data

Discretize output

# Trend

- Big data and open data



## 開放資料與資訊科技的群眾參與

- html5 web platform for interactive display

# **SYLLABUS**

# Definition

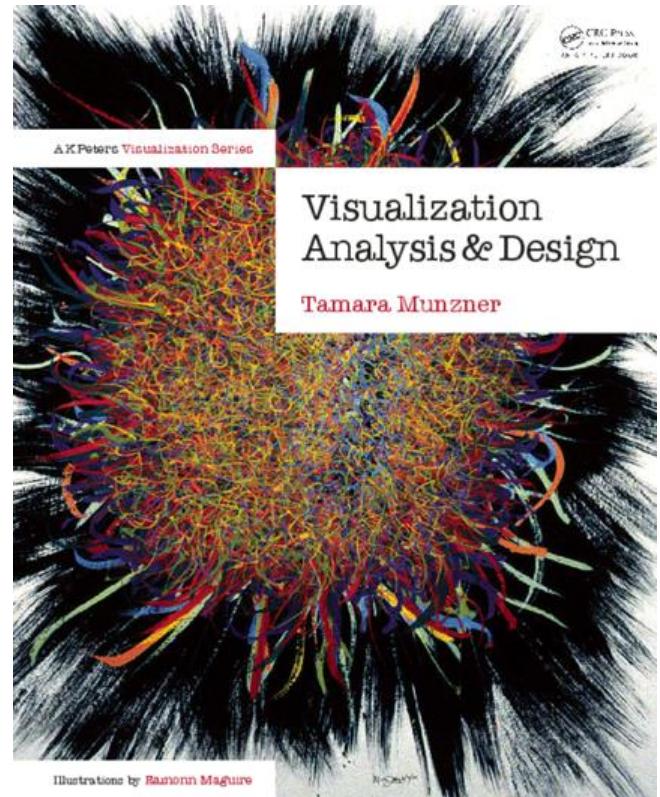
- The use of computer-generated, interactive, visual representations of data to amplify cognition.  
[Card, Mackinlay, & Shneiderman 1999]
- Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.  
Tamara Munzner

# Text book

*Visualization Analysis and Design.*

Munzner.

A K Peters Visualization Series, CRC  
Press, Visualization Series,  
2014.



# Content

- Visualization Analysis Framework
  - Analysis: What, Why, How
- Spatial Layout
- Color & Interaction
- Guidelines and Examples
- Tooling mechanics / programming
  - D3, JavaScript, CSS, HTML5

# Why is validation difficult?

- different ways to get it wrong at each level

## ⚠ Domain situation

You misunderstood their needs

## 💡 Data/task abstraction

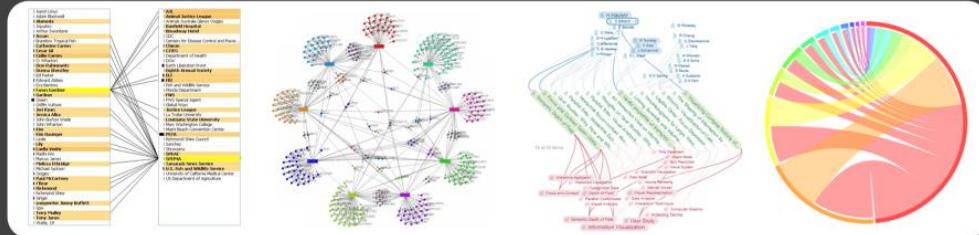
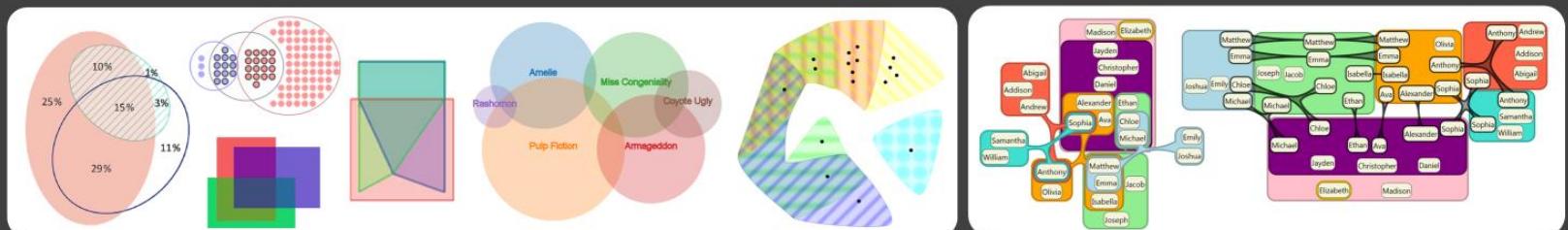
You're showing them the wrong thing

## 👀 Visual encoding/interaction idiom

The way you show it doesn't work

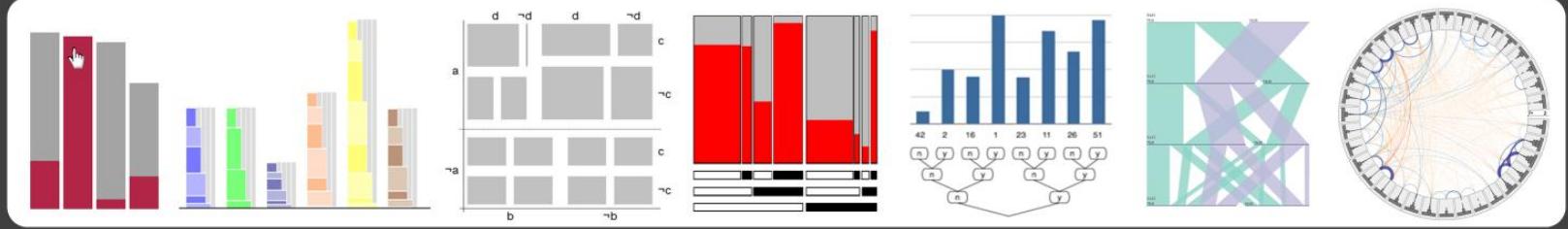
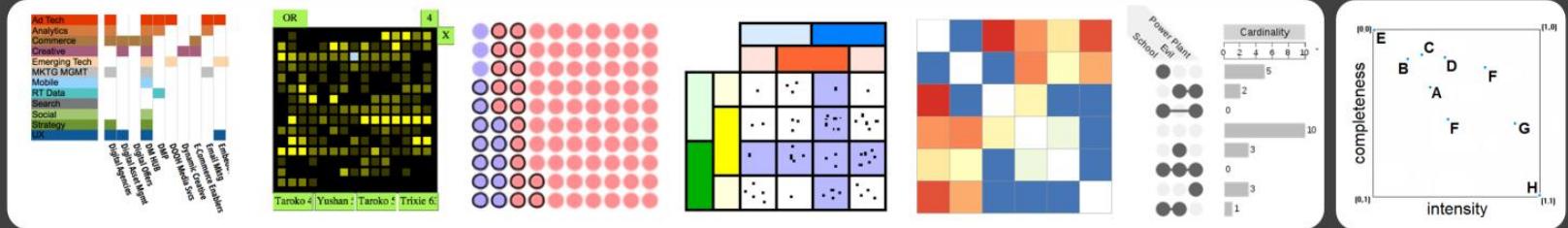
## ☒ Algorithm

Your code is too slow



# SetViz.net

Visualizing Sets and Set-typed Data



# Grading

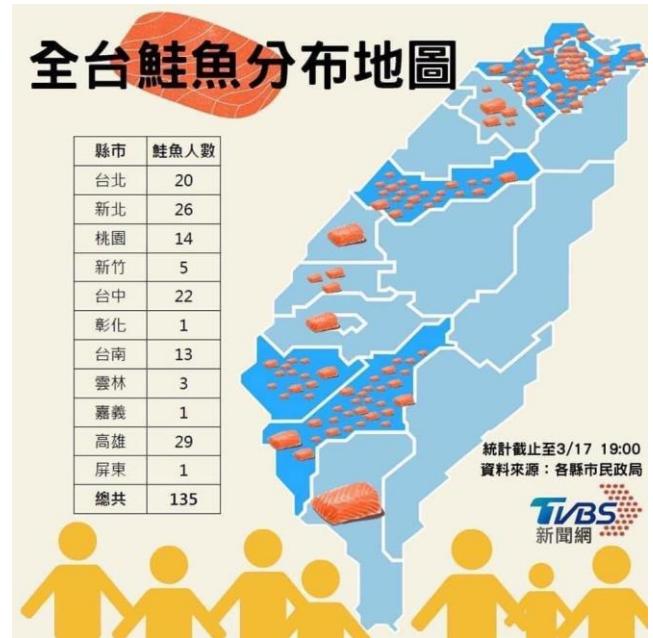
- Homework (40%)
- Paper Presentation/report (20%)
- Final Projects (40%)

# Homework (40%)

- HW1: Basic visualization using D3.js
- HW2: Advance visualization using D3.js

# Homework (40%)

- HW3: News visualization  
(team work 1~3 people)
  - Find a news/article with visualization
  - Find the weakness
  - Improve or recreate the visualization



# 數據看台灣



用數據看台灣

台灣開放即時資料

台灣開放統計資料

世界即時資訊

世界統計資訊

開放資料分析部落格

關於我們



# Paper Presentation/report (20%)

## **Week13~week16**

before one of the classes: you each read paper  
on topic of your choice

- during that class: you present it to everybody else (~10 min)

# Final Projects (40%)

- group of 3 ~ 5
- Stages
  - pitches (oral, in class):
  - proposals (written):
  - Progress Presentations:
  - Final presentation(oral and report):

# Final Projects

- **Programming**
  - common case
  - three types
    - problem-driven design studies (target specific task/data)
    - technique-driven (explore design choice space for encoding or interaction idiom)
    - algorithm implementation (as described in previous paper)
- **Analysis**
  - analyze a dataset/problem **using a variety of existing visualization tools** of your choosing, as well as analyze the strengths and weaknesses of those tools and discuss in detail
  - this option is suitable for non-CS students

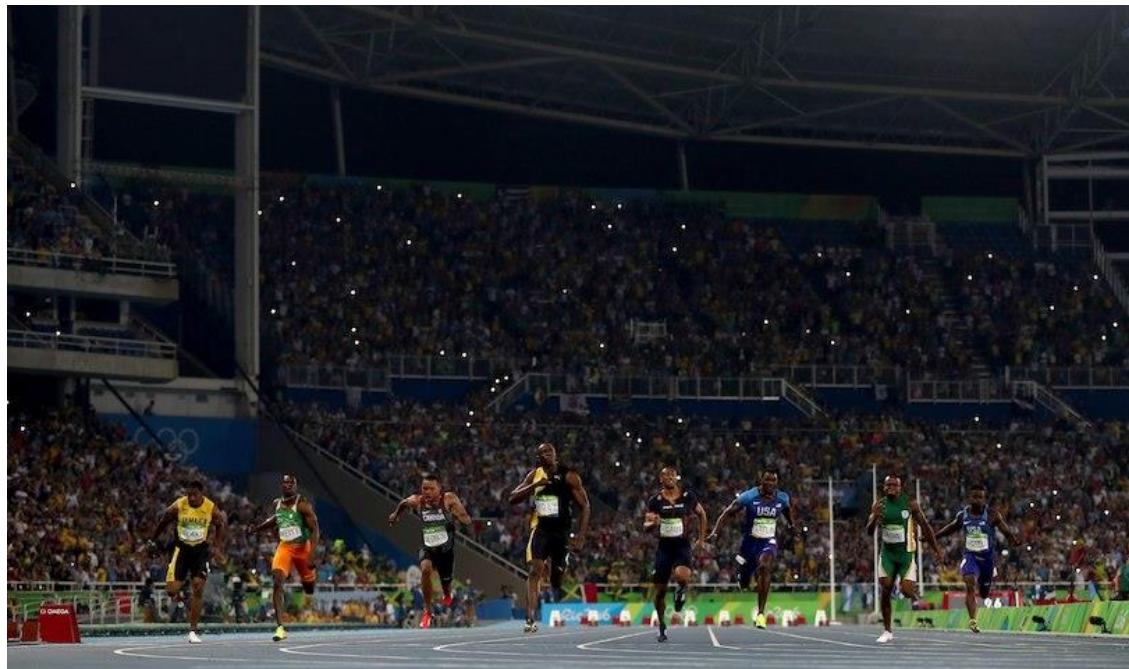
# **NEWS VISUALIZATION**

# NY Times - Men's 100-Meter Sprint

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- Olympic 2012

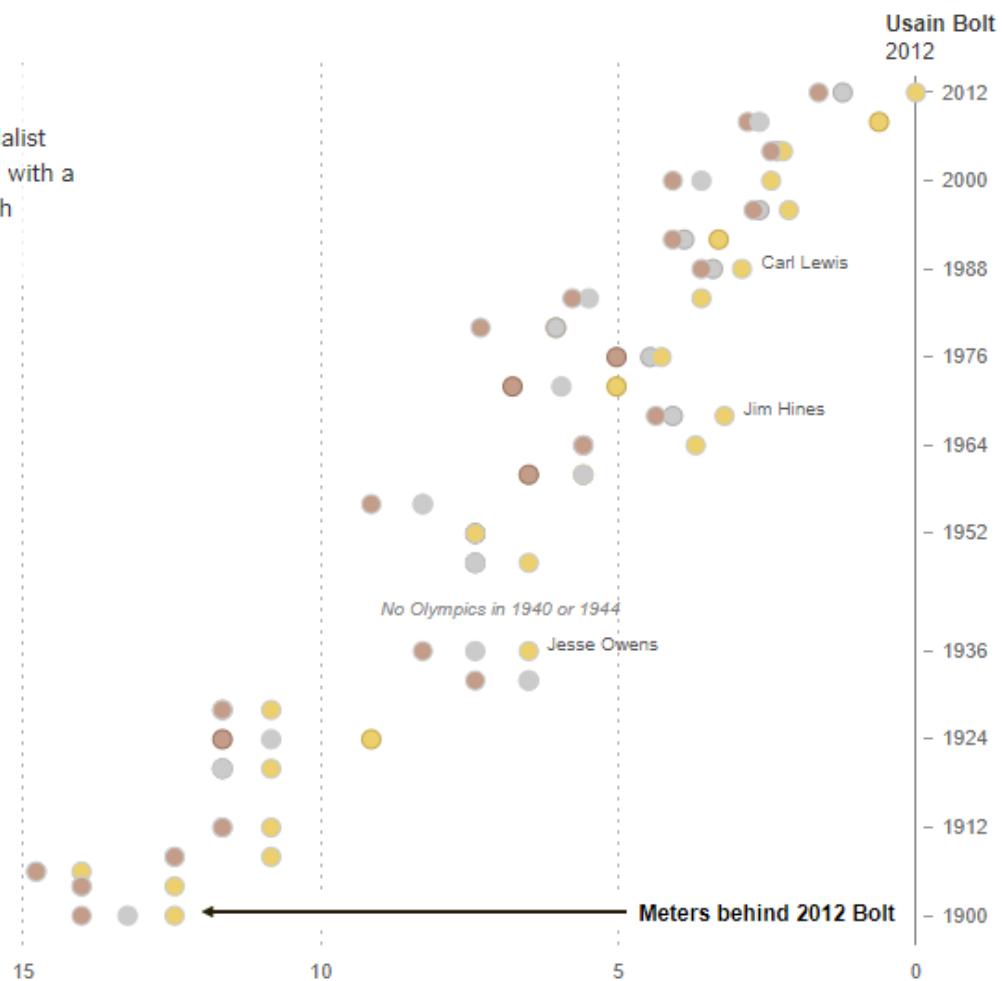
	Gold	Silver	Bronze
2012	9.63	9.75	9.79
2008	9.69	9.89	9.91
2004	9.85	9.86	9.87
...			



## Usain Bolt vs. 116 years of Olympic sprinters

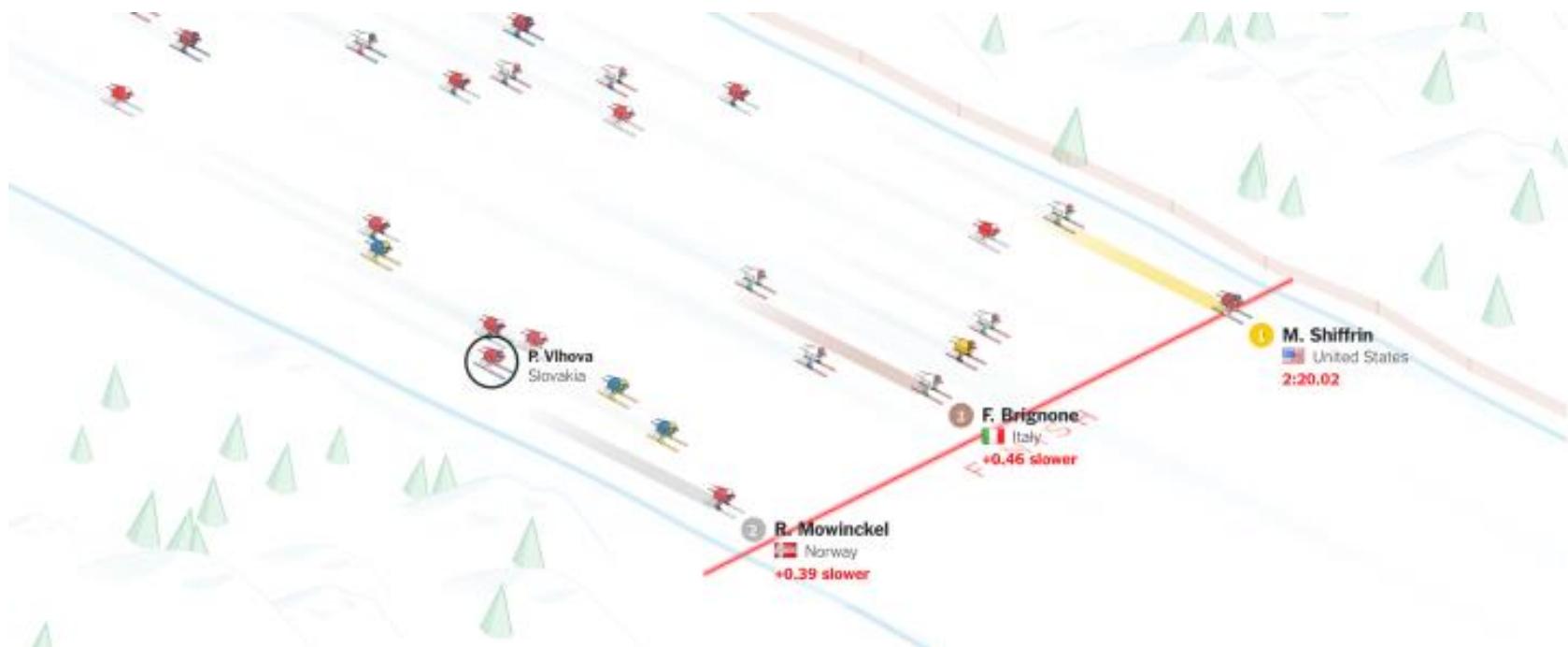
Based on the athletes' average speeds, if every Olympic medalist raced each other, Usain Bolt (the London version) would win, with a wide distribution of Olympians behind him. Below, where each sprinter would be when Bolt finishes his race.

MEDALS BY COUNTRY			
United States	40	Barbados	1
Britain	8	Bulgaria	1
Jamaica	7	Hungary	1
Canada	5	Netherlands	1
Trinidad and Tobago	4	New Zealand	1
Australia	3	Panama	1
Germany	3	Portugal	1
Cuba	2	South Africa	1
Namibia	2	United Team of Germany	1
Soviet Union	2		



This chart includes medals for the United States and Australia in the "Intermediary" Games of 1906, which the I.O.C. does not formally recognize.

# Mikaela Shiffrin pulling away for gold



數位敘事

互動

動畫

# How Uber Uses Psychological Tricks to Push Its Drivers' Buttons



互動

模擬

遊戲

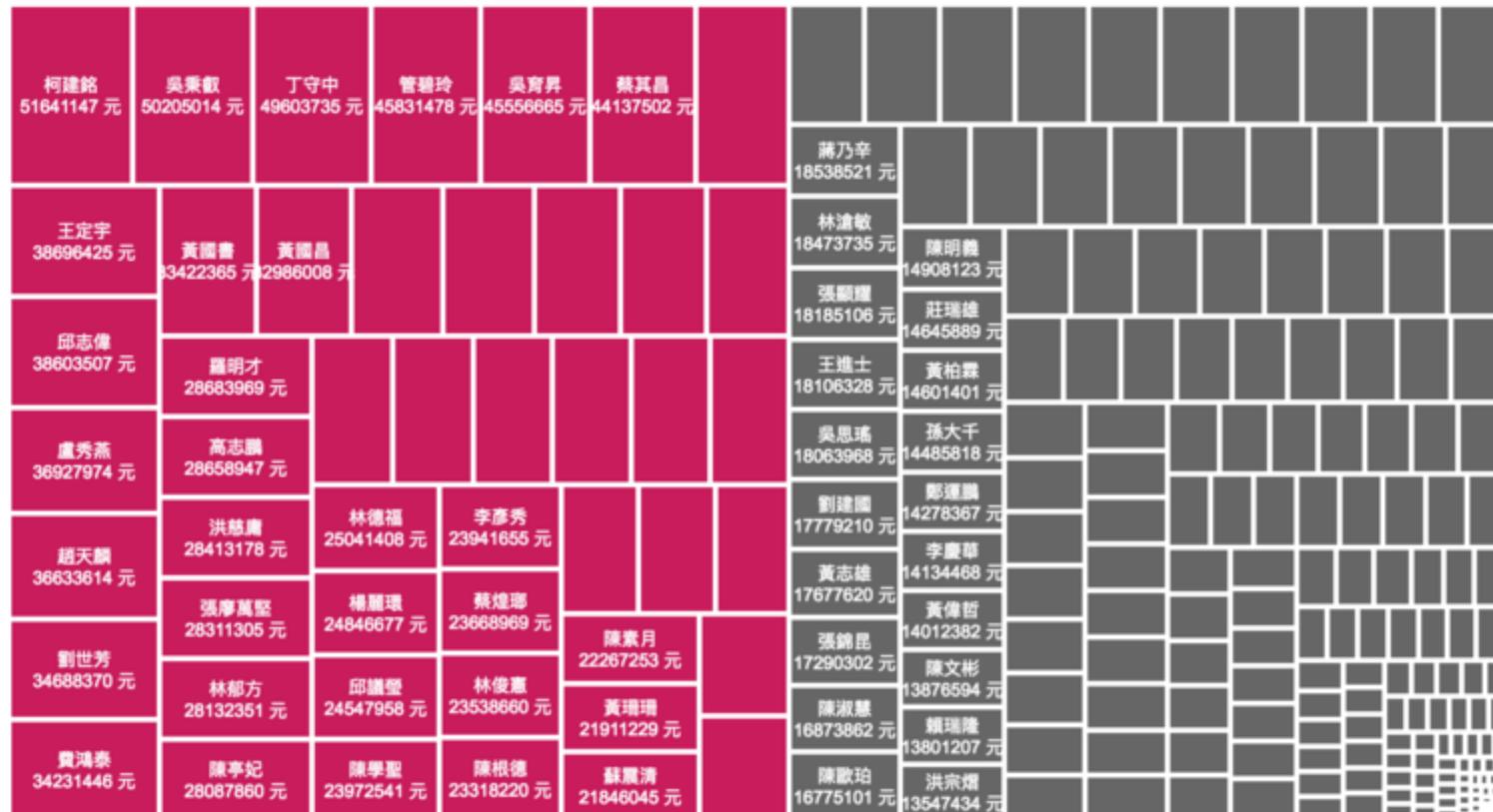
# 鏡周刊-數讀政治獻金

## 第一次參選公職者獻金收入前十名

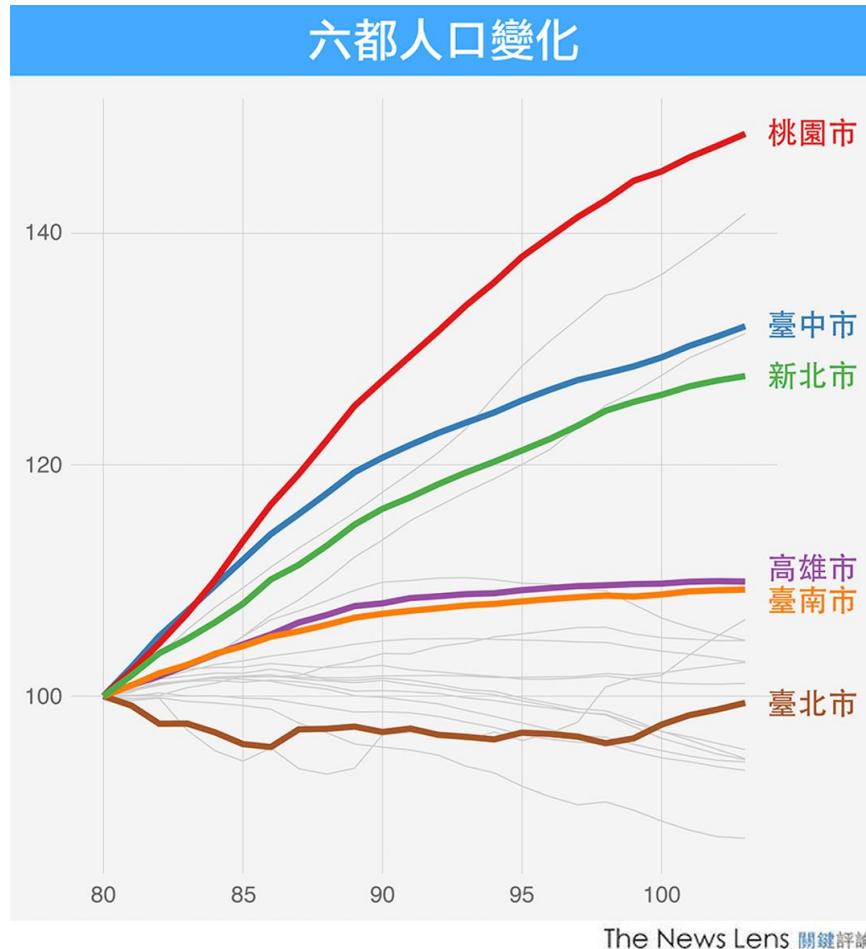
● 中國國民黨 ● 民主進步黨 ● 時代力量

排名	姓名	政治獻金總收入	營利事業 佔總收入比	當選	政治世家（註）
1	● 黃國昌	32,986,008	14.93%	∅	
2	● 洪慈庸	28,413,178	17.59%	∅	
3	● 蘇巧慧	20,398,298	32.89%	∅	✓
4	● 鍾易仲	16,367,803	15.21%		✓
5	● 張鎔麒	15,464,175	54.05%		✓
6	● 陳文彬	13,876,594	39.09%		
7	● 賴瑞隆	13,801,207	47.6%	∅	
8	● 蔣萬安	13,466,432	30.63%	∅	✓
9	● 林昶佐	12,580,453	19.51%	∅	
10	● 黃韻涵	10,241,024	30.72%		✓

## 48 名候選人（20%）掌握了 50% 的政治獻金



# 關鍵評論-中南部人口減少有多嚴重？



# Dashboard



Tesla Model S



COCKPIT DISPLAY



SPACEX- CREW DRAGON DISPLAYS



# InfoVis Resource

- [NY Times - Flowingata](#)
- [Information is beautiful awards](#)
- [D3.js - gallery](#)

d3js.org  
Bring your data to life.

By Mike Bostock Published Feb 5, 2020 ISC 18 forks 1 collection 408 likes

Fork Up Heart ...

## Gallery

Looking for a good D3 example? Here's a few (okay, 168...) to peruse.

### Animation

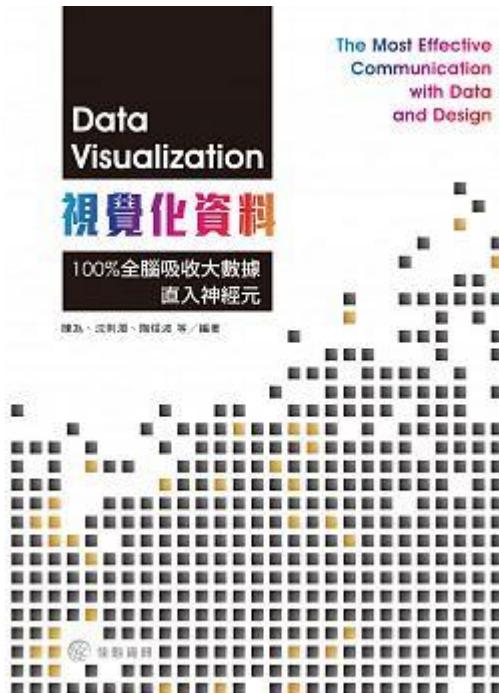
D3's [data join](#), [interpolators](#), and [easings](#) enable flexible animated transitions between views while preserving [object constancy](#).

The visualizations include:

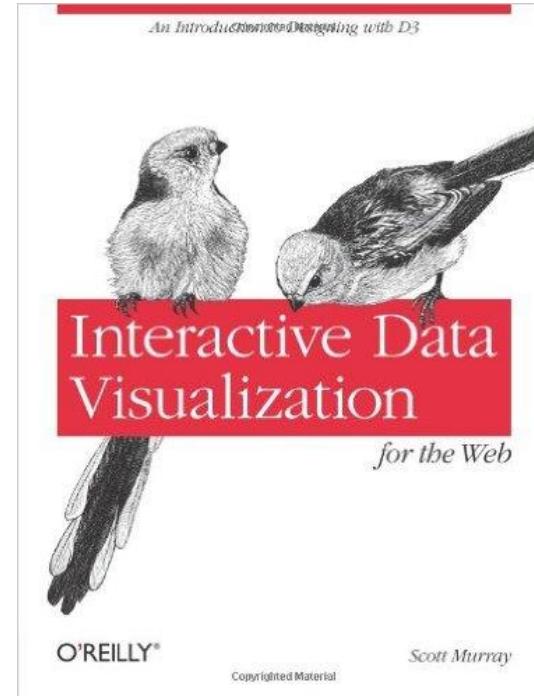
- Animated treemap
- Temporal force-directed graph
- Connected scatterplot
- The wealth & health of nations
- Scatterplot tour
- Bar chart race
- Stacked-to-grouped bars
- Streamgraph transitions
- Smooth zooming
- Zoom to bounding box
- Orthographic to equirectangular
- World tour
- Walmart's growth
- Hierarchical bar chart
- Zoomable treemap

# **RESOURCE**

# Reference book



視覺化資料 – 100% 全腦吸收大  
數據，直入神經元。  
陳為、沈則潛、陶煜波。  
佳魁資訊。2014



**Interactive Data Visualization for  
the Web: An Introduction to  
Designing with D3**  
Scott Murray  
O'Reilly Media; 1 edition (April 5,  
2013) (2ed Oct, 2017)

# Reference conference

- IEEE VIS conference
  - VAST, InfoVis, SciVIs
- IEEE PacificVis
- ACM Siggraph

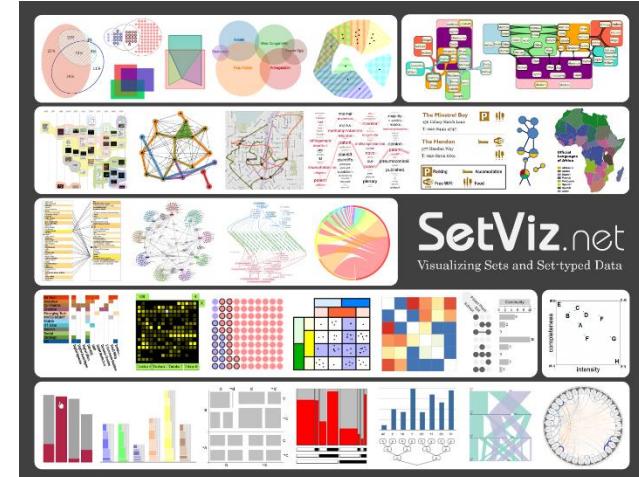
# SciVis

- continuous data
- inherent spatial position
- from computer graphics
- algorithmic focus



# InfoVis

- discrete data
- abstract
- from HCI
- usability focus



# Reference

- Stanford Vis Group
  - <http://vis.stanford.edu/papers/>
- UC Davis center for visualization
  - <http://vis.ucdavis.edu/>
- 浙江大学可视分析小组
  - <http://www.cad.zju.edu.cn/home/vagblog/>

Chapter 1

# **INTRODUCTION**

# Definition

- Computer-based **visualization** systems provide visual representations of datasets designed to help people carry out tasks more effectively.

Tamara Munzner

- Why?
- Trade-off

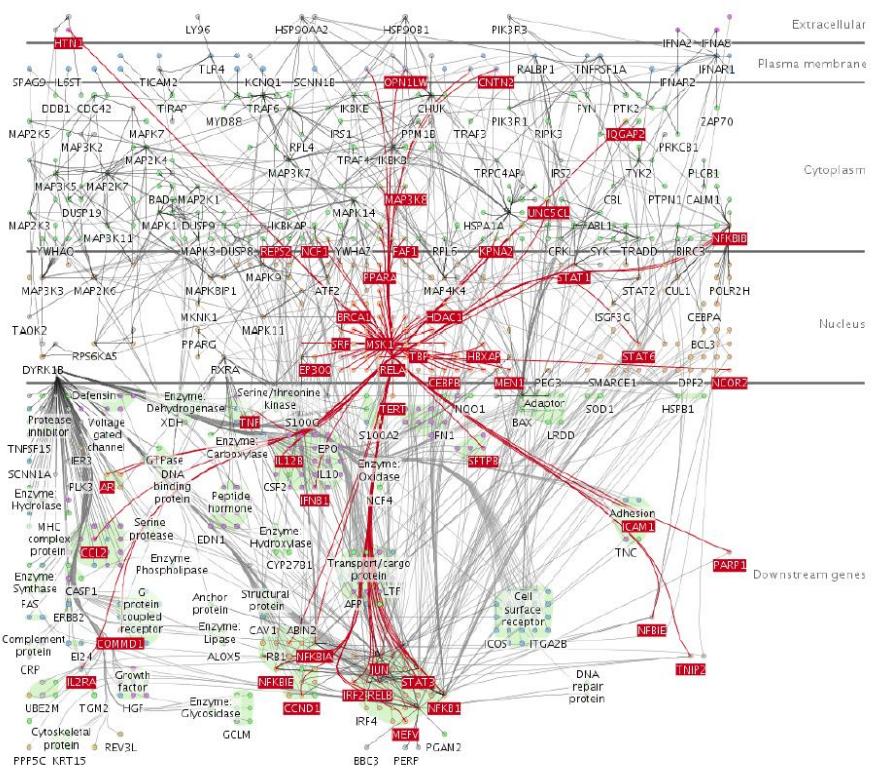
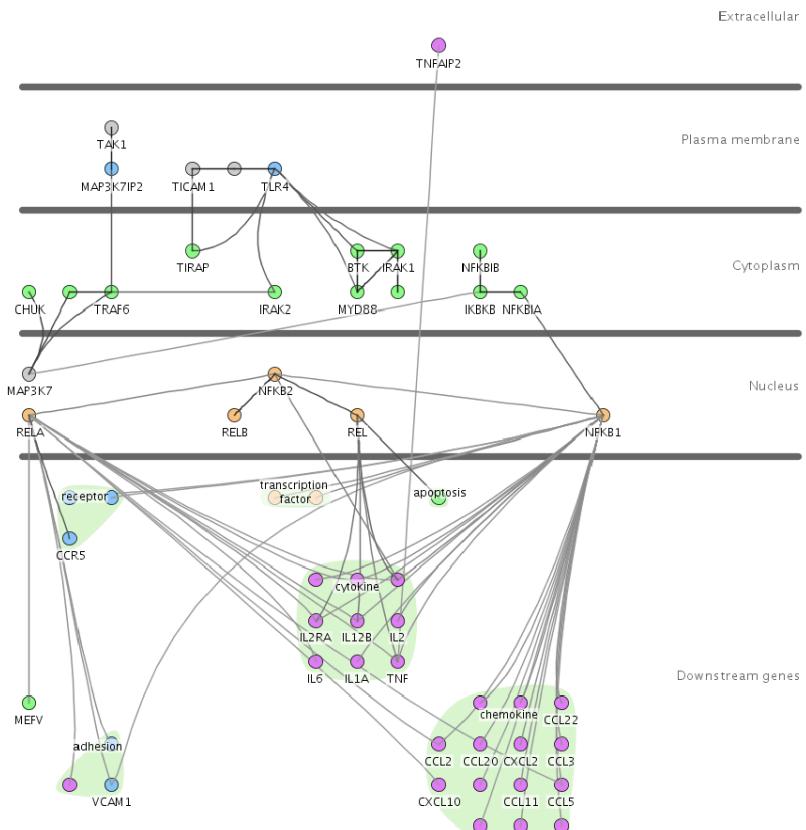
# Why have a human in the loop?

Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.

Visualization is suitable when there is a need to augment human capabilities rather than replace people with computational decision-making methods.

- don't need vis when fully automatic solution exists and is trusted
- many analysis problems ill-specified
  - don't know exactly what questions to ask in advance
- possibilities
  - long-term use for end users (e.g. exploratory analysis of scientific data)
  - presentation of known results
  - stepping stone to better understanding of requirements before developing models
  - help developers of automatic solution refine/debug, determine parameters
  - help end users of automatic solutions verify, build trust

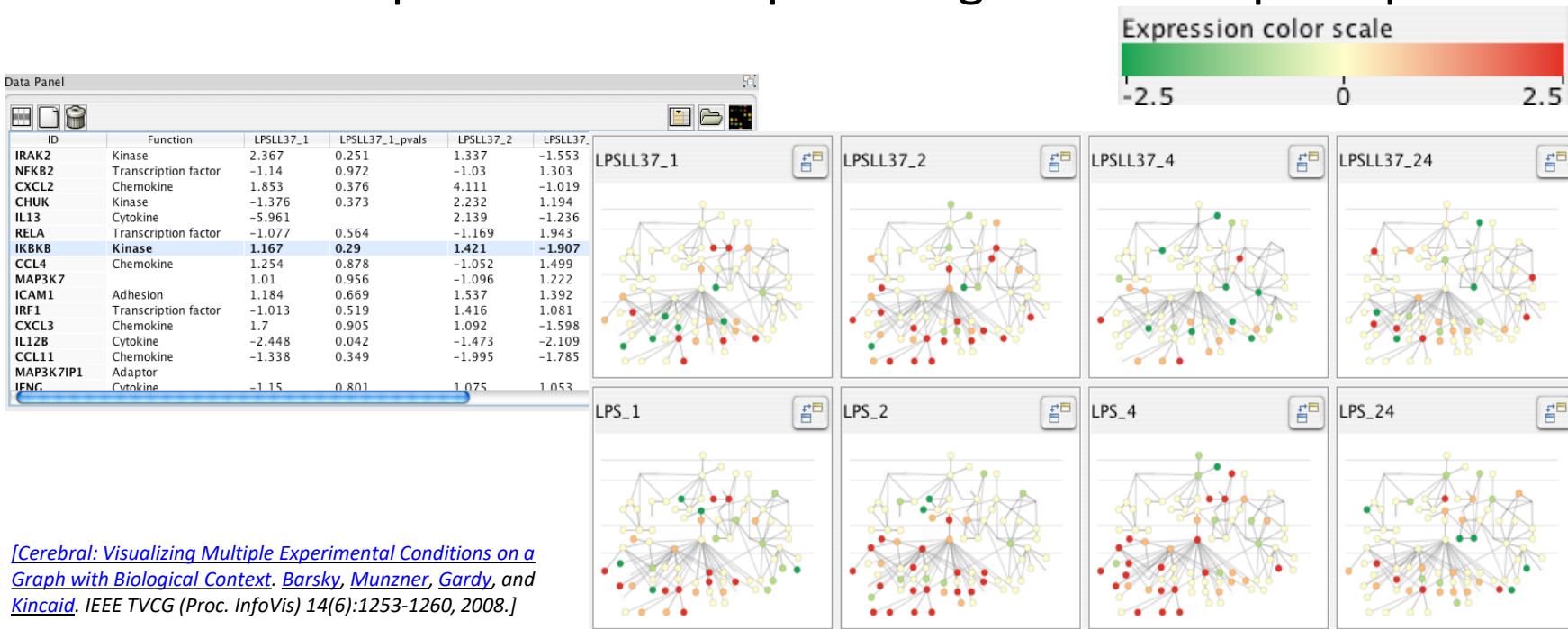
# Why have a Computer in the loop?



# Why use an external representation?

Computer-based visualization systems provide **visual representations** of datasets designed to help people carry out tasks more effectively.

- external representation: replace cognition with perception



# Why depend on vision?

Computer-based visualization systems provide **visual** representations of datasets designed to help people carry out tasks more effectively.

- human visual system is high-bandwidth channel to brain
  - overview possible due to background processing
    - subjective experience of seeing everything simultaneously
    - significant processing occurs in parallel and pre-attentively
- sound: lower bandwidth and different semantics
  - overview not supported
    - subjective experience of sequential stream
- touch/haptics: impoverished record/replay capacity
  - only very low-bandwidth communication thus far
- taste, smell: no viable record/replay devices

# Why represent all the data?

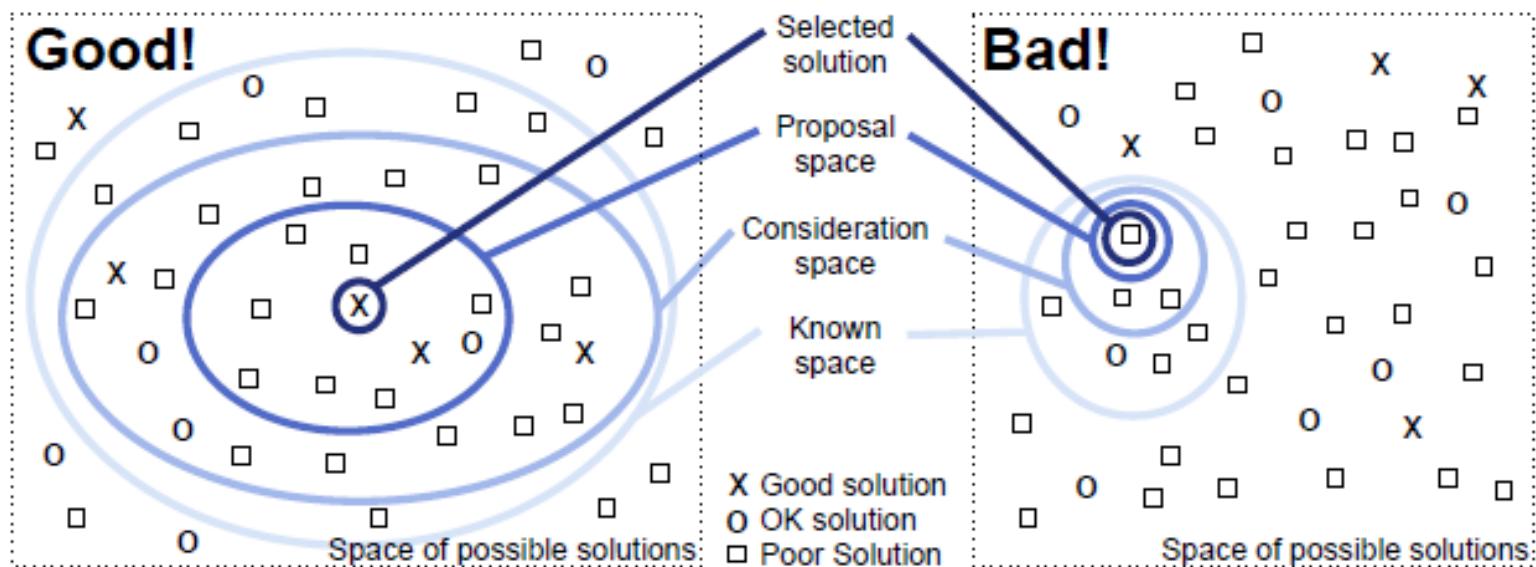
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
	10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
	8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
	13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
	9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
	11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
	14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
	6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
	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

# Why focus on tasks and effectiveness?

Computer-based visualization systems provide visual representations of datasets designed to help people carry out **tasks more effectively**.

- tasks serve as constraint on design (as does data)
  - idioms do not serve all tasks equally!
  - challenge: recast tasks from domain-specific vocabulary to abstract forms
- most possibilities ineffective
  - validation is necessary, but tricky
  - increases chance of finding good solutions if you understand full space of possibilities
- what counts as effective?
  - novel: enable entirely new kinds of analysis
  - faster: speed up existing workflows

# Why are most designs ineffective?

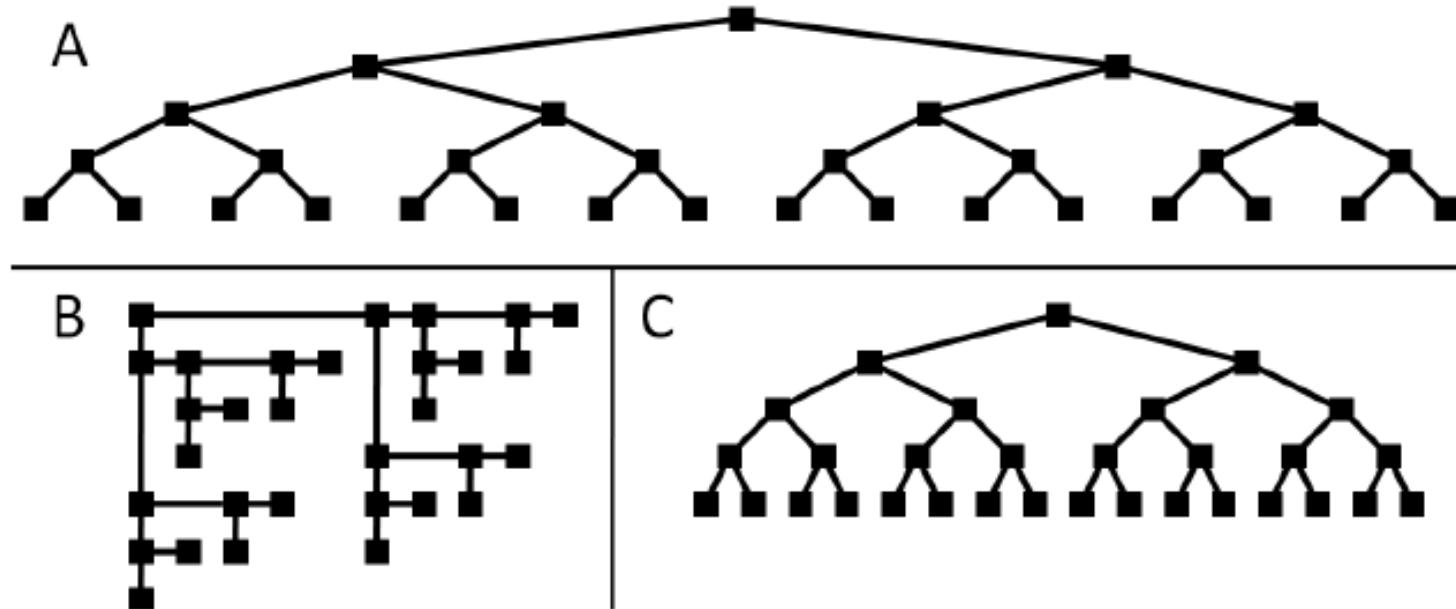


# What resource limitations are we faced with?

Vis designers must take into account three very different kinds of resource limitations: those of computers, of humans, and of displays.

- Computational limits
  - processing time
  - system memory
- Human limits
  - human attention and memory
- Display limits
  - pixels are precious resource, the most constrained resource
  - information density: ratio of space used to encode info vs unused whitespace
    - tradeoff between clutter and wasting space, find sweet spot between dense and sparse

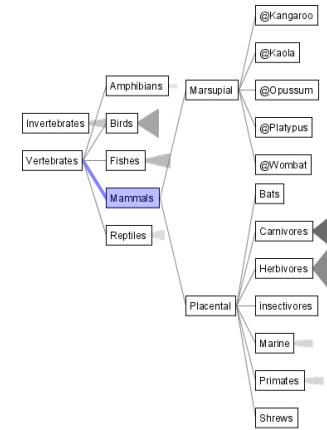
# Display limits



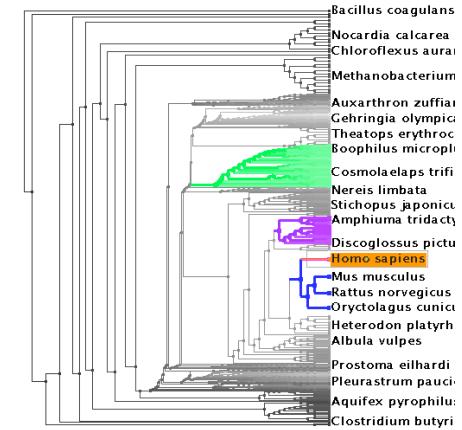
# Why analyze?

- imposes structure on huge design space
  - scaffold to help you think systematically about choices
  - analyzing existing as stepping stone to designing new
  - most possibilities ineffective for particular task/data combination

SpaceTree

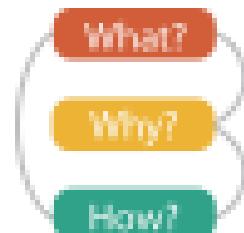
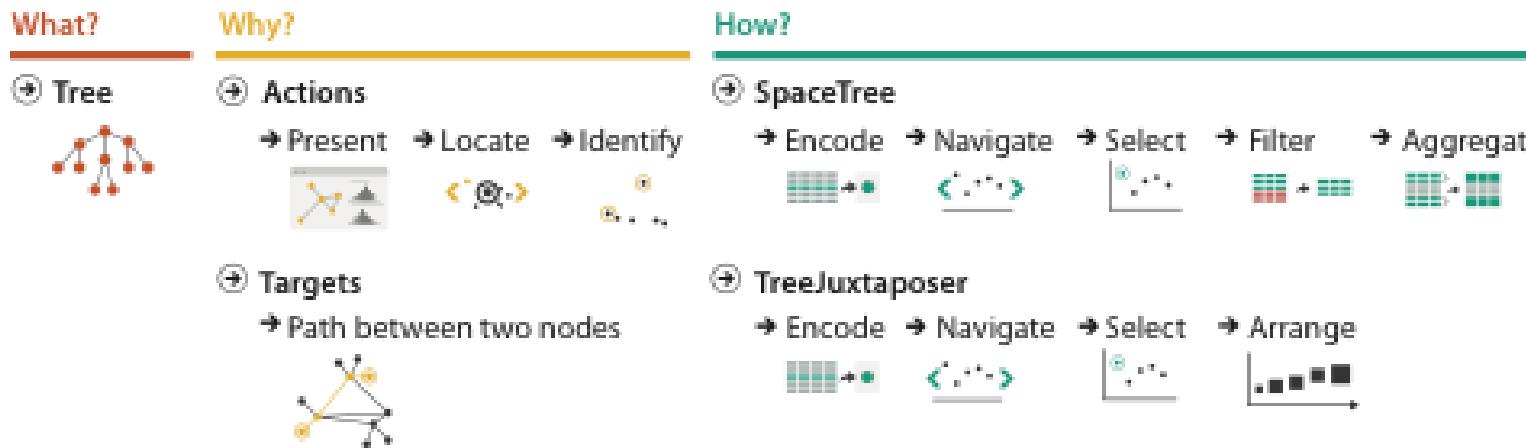


TreeJuxtaposer



[SpaceTree: Supporting Exploration in Large Node Link Tree, Design Evolution and Empirical Evaluation. Grosjean, Plaisant, and Bederson. Proc. InfoVis 2002, p 57–64.]

[TreeJuxtaposer: Scalable Tree Comparison Using Focus+Context With Guaranteed Visibility. ACM Trans. on Graphics (Proc. SIGGRAPH) 22:453–462, 2003.]



# Further reading

- Visualization Analysis and Design.  
Munzner. AK Peters Visualization Series, CRC Press, 2014.
  - *Chap 1: What's Vis, and Why Do It?*
- A Tour through the Visualization Zoo.  
Communications of the ACM, 53(6),  
pp. 59-67, Jun 2010