

Types de données et représentations

Sylvain Malacria

Size



cartogram

qualitative differences

Color Hue



qualitative differences

Color Value



quantitative differences

Color Intensity



qualitative differences

Master 2 IVI

qualitative &

Note: Transparents réalisés par Fanny Chevalier et très largement inspirés des cours de Petra Isenberg, Jean-Daniel Fekete, Pierre Dragicevic, Wesley Willet et Frédéric Vernier (www.aviz.fr) et Jeffrey Heer (<http://courses.cs.washington.edu/courses/cse512/14wi/>).

Recapitulatif

- Pour l'instant, vous avez
 - Appris ce qu'était la visualisation d'information
 - Appris quels étaient les avantages de l'infovis
 - Vu un certain nombre d'exemples historiques et récents
 - Appris qu'on ne peut pas toujours faire confiance à ce que l'on voit
- Aujourd'hui, vous allez
 - Apprendre quel est le pipeline pour transformer des données en représentations visuelles
 - Apprendre à connaître vos données
 - Apprendre les composants basiques de la visualisation
 - Essayer de créer votre première visualisation à partir d'un jeu de données

La visualisation d'information...

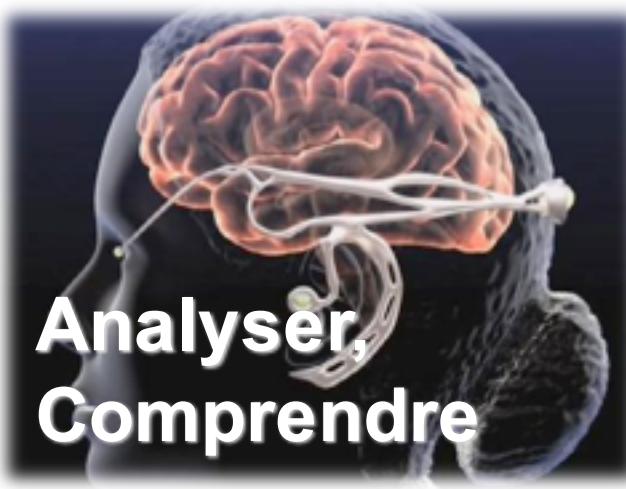
... pour augmenter les
capacités cognitives



Information

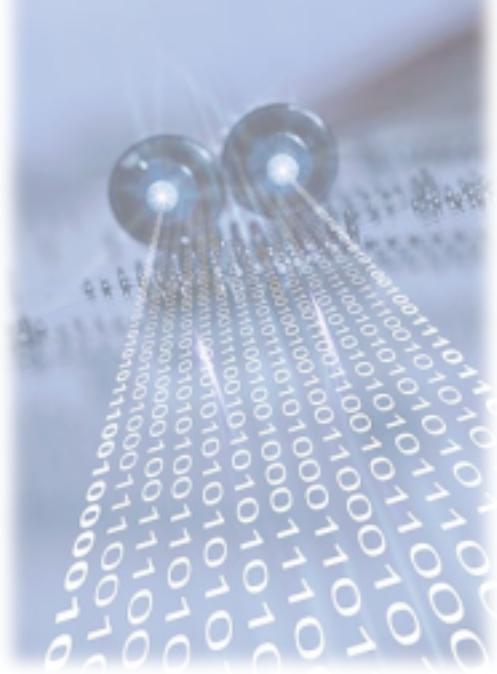


Action / Perception

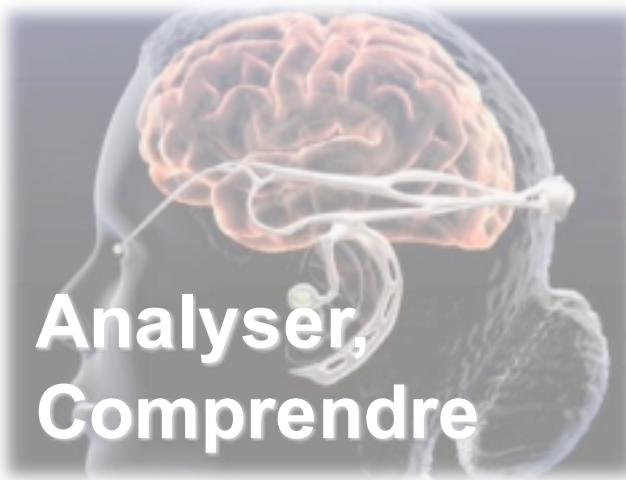


**Analyser,
Comprendre**

Information

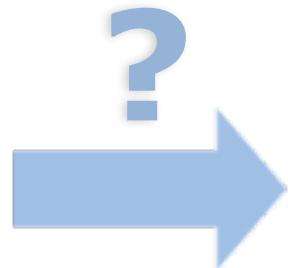
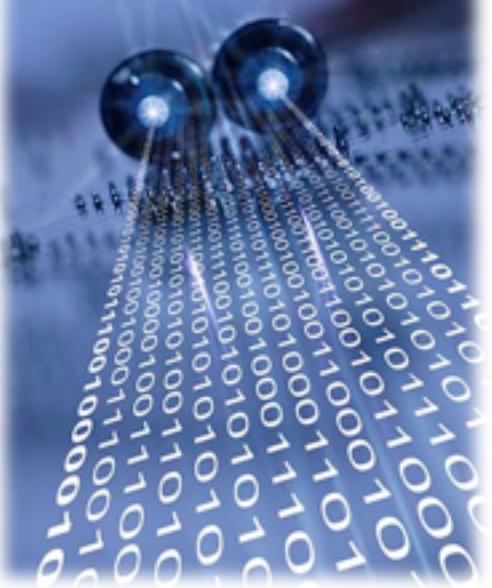


Action / Perception



**Analyser,
Comprendre**

Information



Humain



Information visualization pipeline

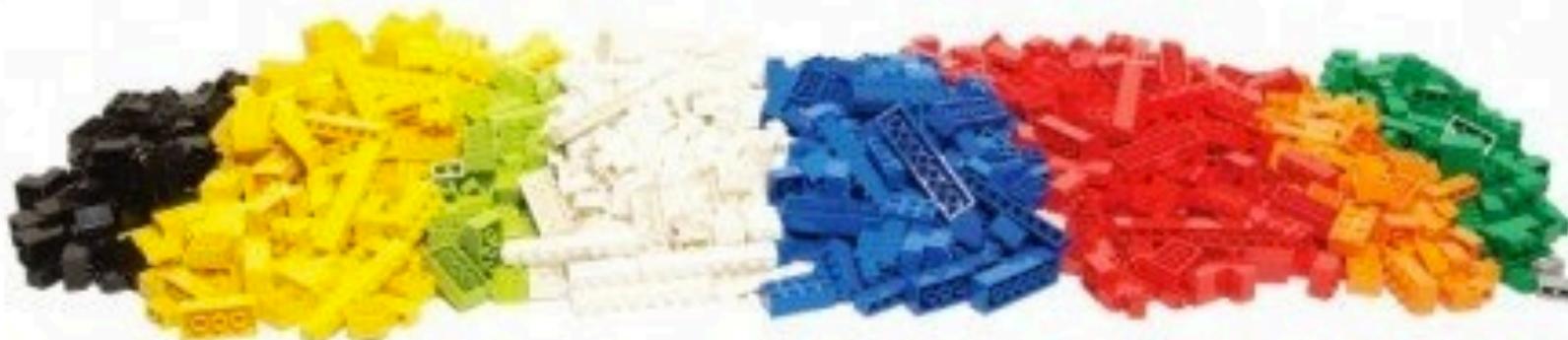
Le pipeline d'infovis



DATA



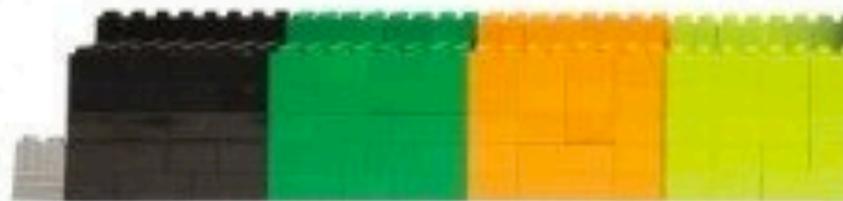
SORTED



ARRANGED



**PRESERVED
VISUALLY**



DATA



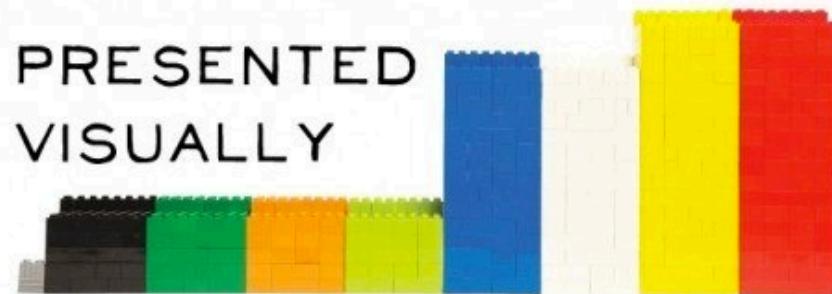
SORTED

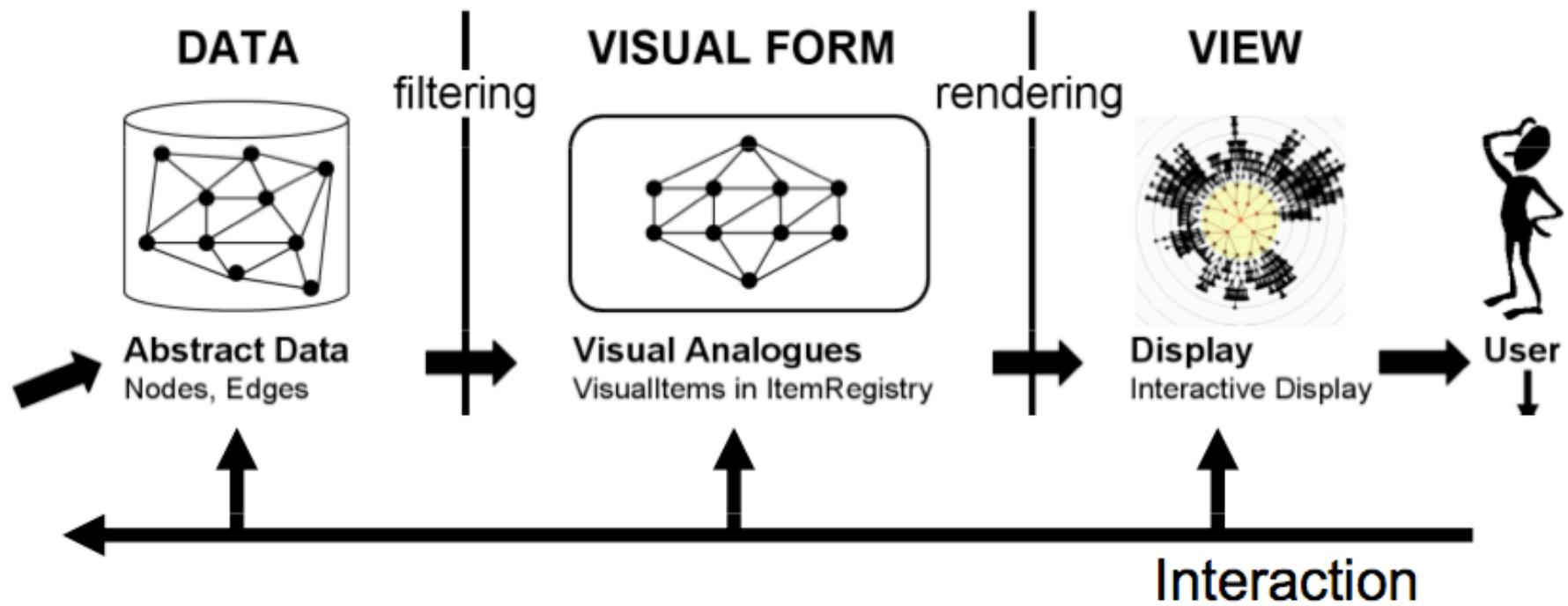


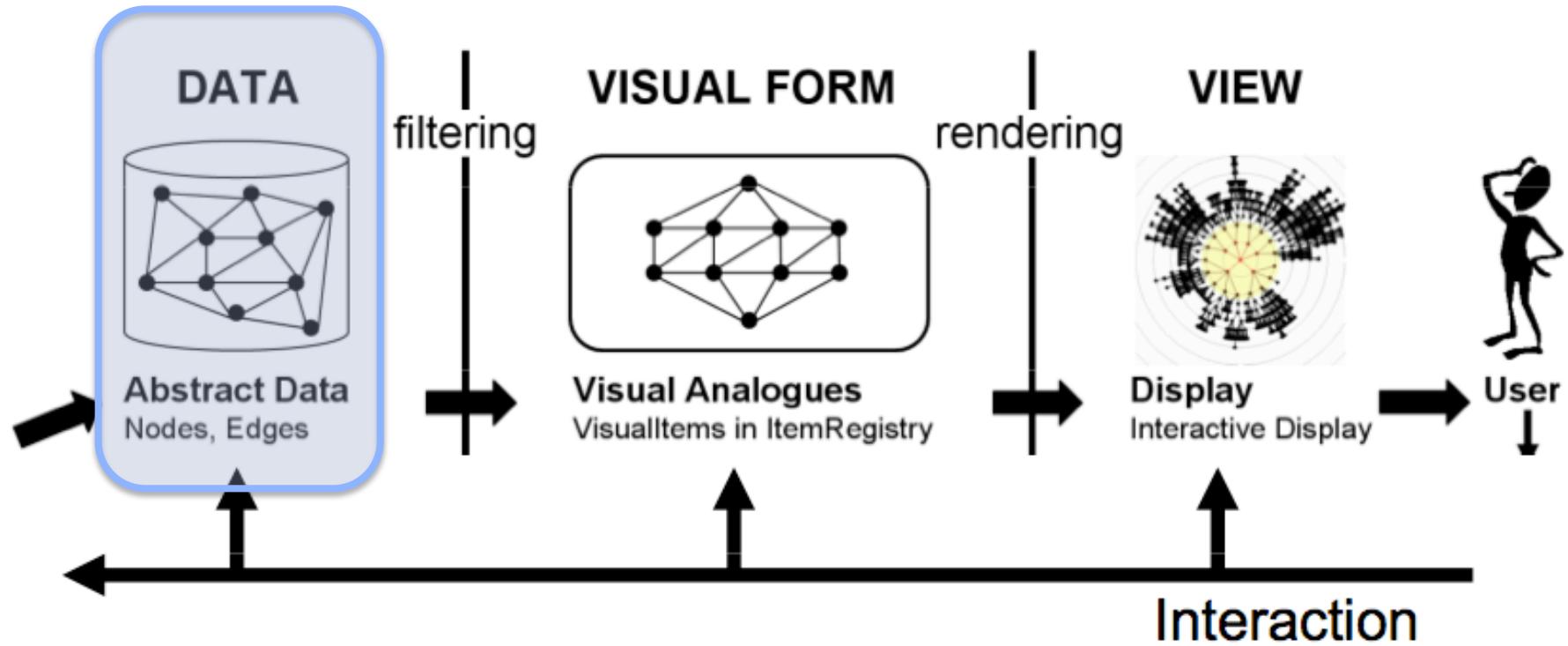
ARRANGED



PRESENTED
VISUALLY



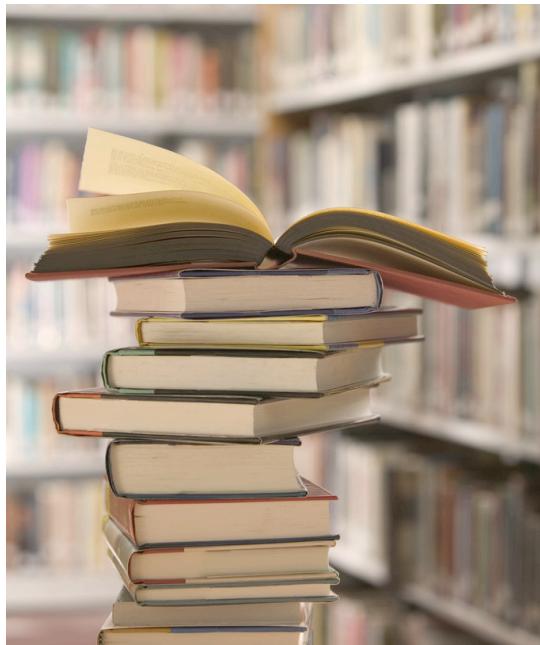




D'où proviennent ces données ?

Connaissances communes (histoire, sciences, art, littérature, ...)

								
1906	1920's	1940's	1954	1984	2001	2004	2005	2006
Acorn Chemical & Refining founded in Cleveland, OH (Later renamed KST Coatings)	Kool Seal brand introduced	Uniflex brand introduced	KST introduces first aluminum reflective roof coating	KST introduces first elastomeric roof coating	KST acquires Oregon Research & Development; makers of Snow Roof Brand	Kool Seal Dura Lite introduced as an innovative light-weight roof coating	KST acquired by Sherwin-Williams	100 Year Club of Cleveland awarded a recognition citation to Kool-Seal.



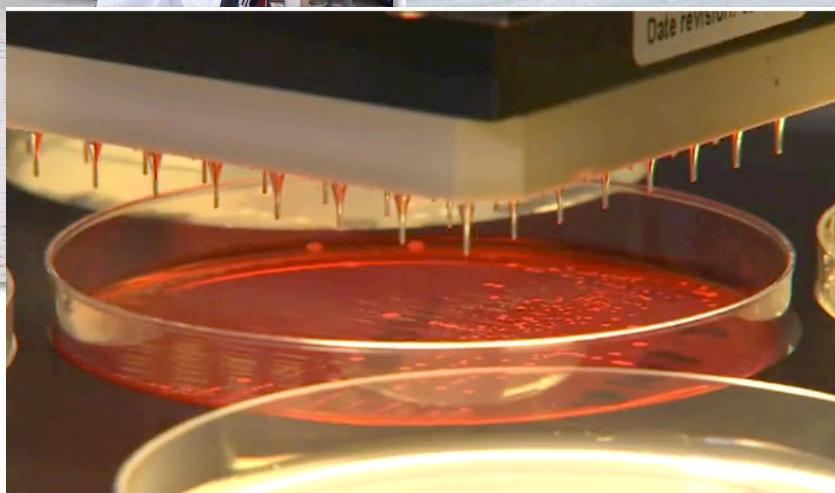
D'où proviennent ces données ?

Logs d'activités quotidiennes (opérations bancaires, communications téléphoniques, transactions en ligne, ...)



D'où proviennent ces données ?

Relevé, acquisition de données (expériences en laboratoire, observations terrain, sondages...)



D'où proviennent ces données ?

Données factuelles (fiches employés/étudiants, information sur les institutions, descriptions de produits, ...)

DATA ENTRY EMPLOYEES SYSTEMS HOURS PAYROLL EQUIP CNTRL FLEET MGMT INVENTORY

EMPLOYEE INFO VEHICLE INFO CONTRACTORS HEALTH INSURANCE REPORTS CHECK LIST

Employee Information

119	SMITH	MICHAEL
ID No	Last Name	First Name
600-002-0000	EMPLOYEE	Middle
SS # or EIN	Cont or Emp	Contract Company
1777 WEST WIND DRIVE		
Address		
TUCSON	AZ	85743
City	State	Zip Code
msmith9876@yahoo.com		
Email Address		
520-555-0020	602-555-0020	128*897855*555
Phone	Cellular Phone	Direct Connect
08/01/1986	TUCSON	
Date of Birth	Location	
	Eyes: Blue	
	Gender: M	
	Hair: Brown	
	Height: 5'10"	
	Depnts: 2	
	Race: White	
Current		
Status	Rehireable?	

System Information

Tech #	System	Position	Pay Scale	IVR #
8519	Tucson	Installer	LEVEL 1	
0923	Phoenix	Installer	LEVEL 1	

Financial Information

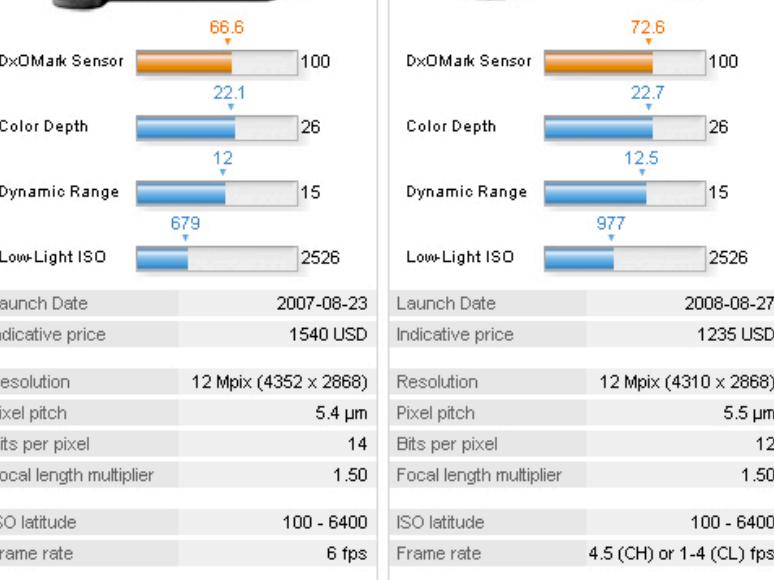
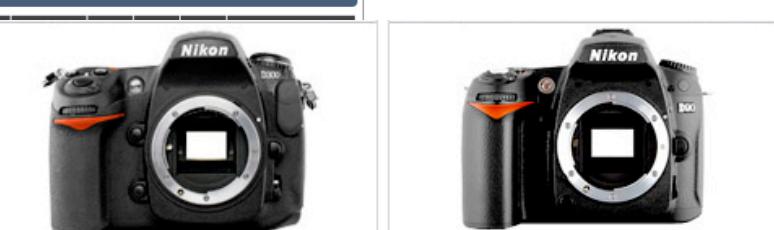
PIECE WORK	\$12.00
Remuneration Method	Hourly Rate
NONE	
Fuel Allowance	Paid
N/A	\$20.00 WK
Truck Rental	Cell Phone Charge

Employment Dates

4/5/2008	10/5/2008	Termination Date
Date of Hire	Date of Next Review	

Emergency Contacts

Elaine Smith	520-555-0987
Emergency Contact	Emergency Phone



Health	Emp
7/4/2	90 Da
8/1/2	Eligit
FRI	Dedu
DxOMark Sensor	
66.6	100
22.1	
Color Depth	26
12	
Dynamic Range	15
679	
Low-Light ISO	2526
Launch Date	2007-08-23
Indicative price	1540 USD
Resolution	12 Mpix (4352 x 2868)
Pixel pitch	5.4 µm
Bits per pixel	14
Focal length multiplier	1.50
ISO latitude	100 - 6400
Frame rate	6 fps
Resolution	12 Mpix (4310 x 2868)
Pixel pitch	5.5 µm
Bits per pixel	12
Focal length multiplier	1.50
ISO latitude	100 - 6400
Frame rate	4.5 (CH) or 1-4 (CL) fps

D'où proviennent ces données ?

Générées par l'utilisateur lui-même (messagerie électronique, blogs, ressources partagées, réseaux sociaux, ...)

facebook Home Profile Friends Inbox Brian Cashman Settings Logout Search

Hank Steinbrenner is runnin' train on free agency, hells yeah! 2 hours ago

Wall Info Photos Boxes Write Share Link Post Photo Causes Record Video

Write something... Post

All Posts Posts by Hank Posts by Others Wall-to-Wall

Today Scott Boras wrote at 11:24am give Jaba \$10 more and I'll personally give you an HJ

Yesterday Alex Rodriguez wrote at 10:08pm oh my god oh my god oh my god I'm SOOOOO excited!!!! ahhhhh yay!!!! you're doing such as good job this offseason

I FREAKING LOVE YOU, I'M RENEGETTING WITH YOU AGAIN ANYTIME!!!! Wall-to-Wall - Write on Alex's Wall

Hank wrote on John Henry's Wall, 7:24pm - Comment

Information Networks: Central Methodist '79 New York, NY Current City: Bellair, FL

Friends 55,274 friends See All

Rudy Giuliani Billy Martin Kid from Brooklyn Jerry Jones wrote Pumped for the deal Lorne Michaels wrote how bout havin th Red Sox Nation w wuzzup, Fagtown Madonna tagged

Photos 2 of 10 albums See All PARRTAAY!! Updated about 5 months ago

flickr Home You Organize Contacts Groups Explore

Signed in as (2 new) Help Sign Out

Hi Want a Hot Girlfriend?

Chat free with sexy single girls in your area on singlesnet. Thousands of girls online now!

Find Single Women Online

Your Photostream pro Recent Uploads | Recent Activity

Hi

» Your Photostream pro

Recent Uploads | Recent Activity

Upload Photos & Videos

Flickr Blog Posted 09 Sep 08 Kitten Tuesday It's a very special Kitten Tuesday (back story here and here). Team Flickr would like to congratulate Dan and Charlie Catt on the arrival of...

Add your photos to a map

Make a note of where you were, and add to the world map!

Compose Mail

Inbox (5) Starred Chat Sent Mail Drafts (1) All Mail Spam Trash

Archive Report Spam Delete More Actions Refresh 1 - 16 of 16

Select: All, None, Read, Unread, Starred, Unstared

Caitlin, me (2) work Flight number? - Can you let me know which flight Apr 19
me, Nathan (3), Draft friends Gift ideas for Caitlin - Any ideas Apr 19
Paige, me (3) Shopping trip - Awesome, I'll see you then. We can grab a Apr 18
Nicole Brennan Friday drinks? - You guys free on Friday? We're thinking of Apr 18
Lizzie, me (2) Africa airfares - Cool, I'll check it out. Sounds like a good idea Apr 18
Caitlin Ronan work Conference budget - We'll need to sit down with it Apr 18
Nathan Woodward friends Birthday cake - Any idea which kind of cake is Apr 18
Lizzie, me (2) friends Cancelling tennis on Friday - No problem, it was Apr 18
Caitlin Ronan work March expense reports - I've attached the recent report Apr 17
me, Caitlin (4) work Meeting with Mitchell - I think it would be best if we Apr 17
me, Nicola (2) Photos - Can you send me that photo you mentioned earlier? Apr 17
Paige Stevens friends Camera shopping - Did you get the link for the camera? Apr 17
Zach, me (2) work Timesheets? - I think we should ask Wayne for his Apr 17
Nathan Woodward Surprise party - I was wondering if maybe you and Susan Apr 17
Nicola Brennan vacation Fishing - Hi guys, Mark and I have arranged the Apr 17
Lizzie Astley friends Trip to Africa - Hey, so do you still want to go? If so Apr 17

Tasks Add task e.g. TPS report 5pm Set task view here

Today Pick up the milk

Tomorrow Finish TPS reports

This Week Return library books

Next Week Pay electricity bill

Anytime Call Caitlin

Take over the world

Apply for new passport

Order Heroes DVD

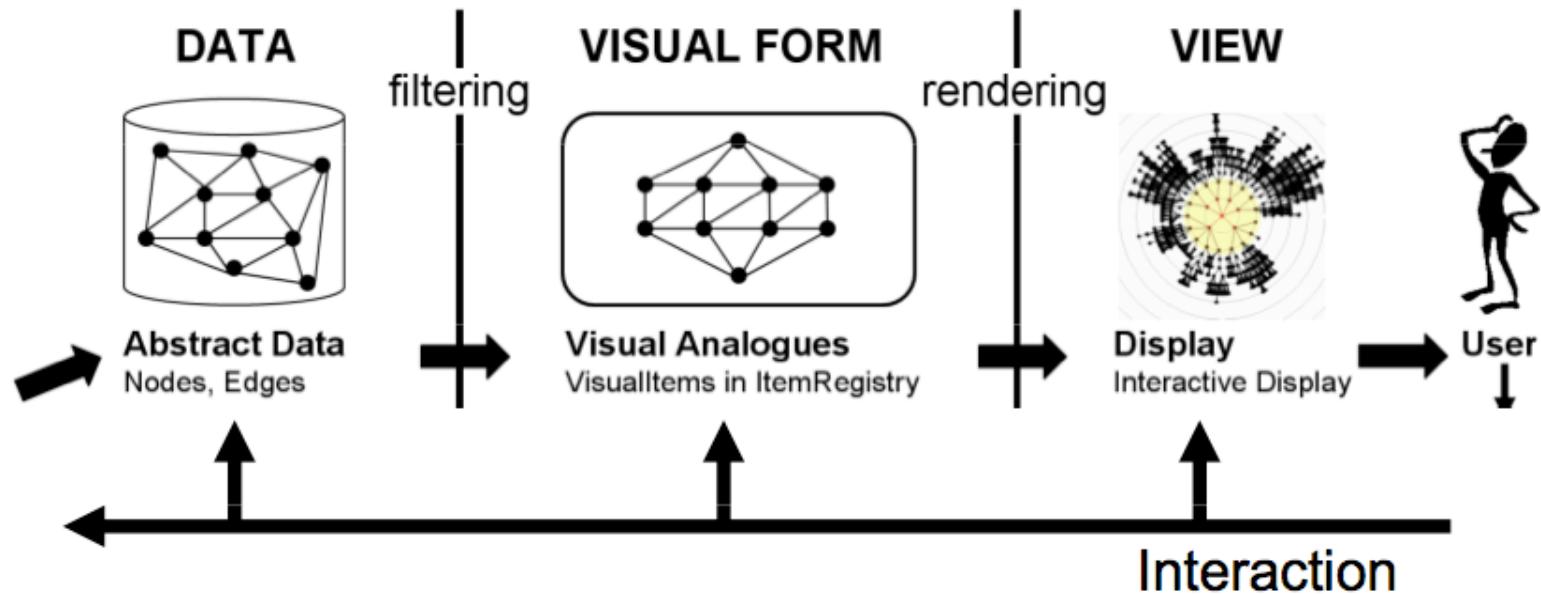
Prepare presentation

Get bananas

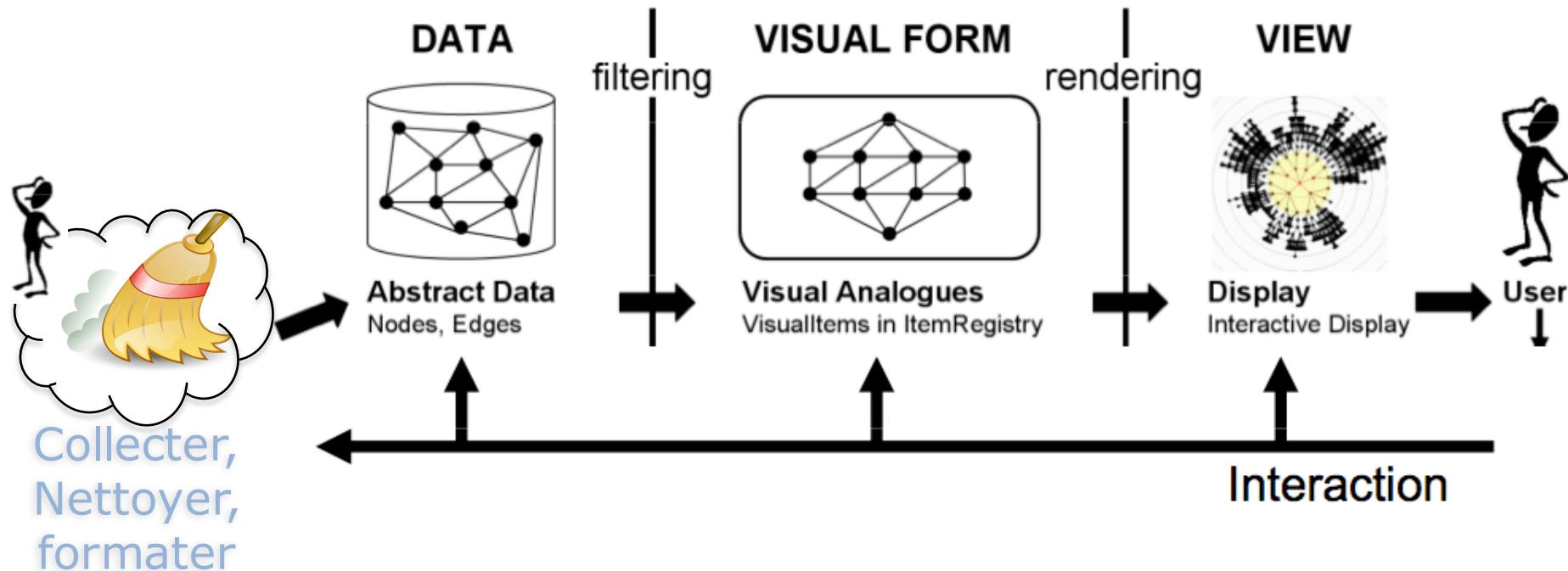
Research Africa airfares

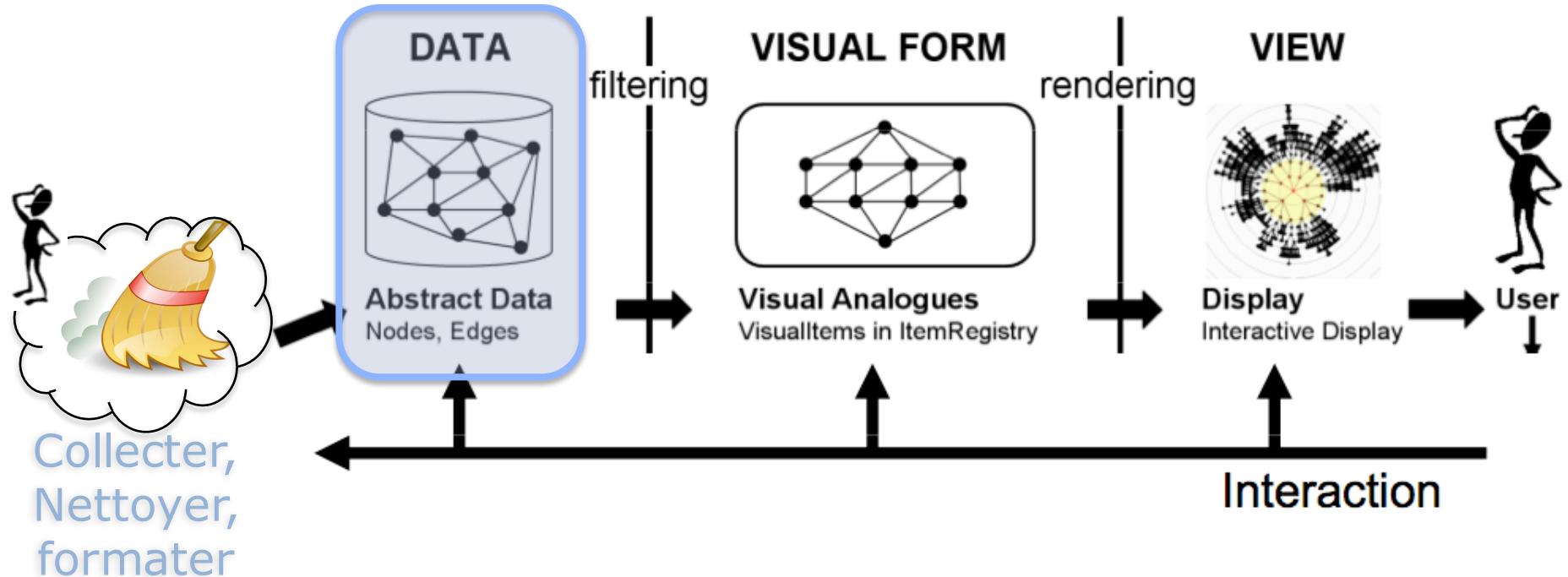
Options Refresh

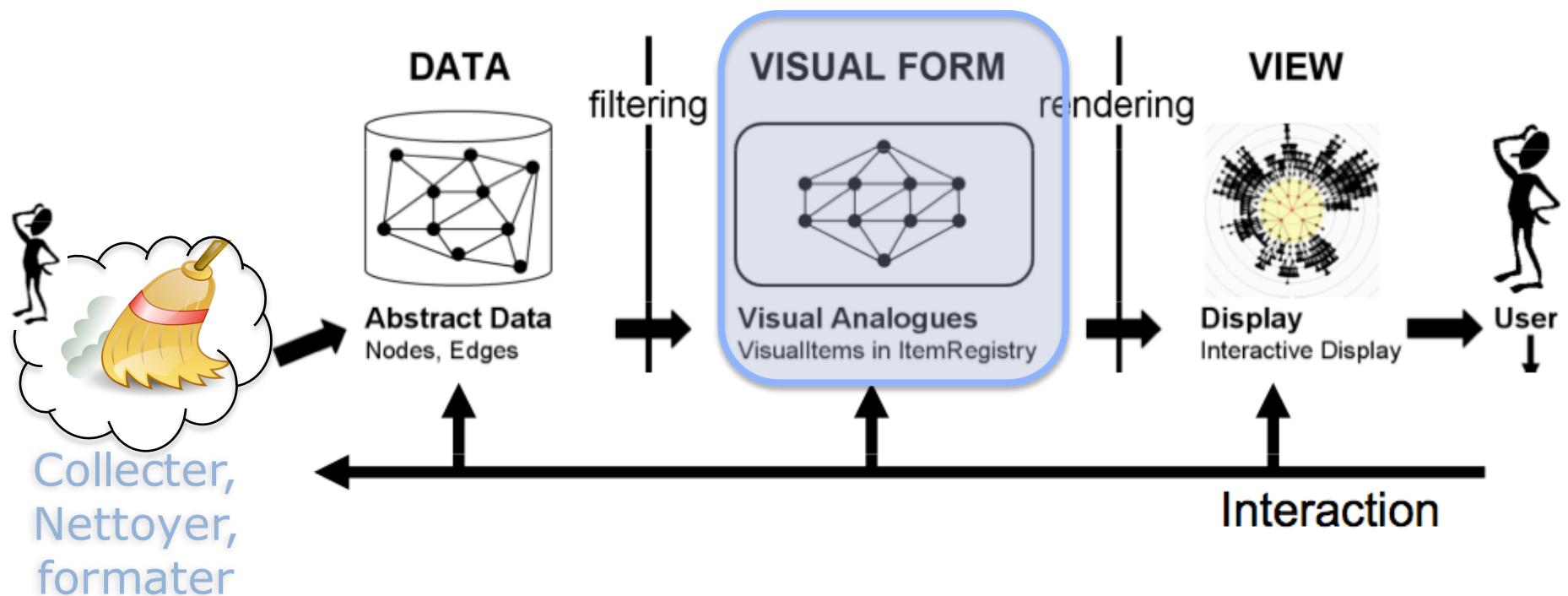
Les données sont **hétérogènes**, **bruitées** et doivent être **formatées** pour être utilisables

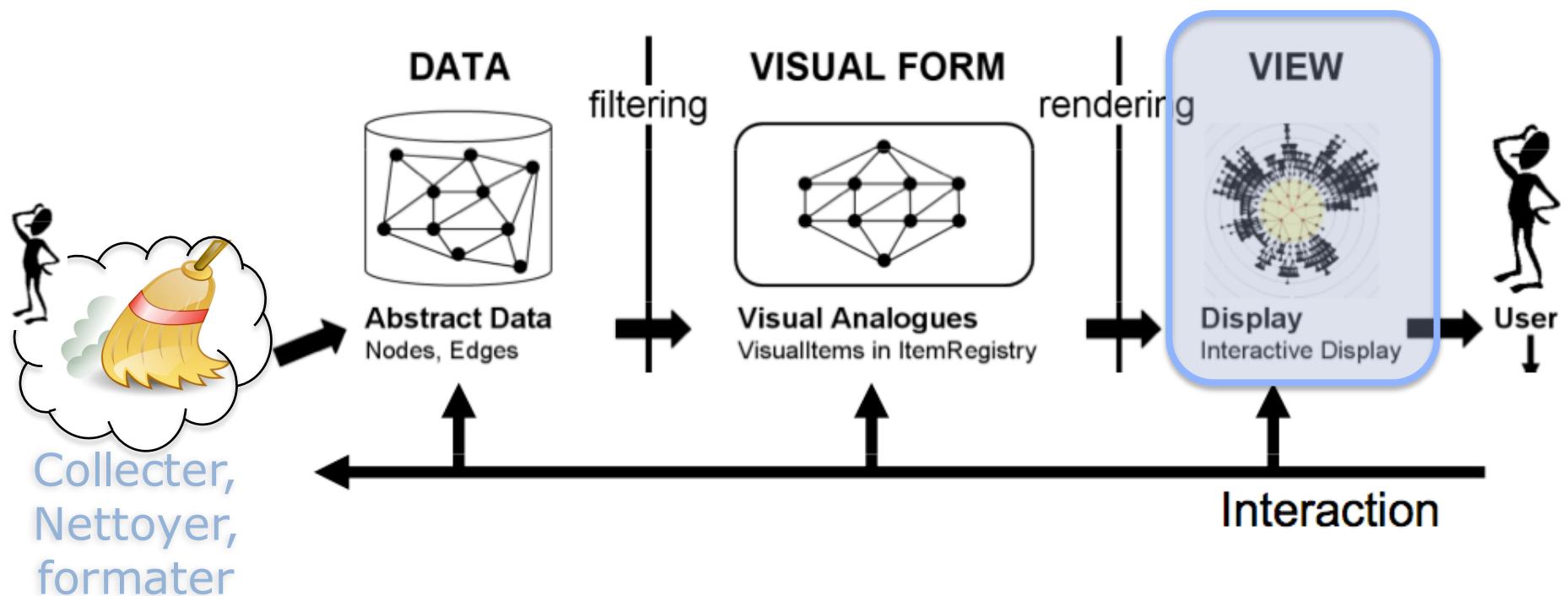


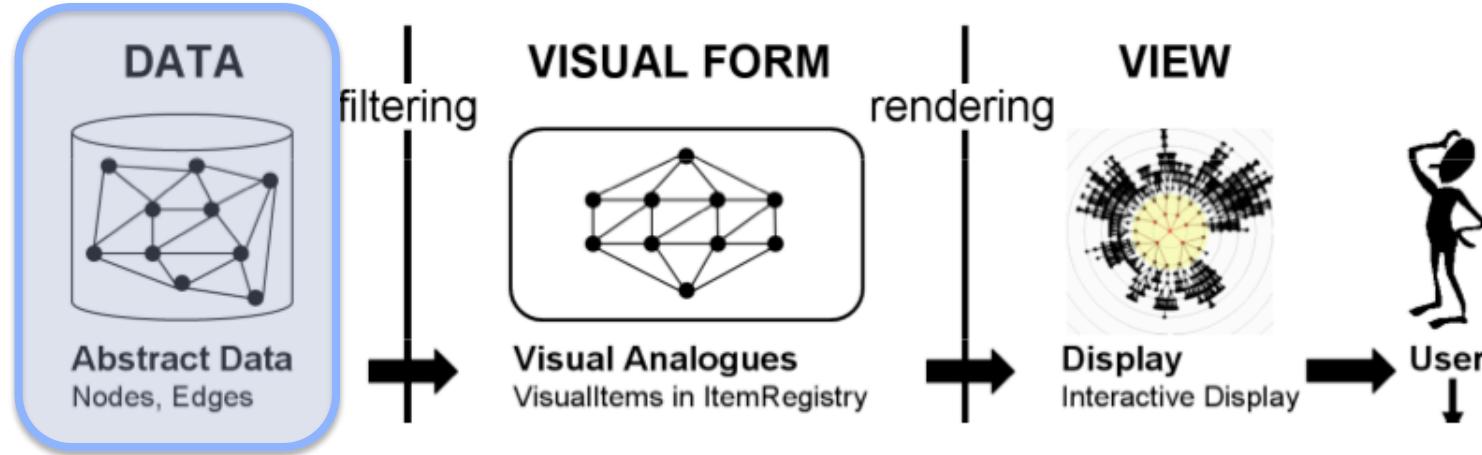
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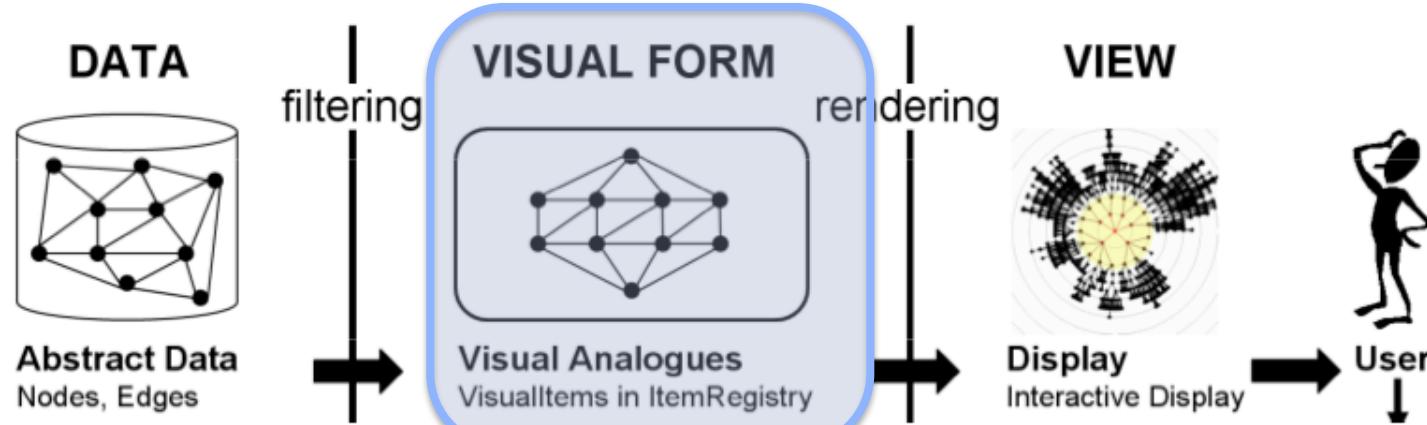




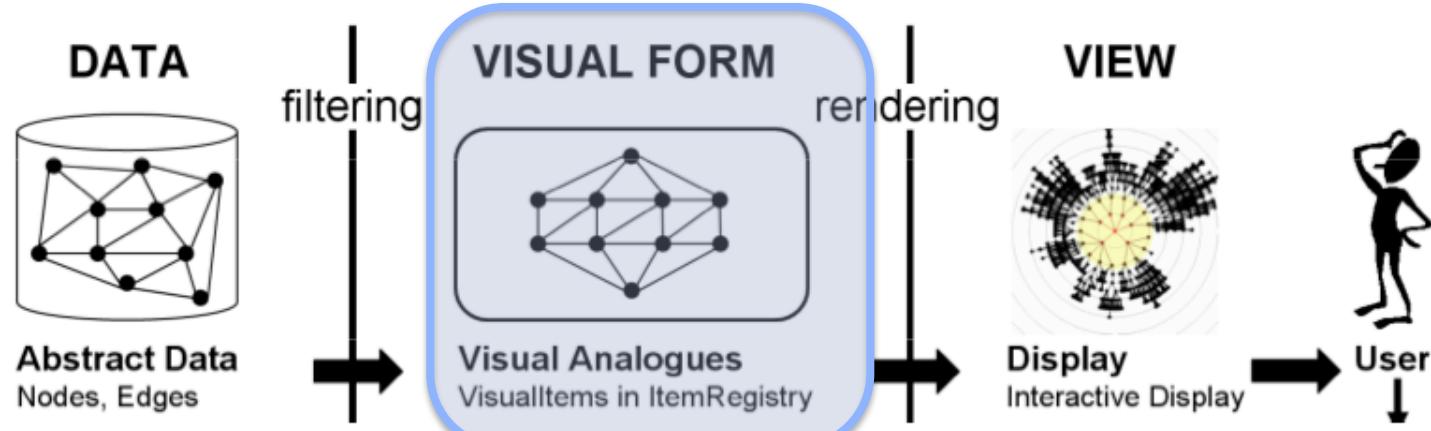




Fanny, Thomas
Fanny, Géry
Fanny, Nicolas
Fanny, Laurent
Fanny, Bruno
Fanny, Laëtitia
Thomas, Géry
Thomas, Nicolas
Laëtitia, Laurent
Laëtitia, Mathieu
Laëtitia, Julie
Bruno, Mathieu
...

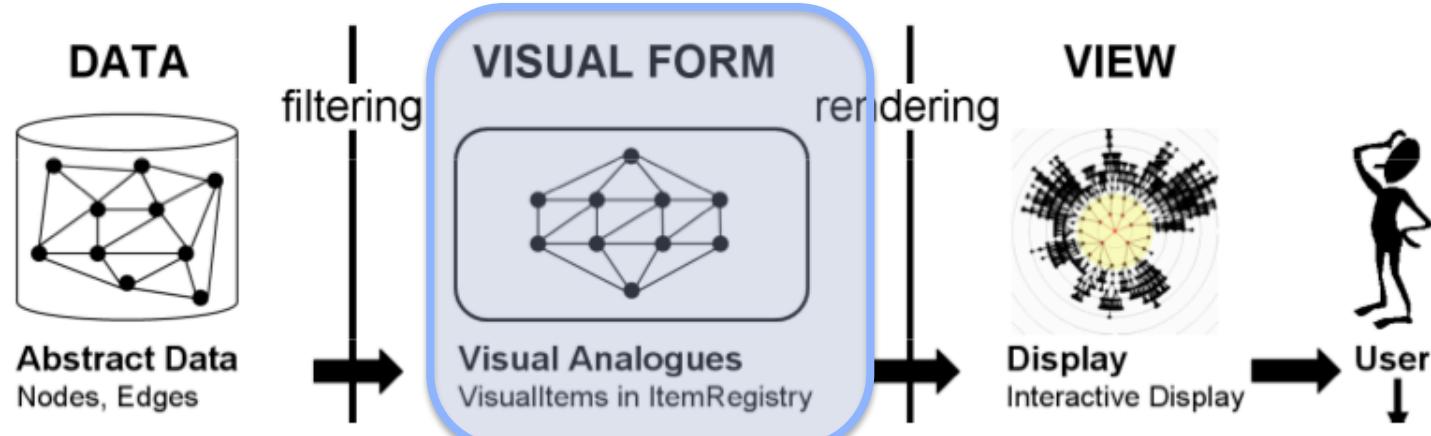


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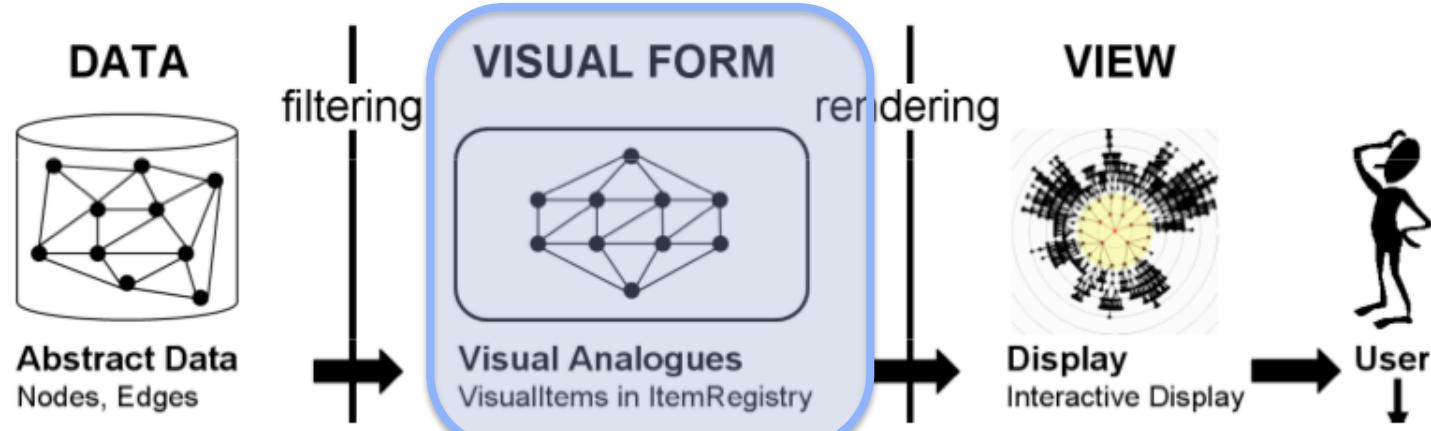
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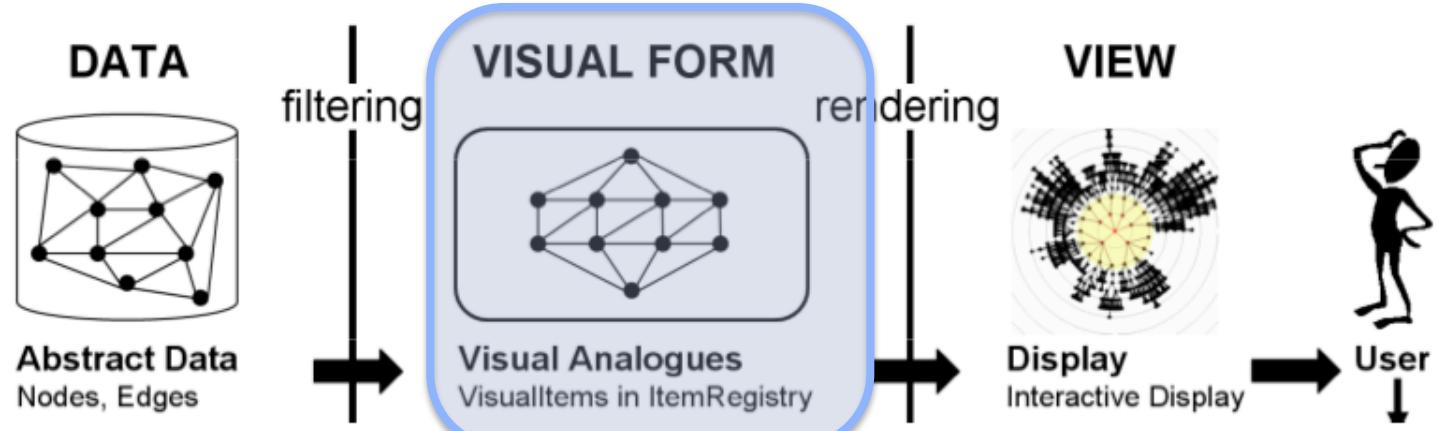
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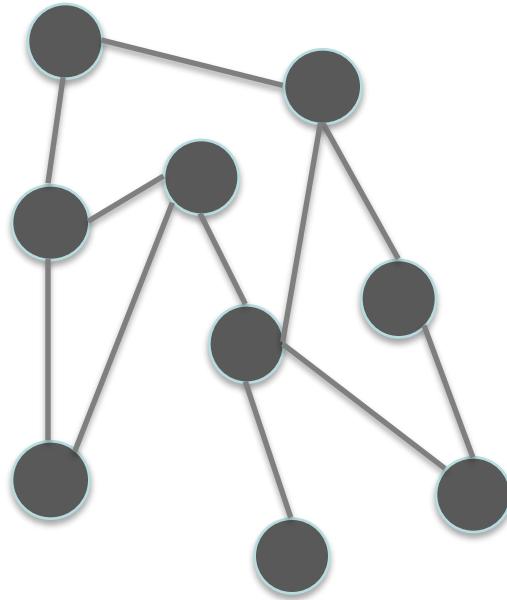


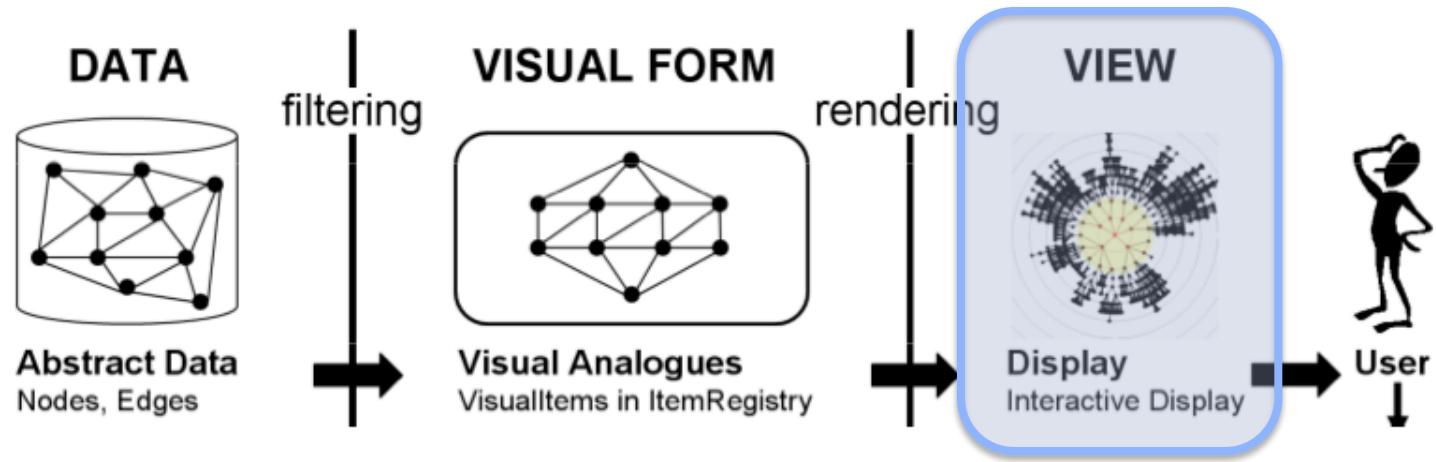
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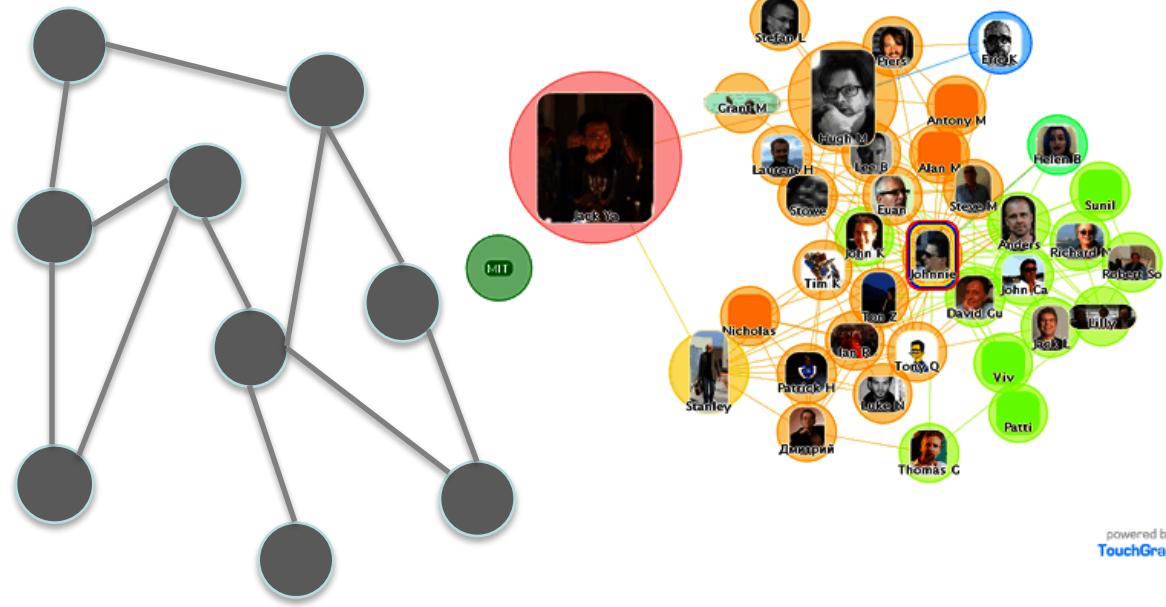


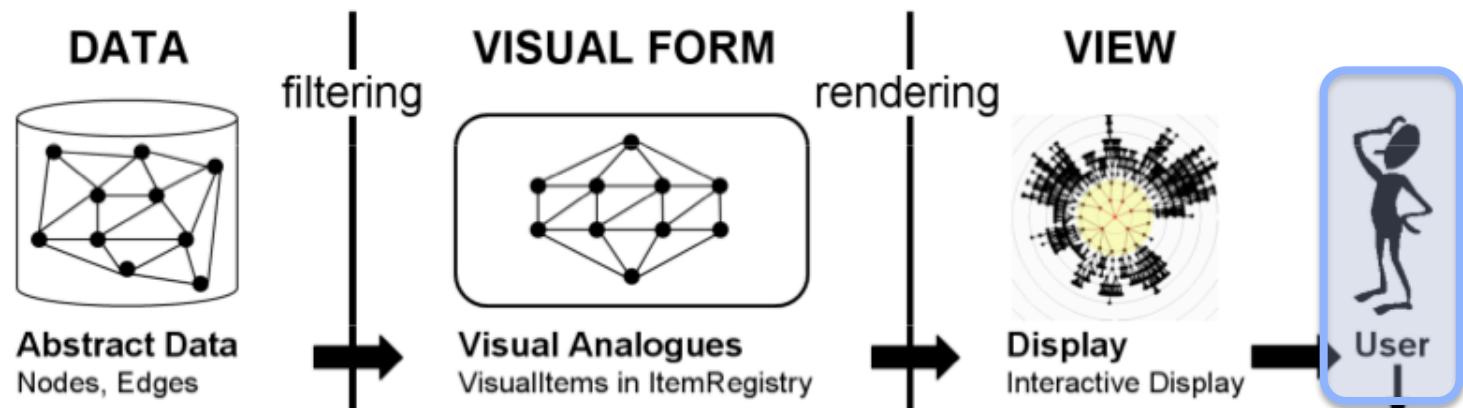
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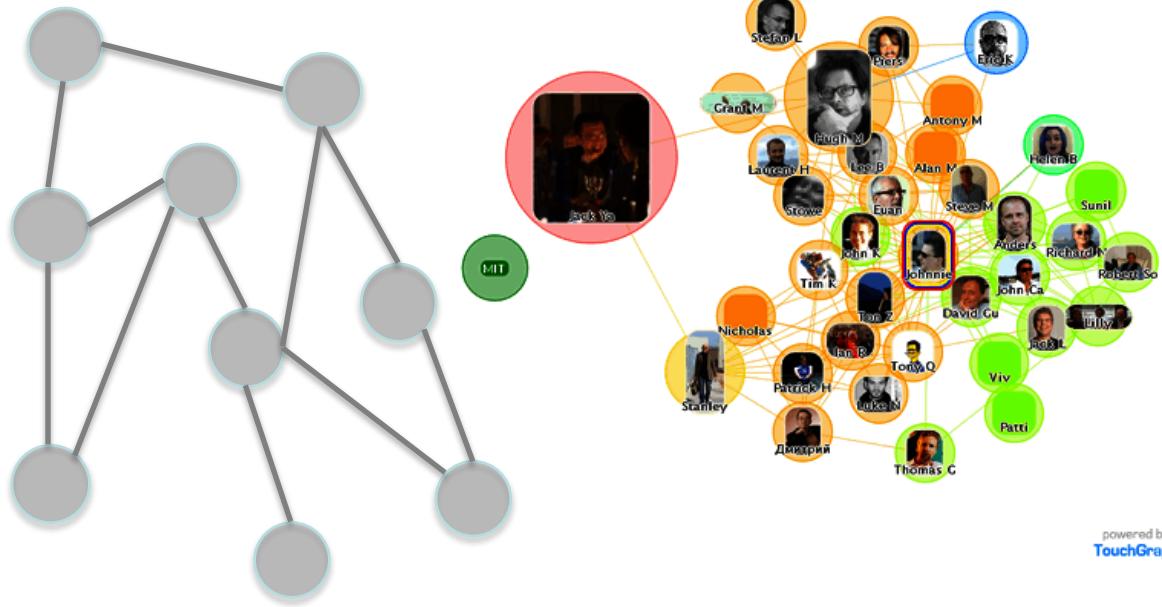


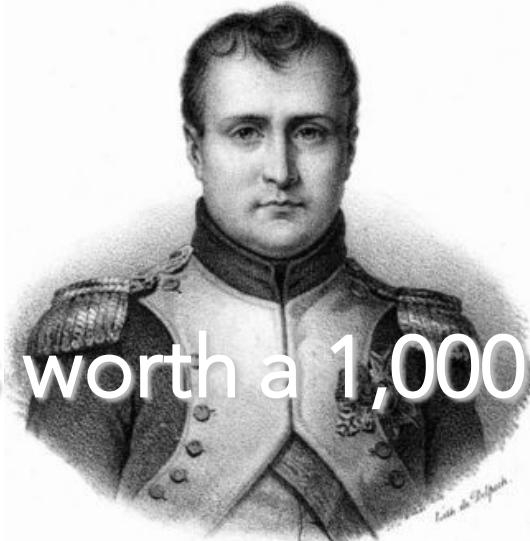
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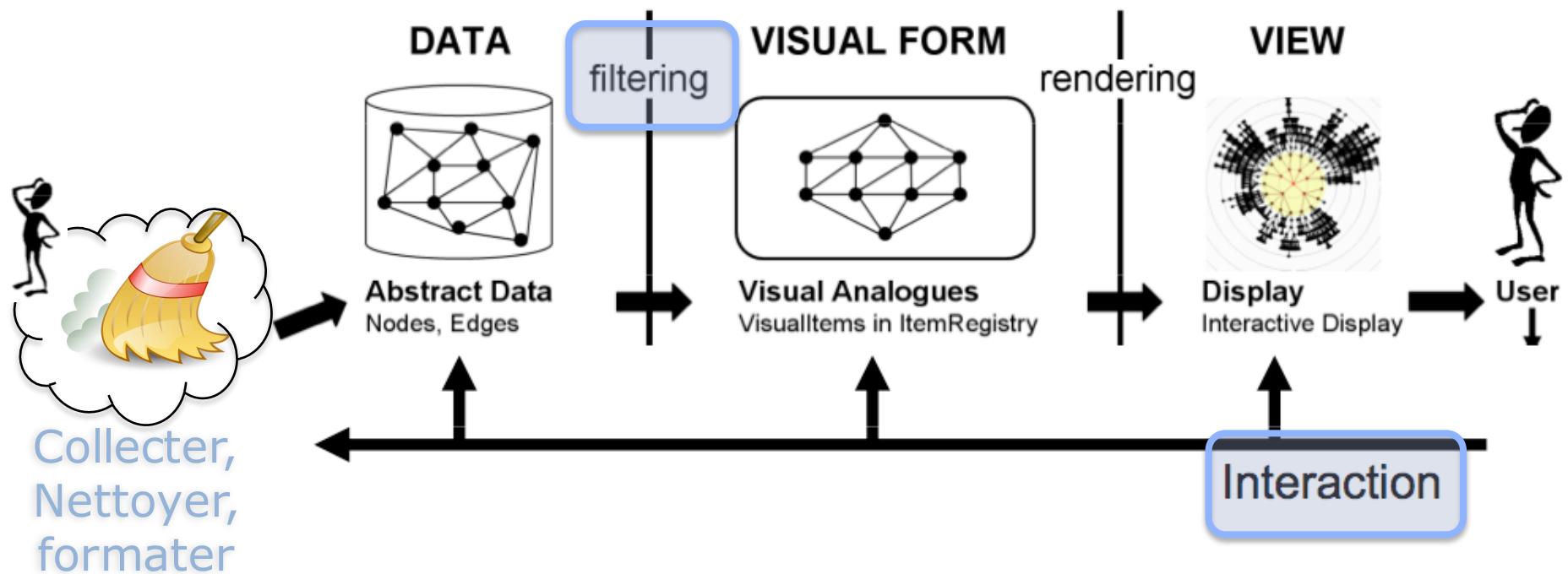


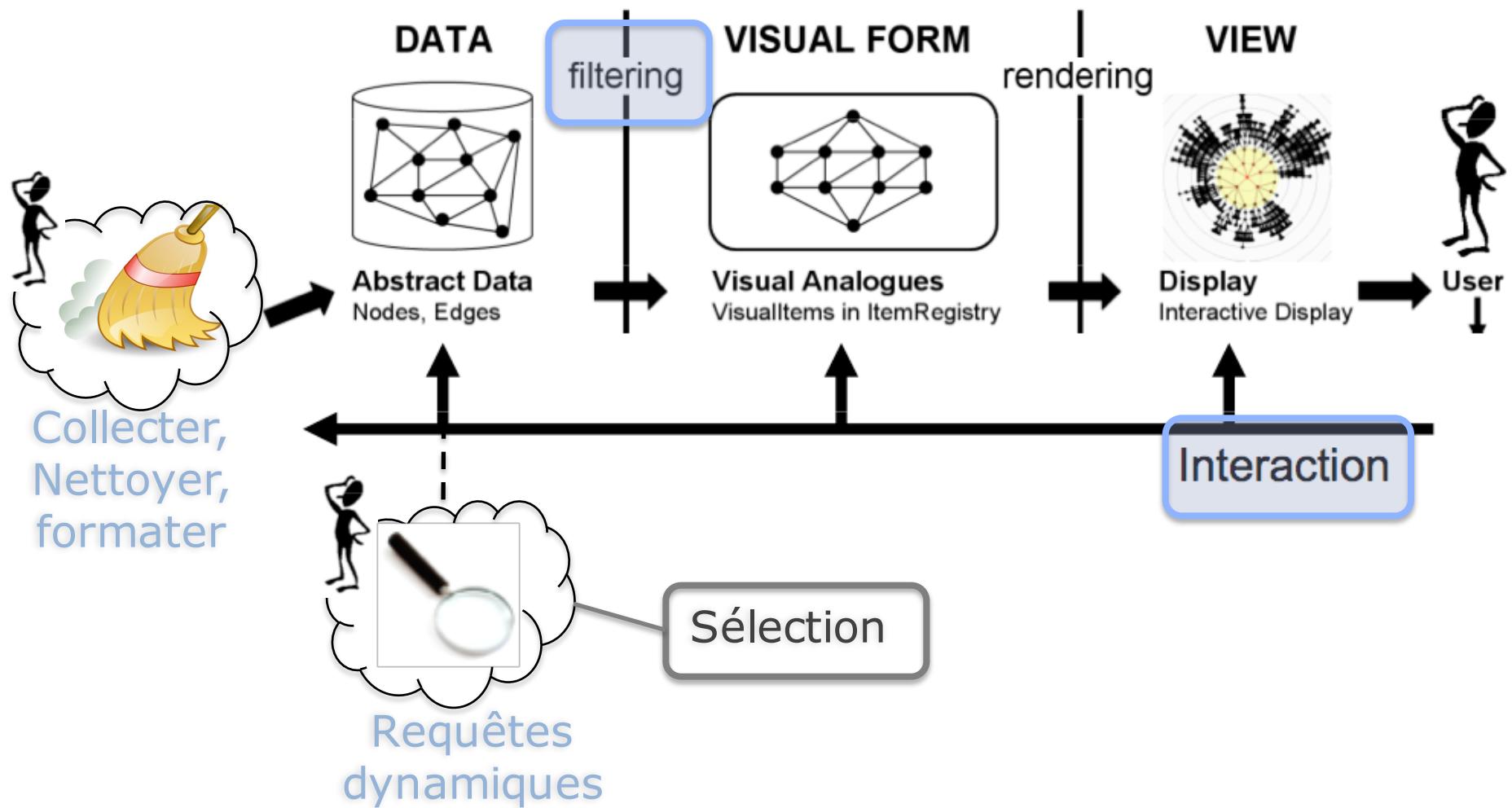
"A picture is worth a 1,000 words"

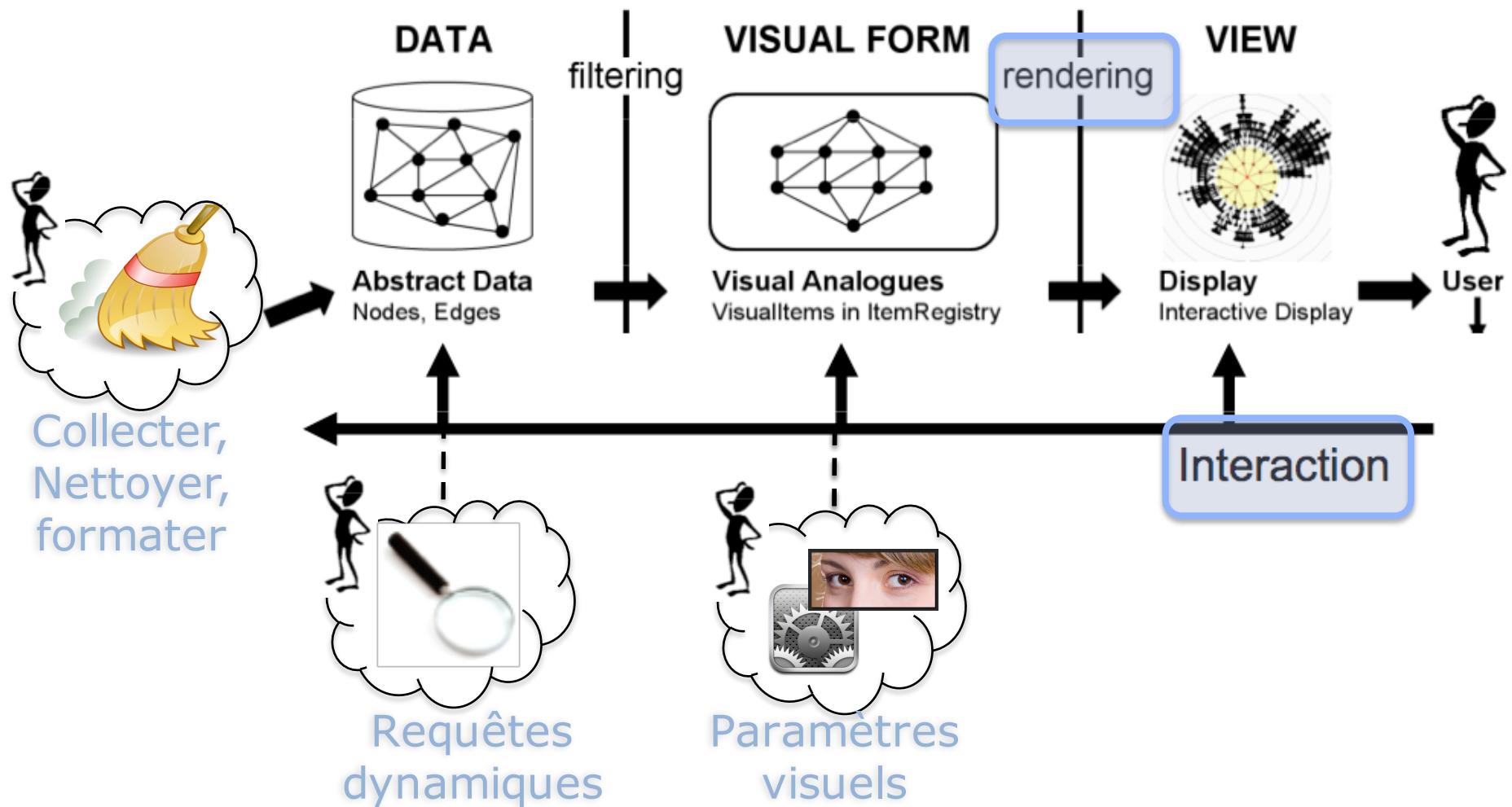


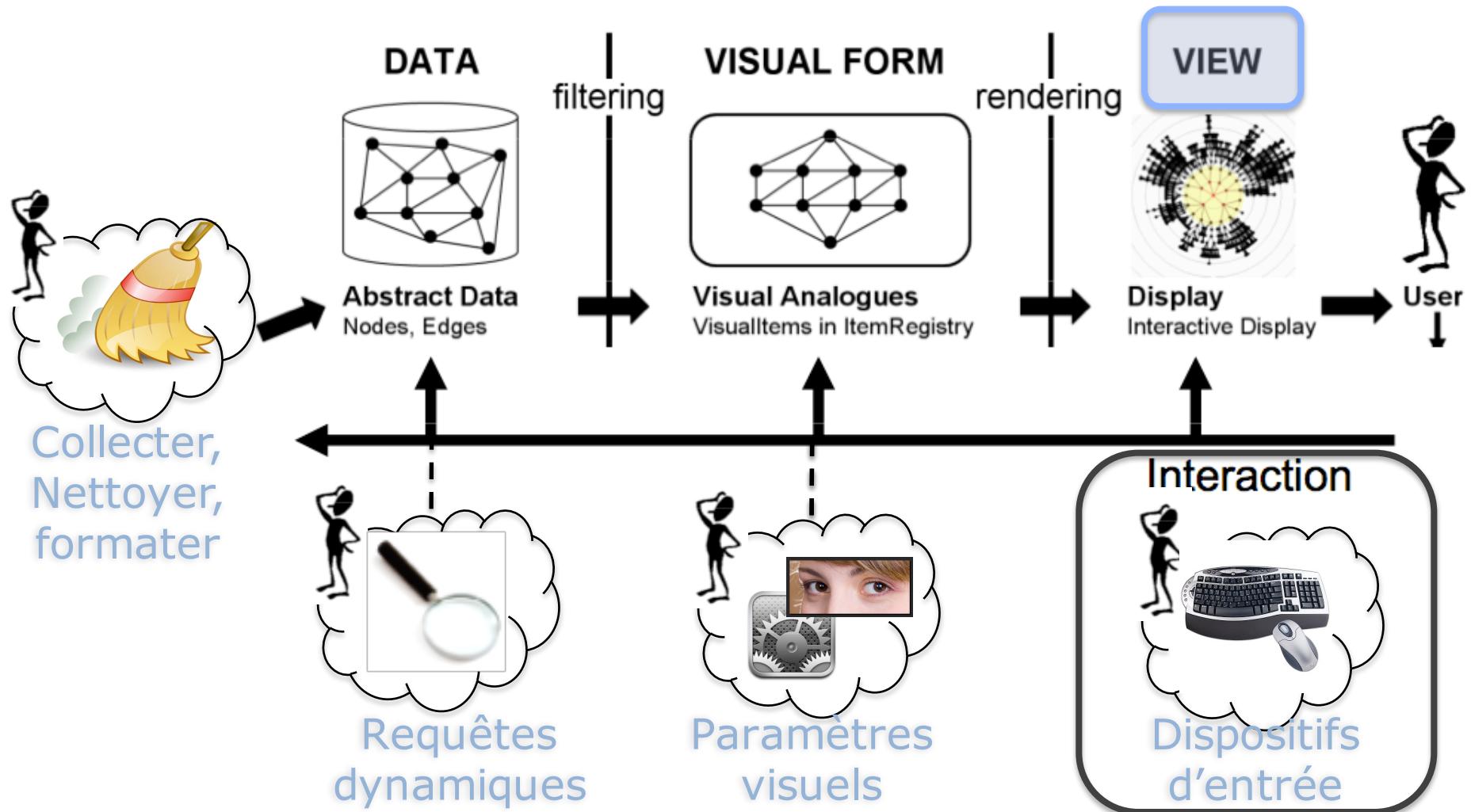
"An interface is worth a 1,000 pictures"

Ben Shneiderman, 1998









Video Lenses

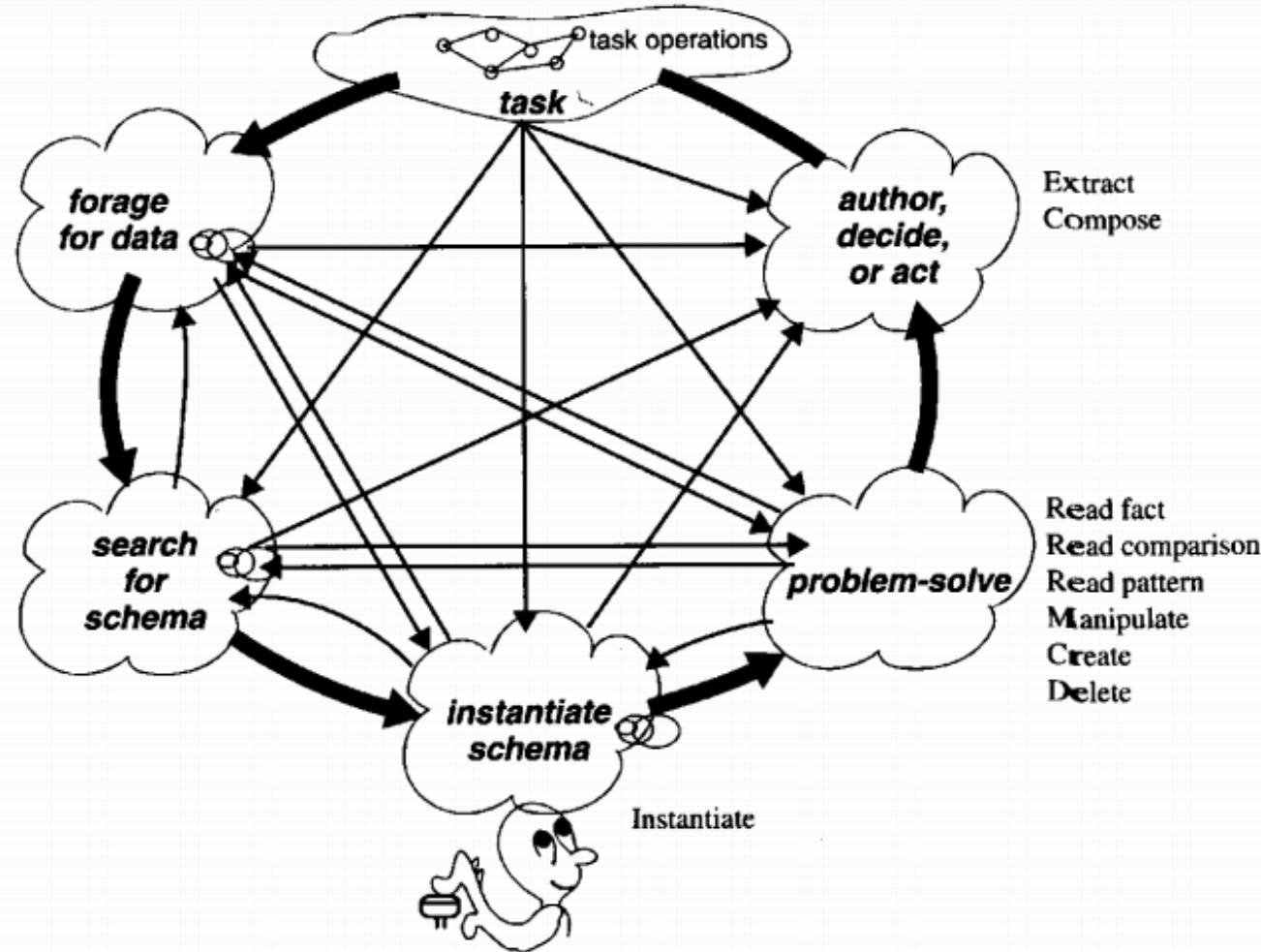


Knowledge crystallization cycle

[Card et al. 1999]

Overview
Zoom
Filter
Details-on-demand
Browse
Search query

Reorder
Cluster
Class
Average
Promote
Detect pattern
Abstract



Travailler avec des visualisations d'information n'est pas un processus linéaire.

Shneiderman's mantra



Les pièges

- Collecter les mauvaises données
- Choisir la mauvaise structure de données
- Filtrer des données importantes
- Choisir la mauvaise représentation
- Mécanismes d'interaction avec les données inappropriés



Les données



Les données

- Les données sont à la base de toute visualisation
- Le concepteur de la visualisation doit comprendre
 - Les propriétés des données
 - Savoir quelles sont les méta-données disponibles
 - Savoir l'information que veulent extraire les gens à partir de ces données

Données nominales, ordinaires et quantitatives

- **Nominales** (étiquettes)
 - Fruits: pommes, oranges
- **Ordinaires**
 - Classe énergétique: A, B, C, D, E
 - Qualité de viande: grade A, AA, AAA
 - Peut être comptées et ordonnées, mais pas mesurées
- **Quantitatives** : Intervalle
 - Pas de zéro absolu (ou alors arbitraire)
 - E.g., dates, longitude, latitude
- **Quantitatives** : Ratio
 - Origine qui a un sens
 - Mesure physique (température, masse, longueur)
 - Comptes et des montants

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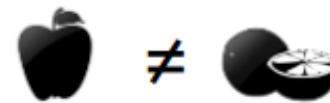
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Données nominales, ordinaires et quantitatives

- **Nominales** (étiquettes)

- Opérations: $=, \neq$



- **Ordinaires**

- Opérations: $=, \neq, <, >$

- **Quantitatives** : Intervalle

- Opérations: $=, \neq, <, >, -, +$
 - Mesure de distance possible

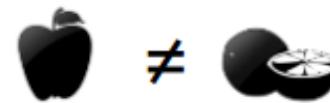
- **Quantitatives** : Ratio

- Opérations: $=, \neq, <, >, -, +, \times, \div$
 - Mesure de ratios ou proportions possible

Données nominales, ordinaires et quantitatives

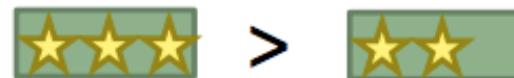
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- **Ordinaires**

- Opérations: $=, \neq, <, >$



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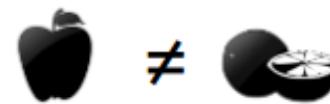
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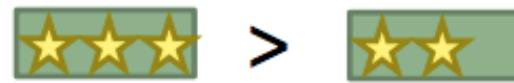
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- **Ordinaires**

- Opérations: $=, \neq, <, >$



- **Quantitatives** : Intervalle

- Opérations: $=, \neq, <, >, -, +$ $[1989 - 1999] + [2002 - 2012]$
- Mesure de distance possible

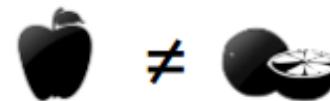
- **Quantitatives** : Ratio

- Opérations: $=, \neq, <, >, -, +, \times, \div$
- Mesure de ratios ou proportions possible

Données nominales, ordinaires et quantitatives

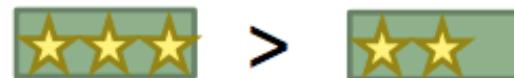
- **Nominales** (étiquettes)

- Opérations: $=, \neq$



- **Ordinaires**

- Opérations: $=, \neq, <, >$



- **Quantitatives : Intervalle**

- Opérations: $=, \neq, <, >, -, +$ $[1989 - 1999] + [2002 - 2012]$

- Mesure de distance possible

- **Quantitatives : Ratio**

$10\text{kg} / 5\text{kg}$

- Opérations: $=, \neq, <, >, -, +, \times, \div$

- Mesure de ratios ou proportions possible

Types de données: taxonomie

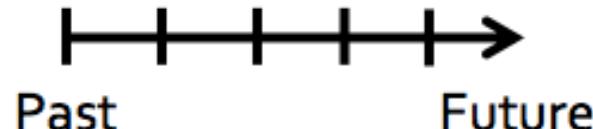
- 1D (linéaire) 
- Temporelles
- 2D (carte)
- 3D
- nD (relationnelles)
- Arbres (hiérarchies)
- Réseaux (graphes)

Types de données: taxonomie

- 1D (linéaire)



- Temporelles



- 2D (carte)

- 3D

- nD (relationnelles)

- Arbres (hiérarchies)

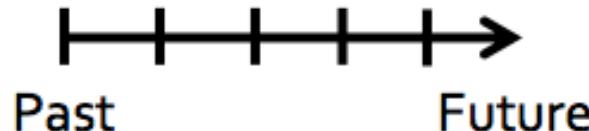
- Réseaux (graphes)

Types de données: taxonomie

- 1D (linéaire)



- Temporelles



- 2D (carte)



- 3D

- nD (relationnelles)

- Arbres (hiérarchies)

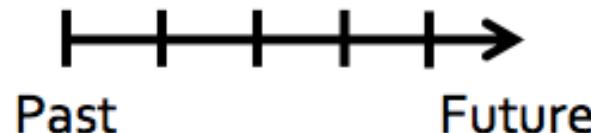
- Réseaux (graphes)

Types de données: taxonomie

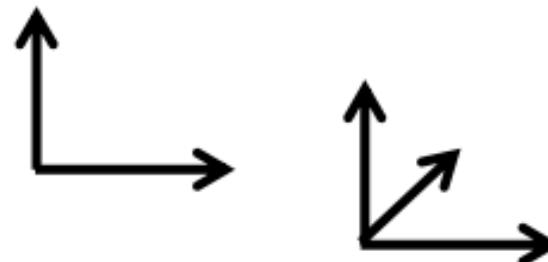
- 1D (linéaire)



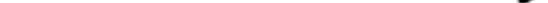
- Temporelles



- 2D (carte)



- 3D



- nD (relationnelles)

- Arbres (hiérarchies)

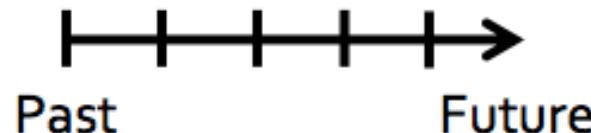
- Réseaux (graphes)

Types de données: taxonomie

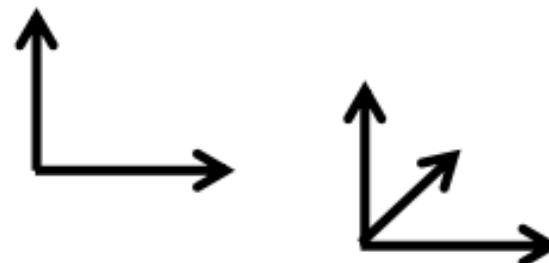
- 1D (linéaire)



- Temporelles



- 2D (carte)



- 3D

- nD (relationnelles) (exemple plus tard)

- Arbres (hiérarchies)

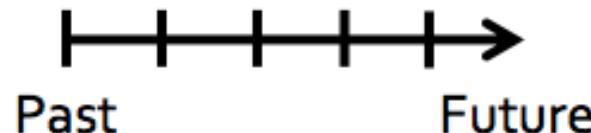
- Réseaux (graphes)

Types de données: taxonomie

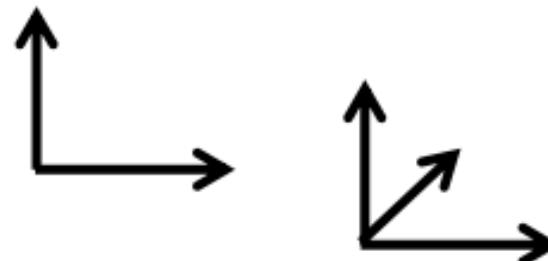
- 1D (linéaire)



- Temporelles



- 2D (carte)



- 3D

- nD (relationnelles)

- Arbres (hiérarchies)



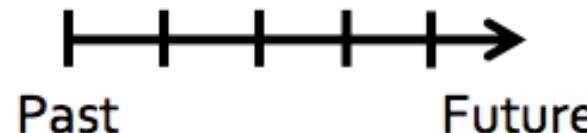
- Réseaux (graphes)

Types de données: taxonomie

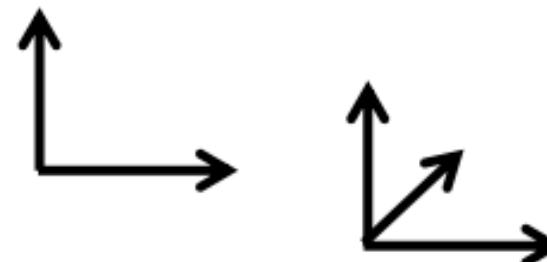
- 1D (linéaire)



- Temporelles



- 2D (carte)



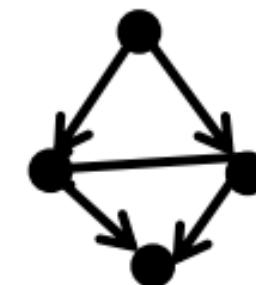
- 3D

- nD (relationnelles)

- Arbres (hiérarchies)



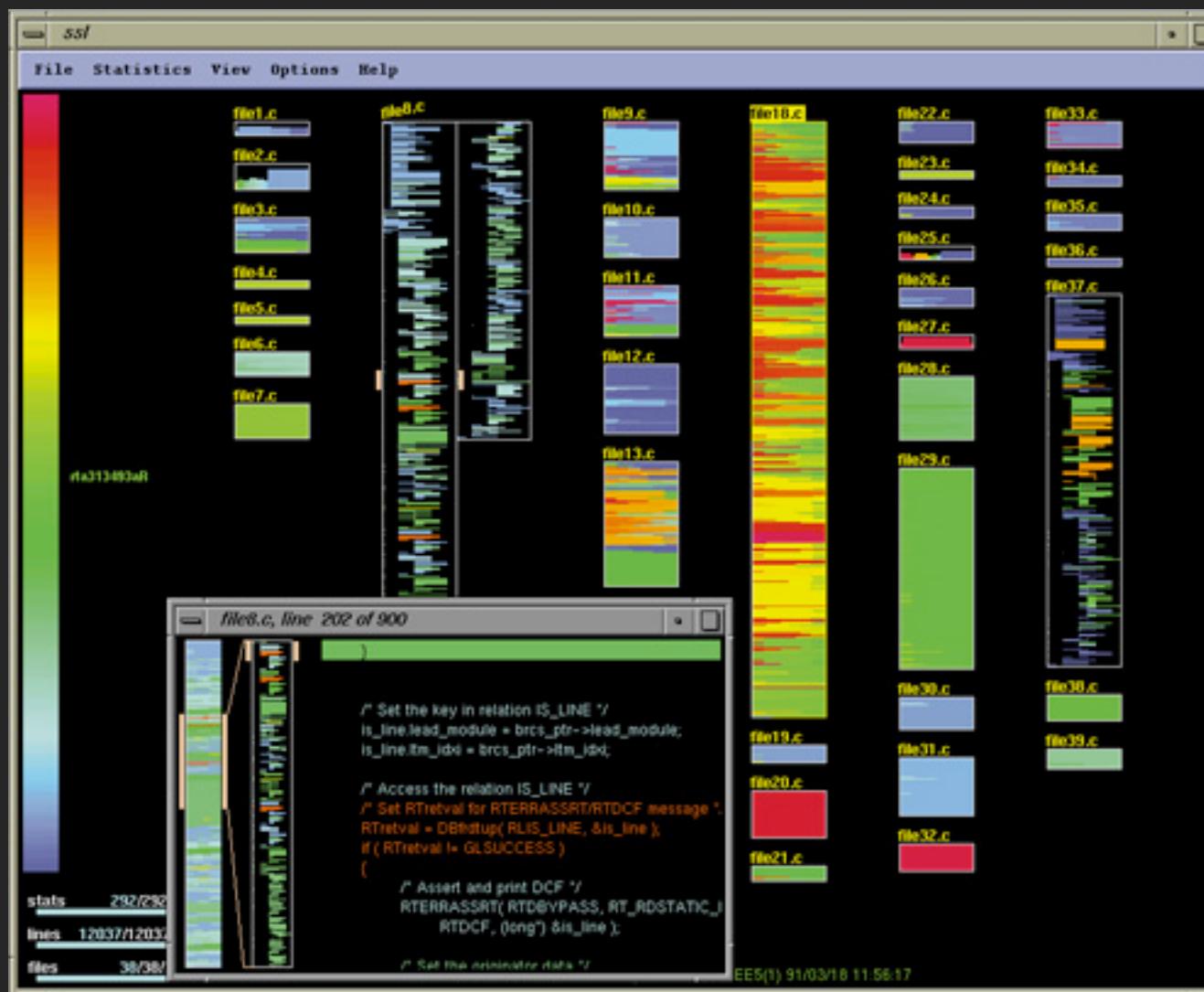
- Réseaux (graphes)



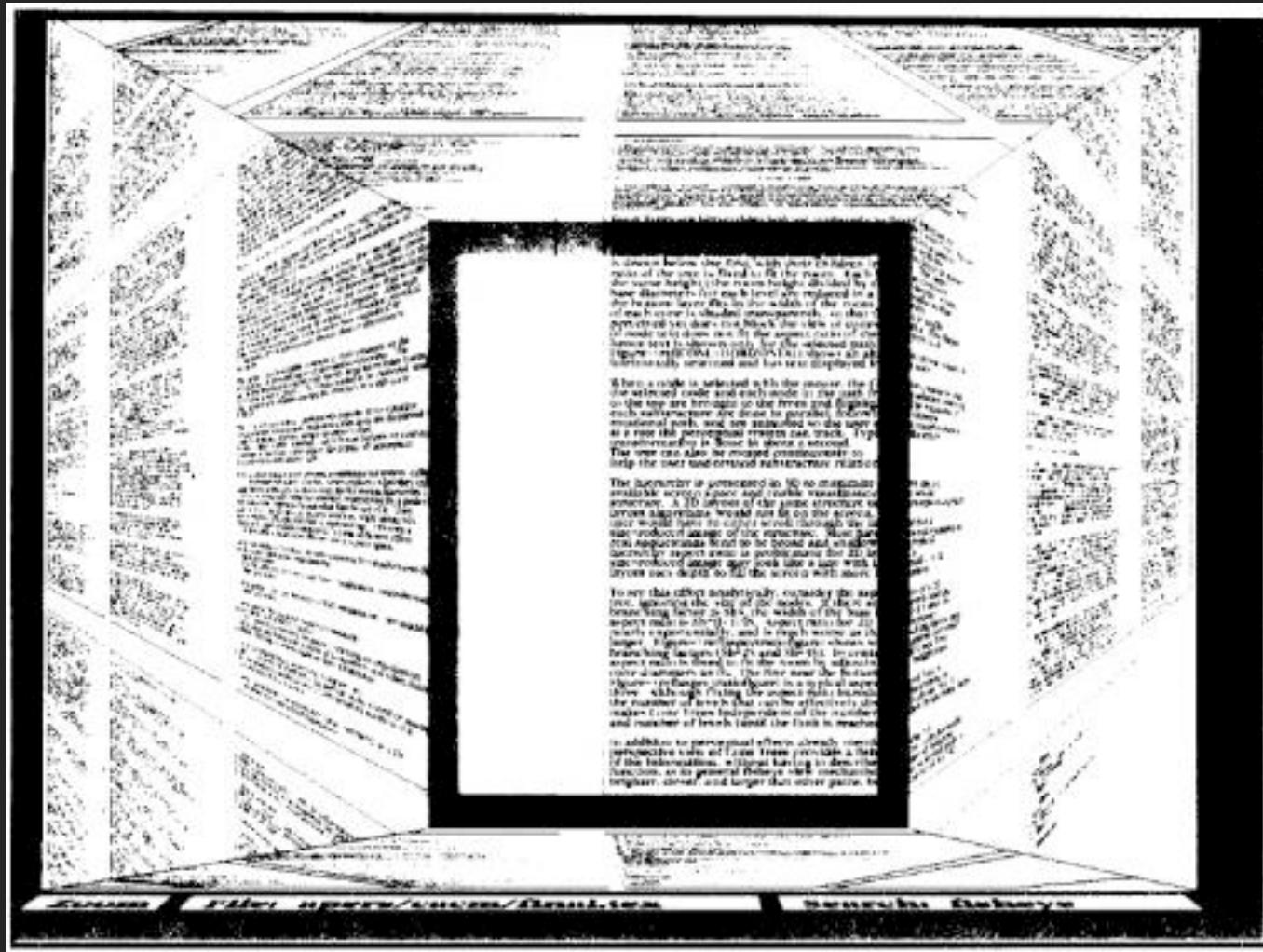
Pourquoi c'est important ?

- Les représentations visuelles les plus appropriées pour exprimer de données nominales, ordinaires, et quantitatives sont différentes
- Les différents types de données ont souvent des tâches propres
 - Données temporelles (comparer des évènements)
 - Hierarchies (comprendre les relations parent-enfants)
 - ...
- Mais:
 - Chacun des types de données (1D, 2D, ...) peut être représenté de multiples façons différentes !

1D – Linéaire

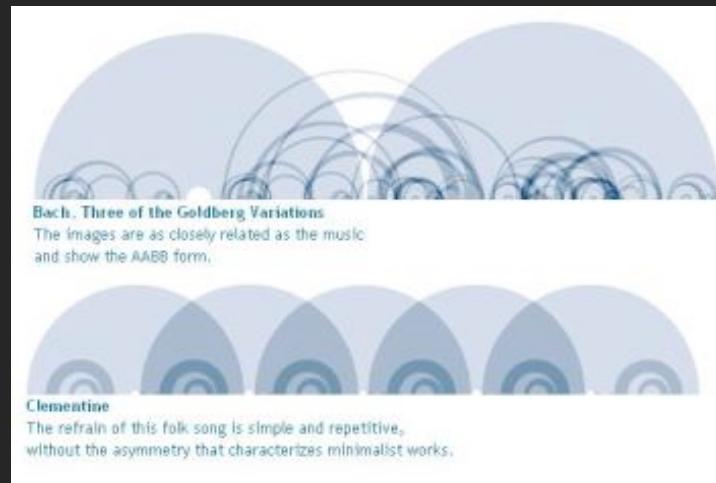
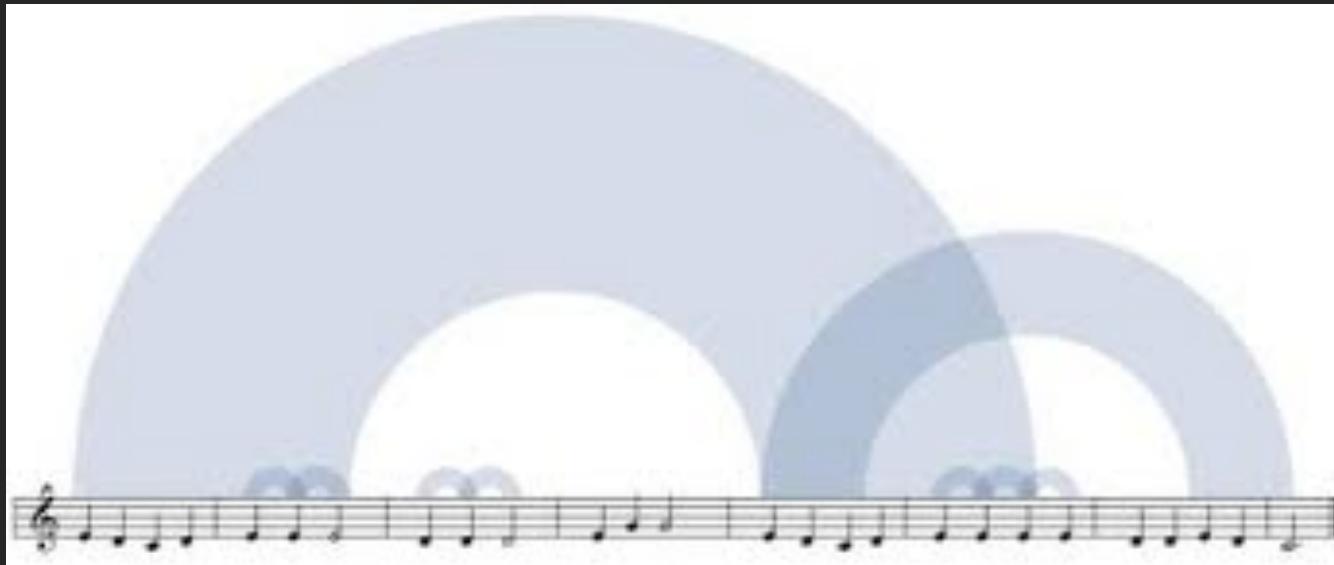


1D – Linéaire

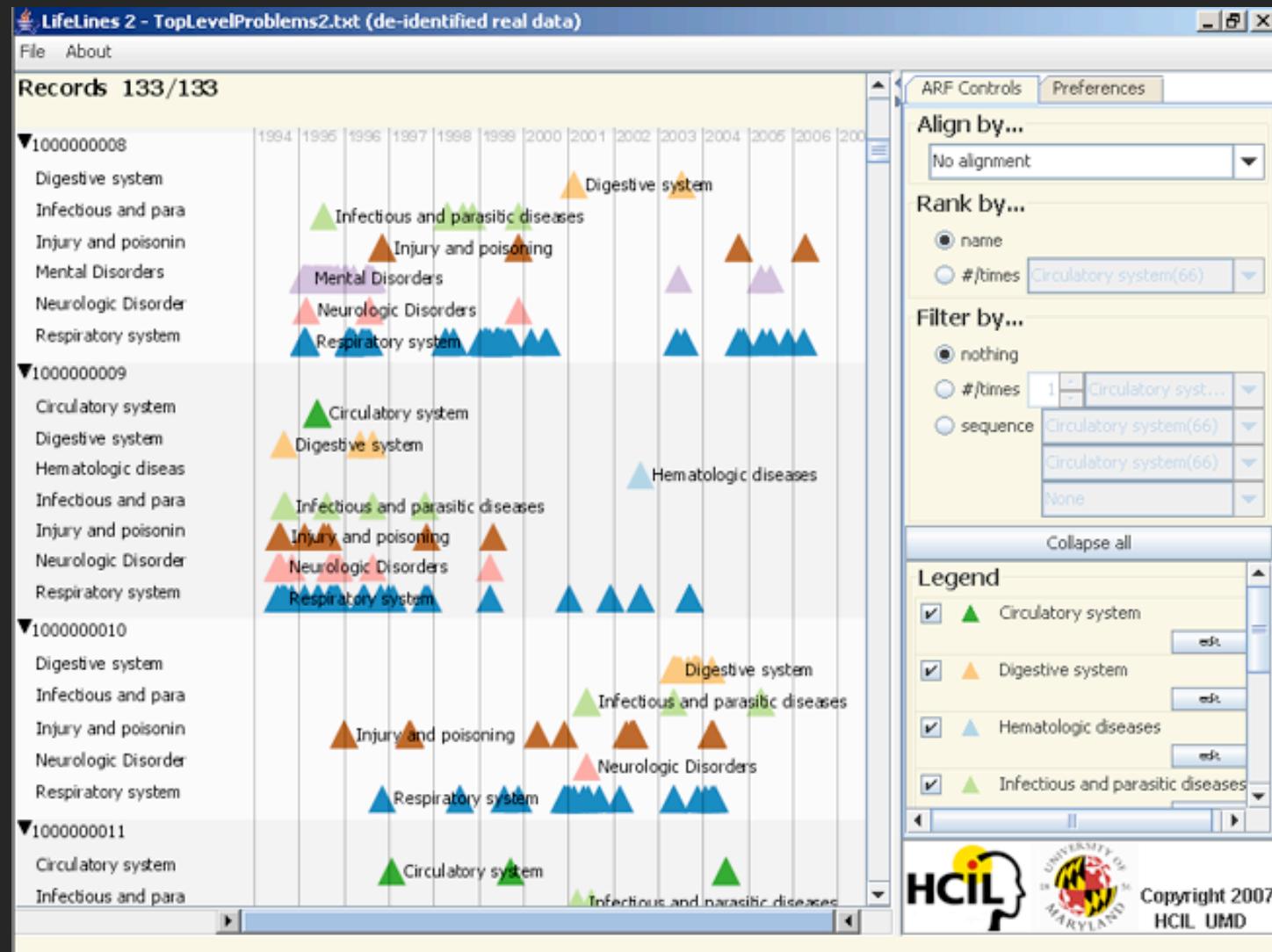


The Document Lens [Robertson & Mackinlay, UIST'93]

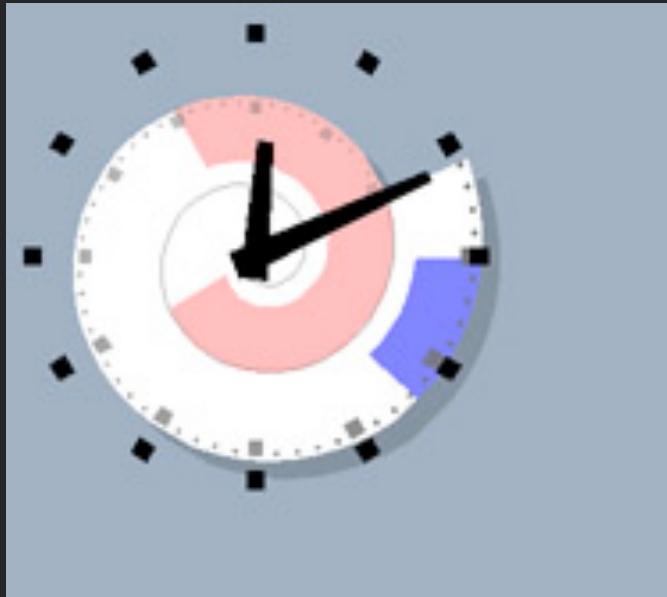
1D – Linéaire



Données temporelles



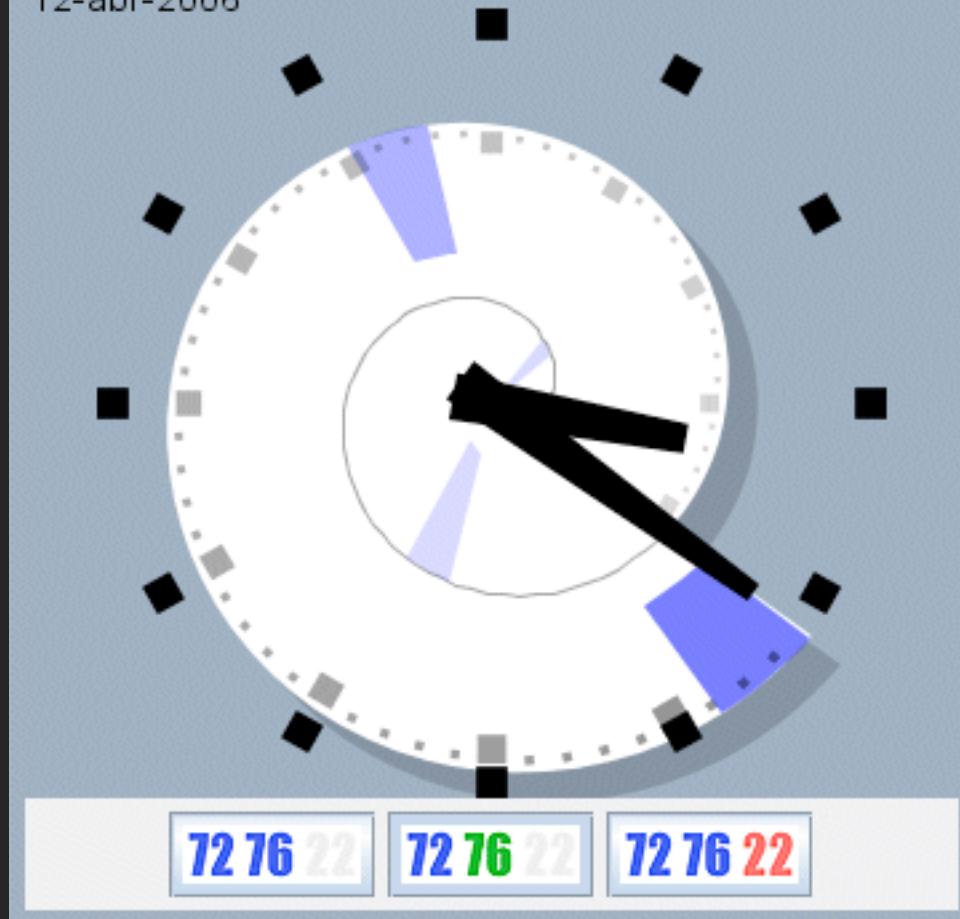
Données temporelles



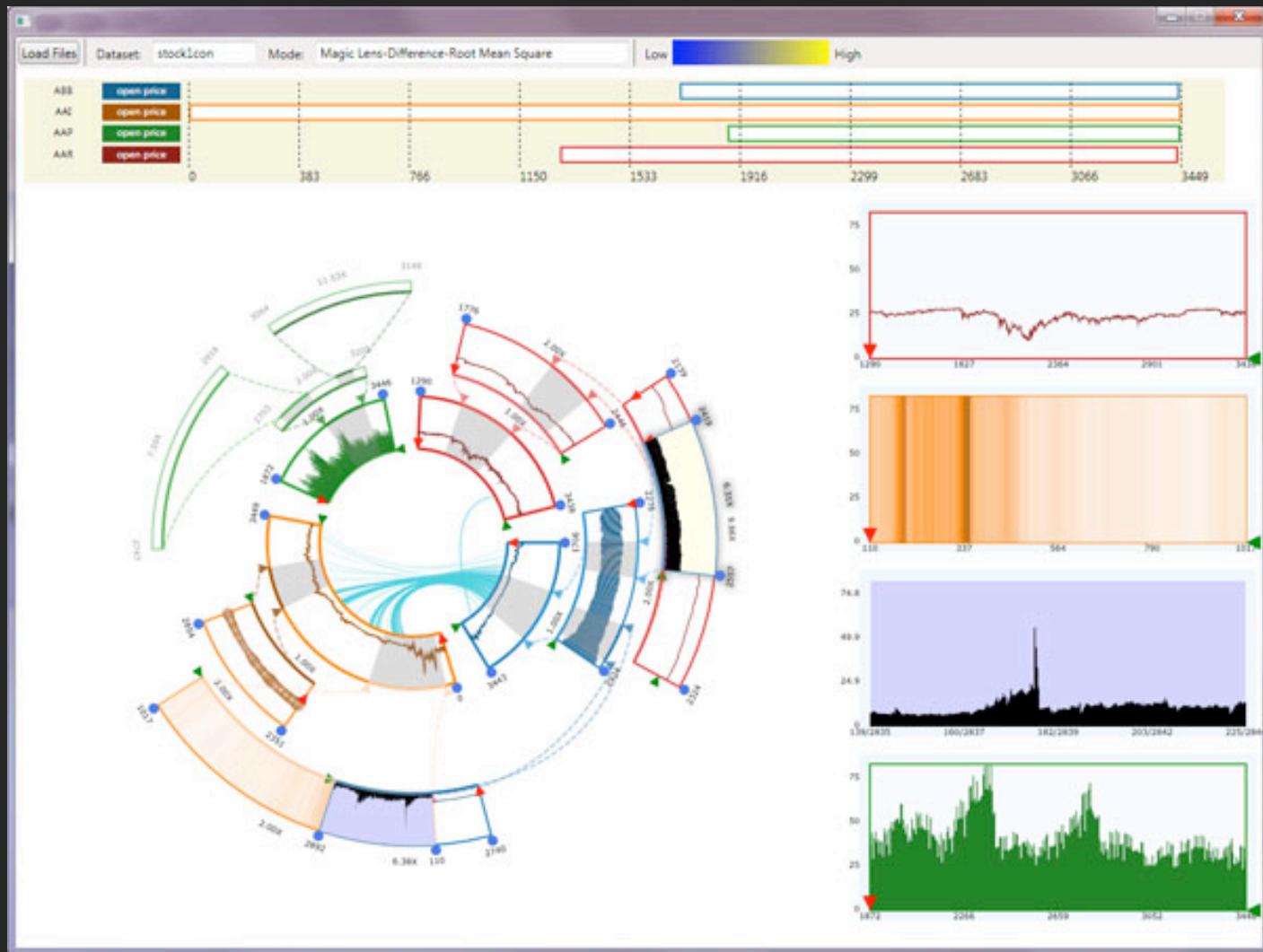
BusClock

Prochains bus en partance de Gachet:

12-abr-2006

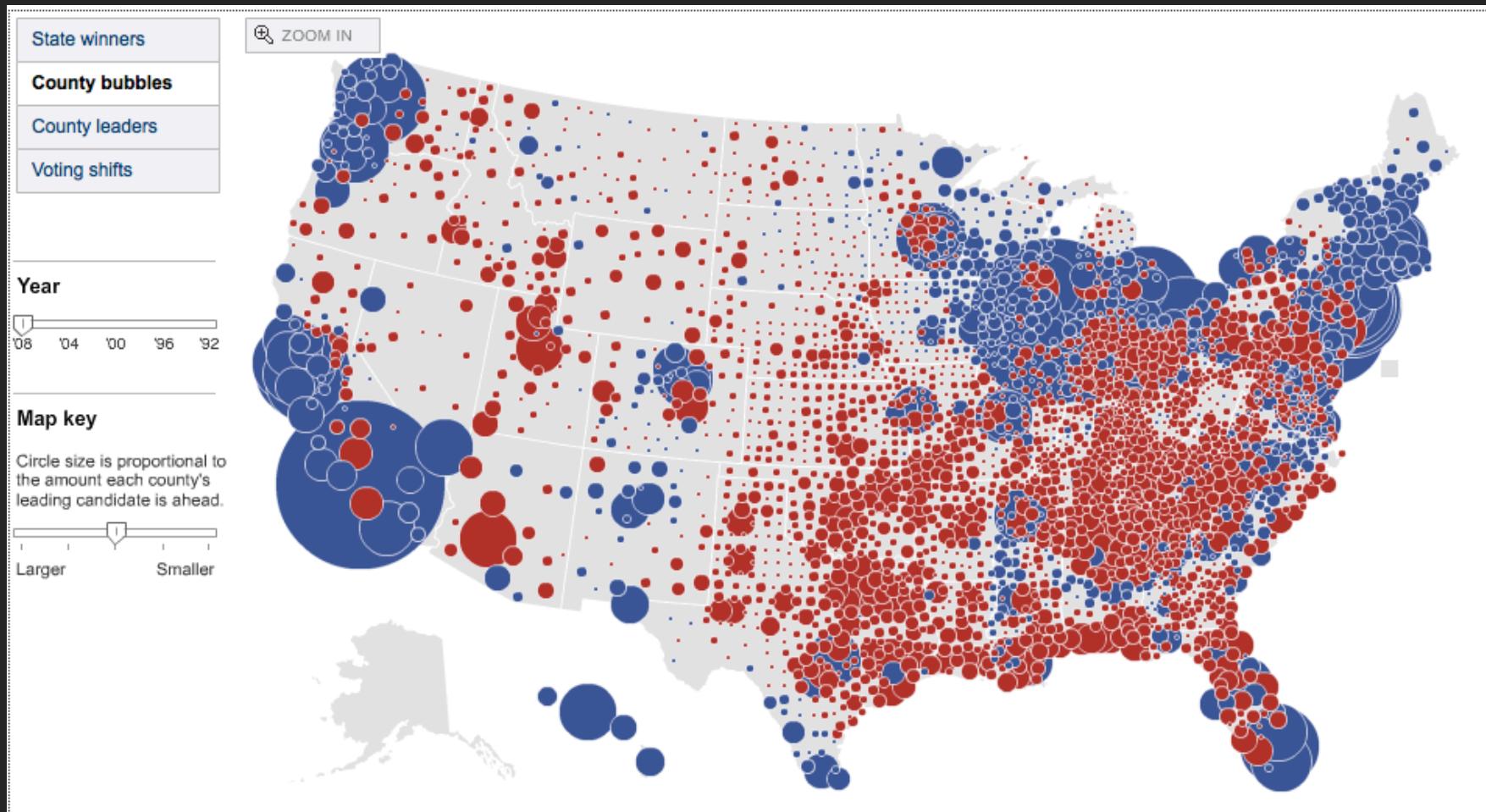


Données temporelles

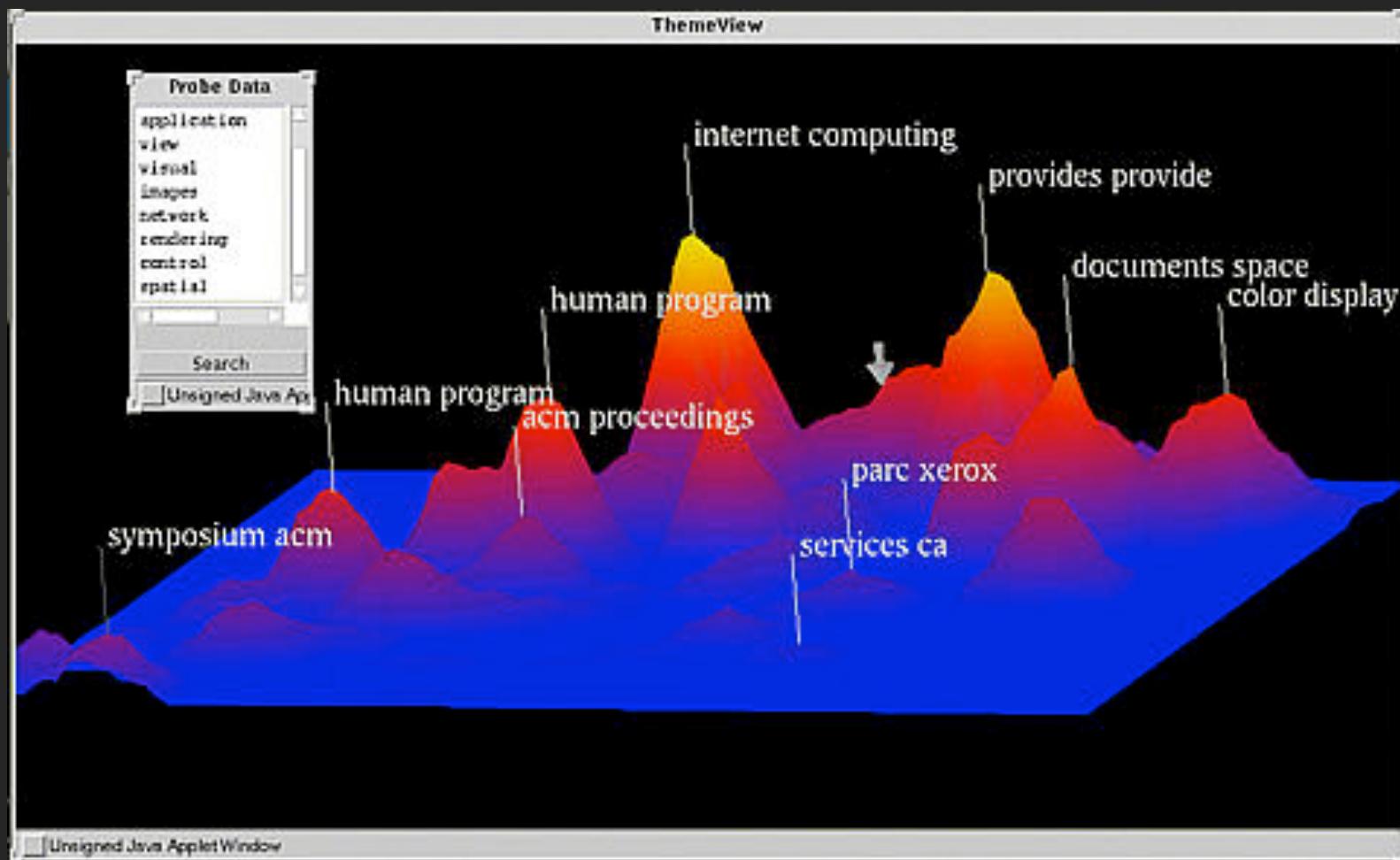


KronoMiner [Zhao et al. CHI'11]

2D - Cartes



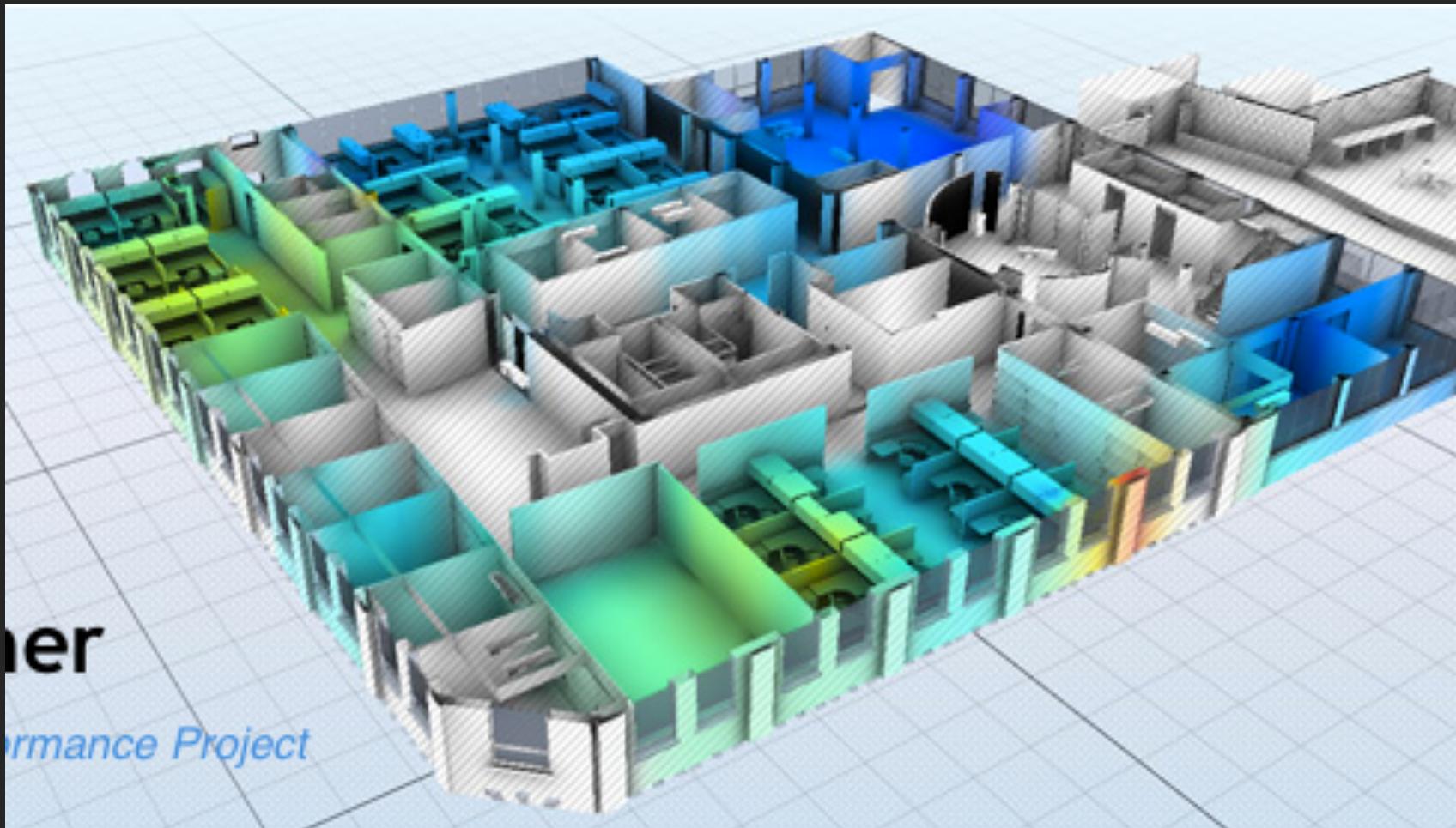
2D



ThemeView [Wise et al., Infovis '95]

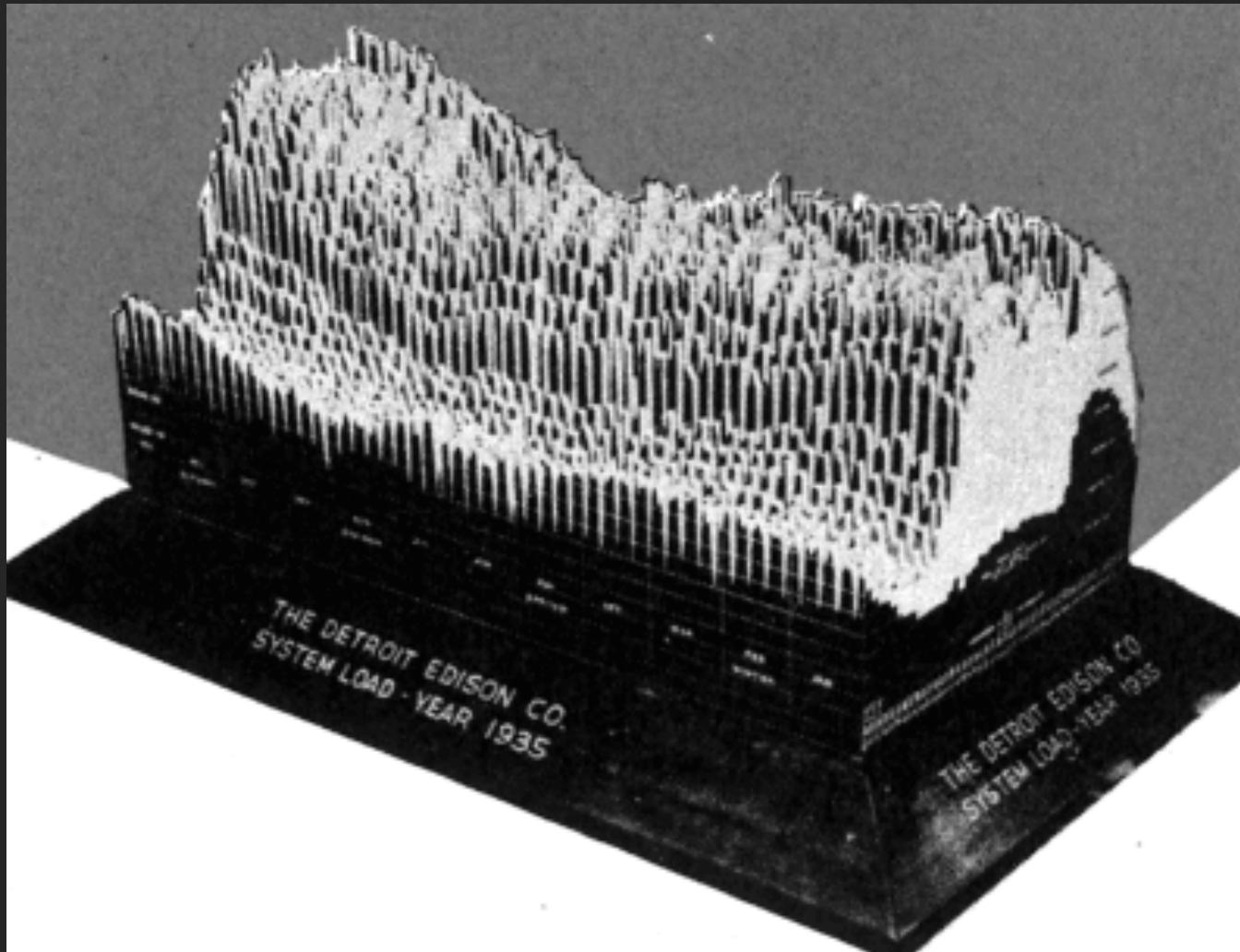


3D



3D

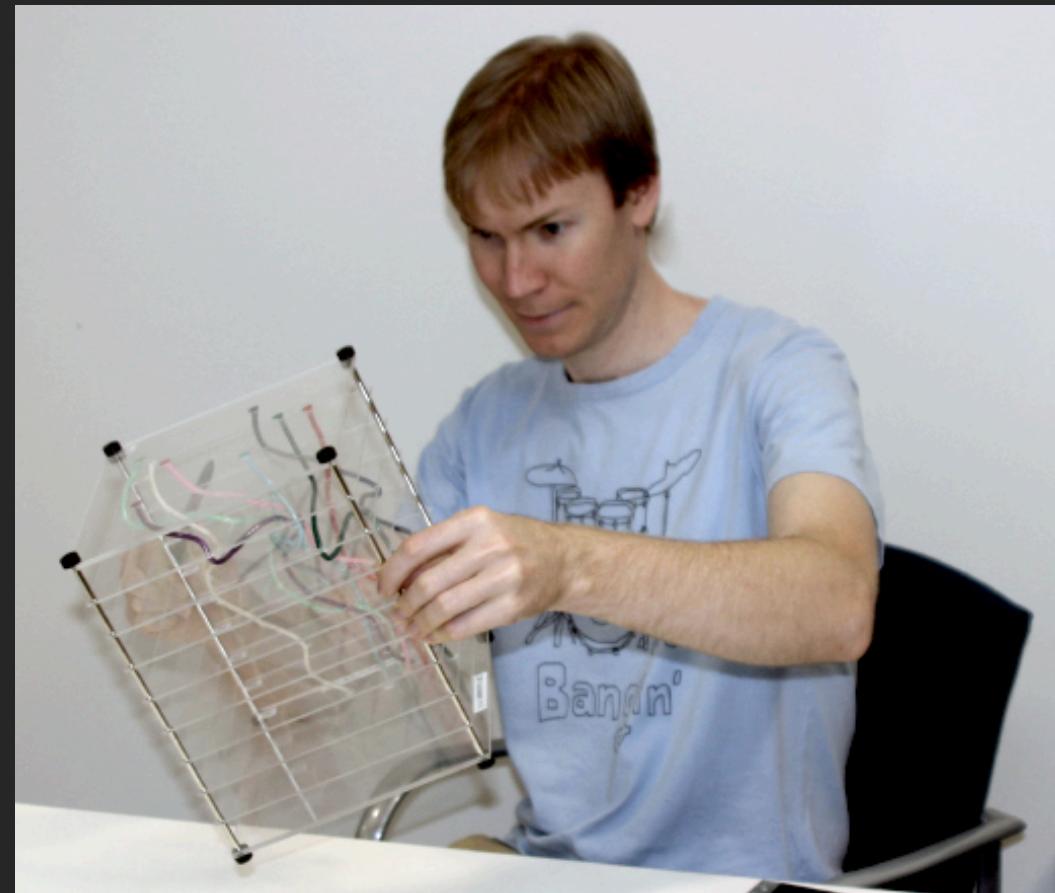
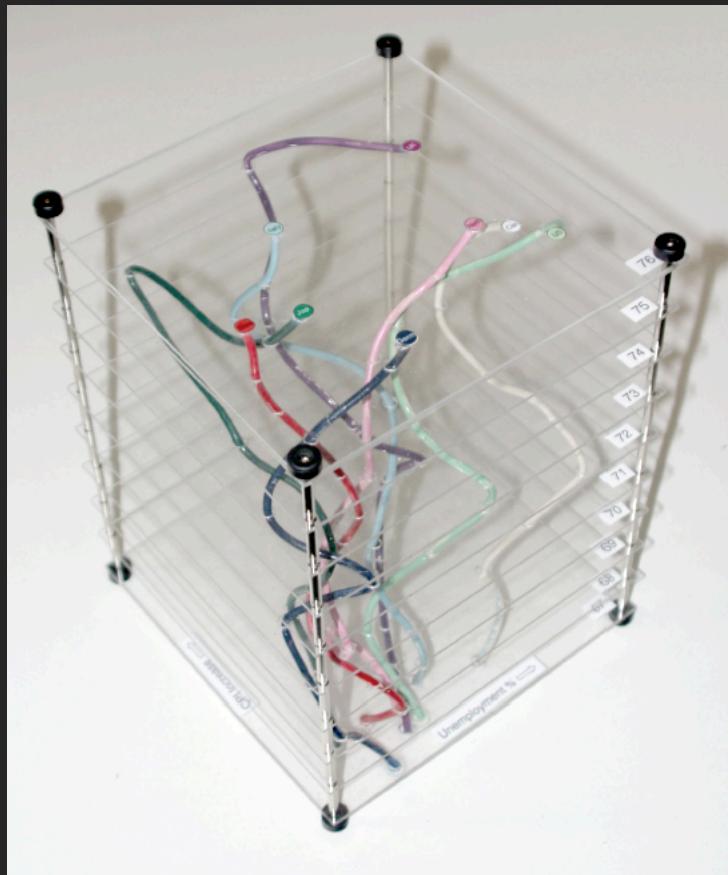
Consommation d'électricité pour l'année 1935.
Chaque tranche correspond à un jour, et chaque
jour est découpé en intervalles de 30min.



Willard Cope Brinton (1939) Graphic Presentation pp 364-365.

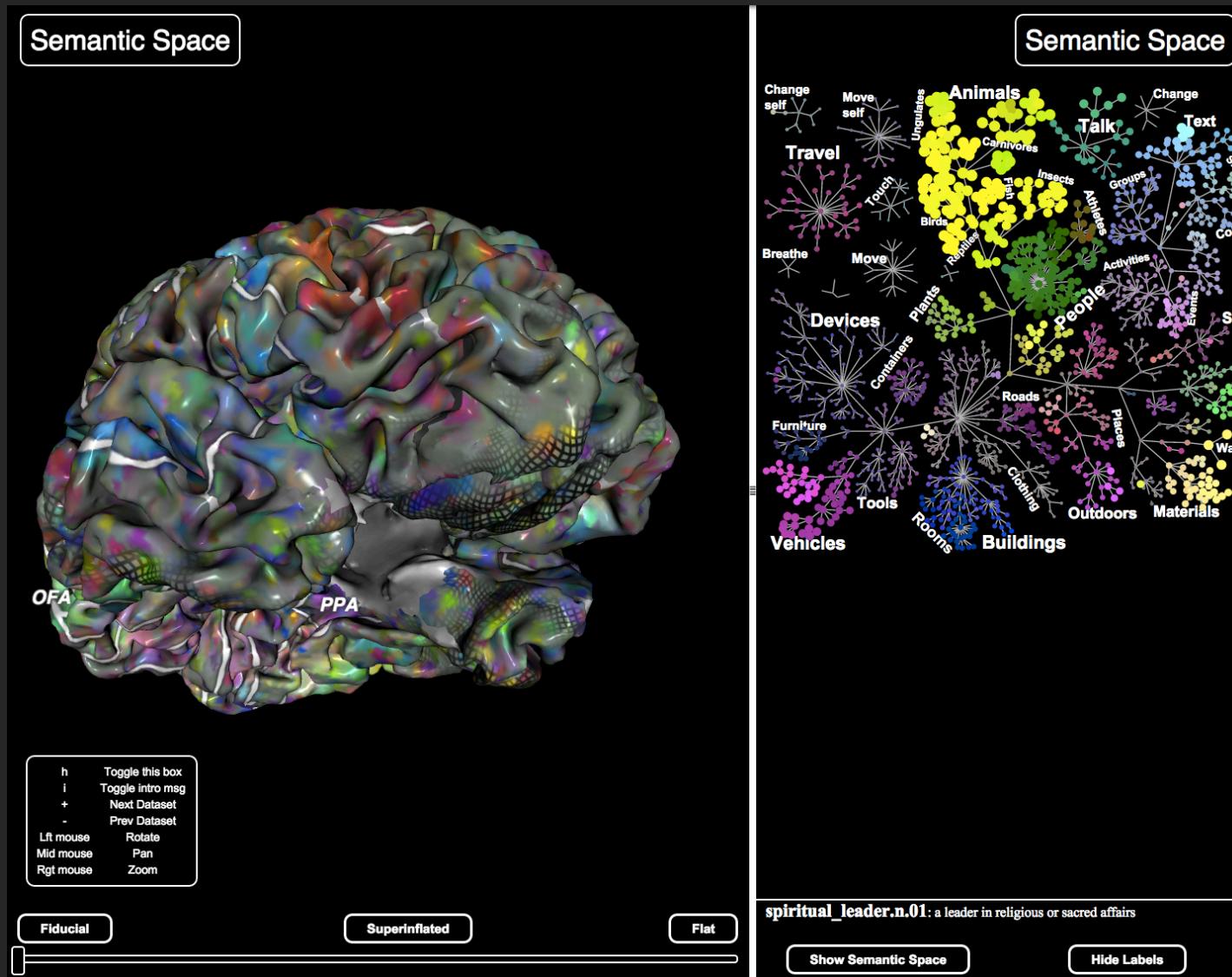
3D

Scatterplot temporel. Taux de chômage vs. inflation pour 8 pays, pour 10 années consécutives.

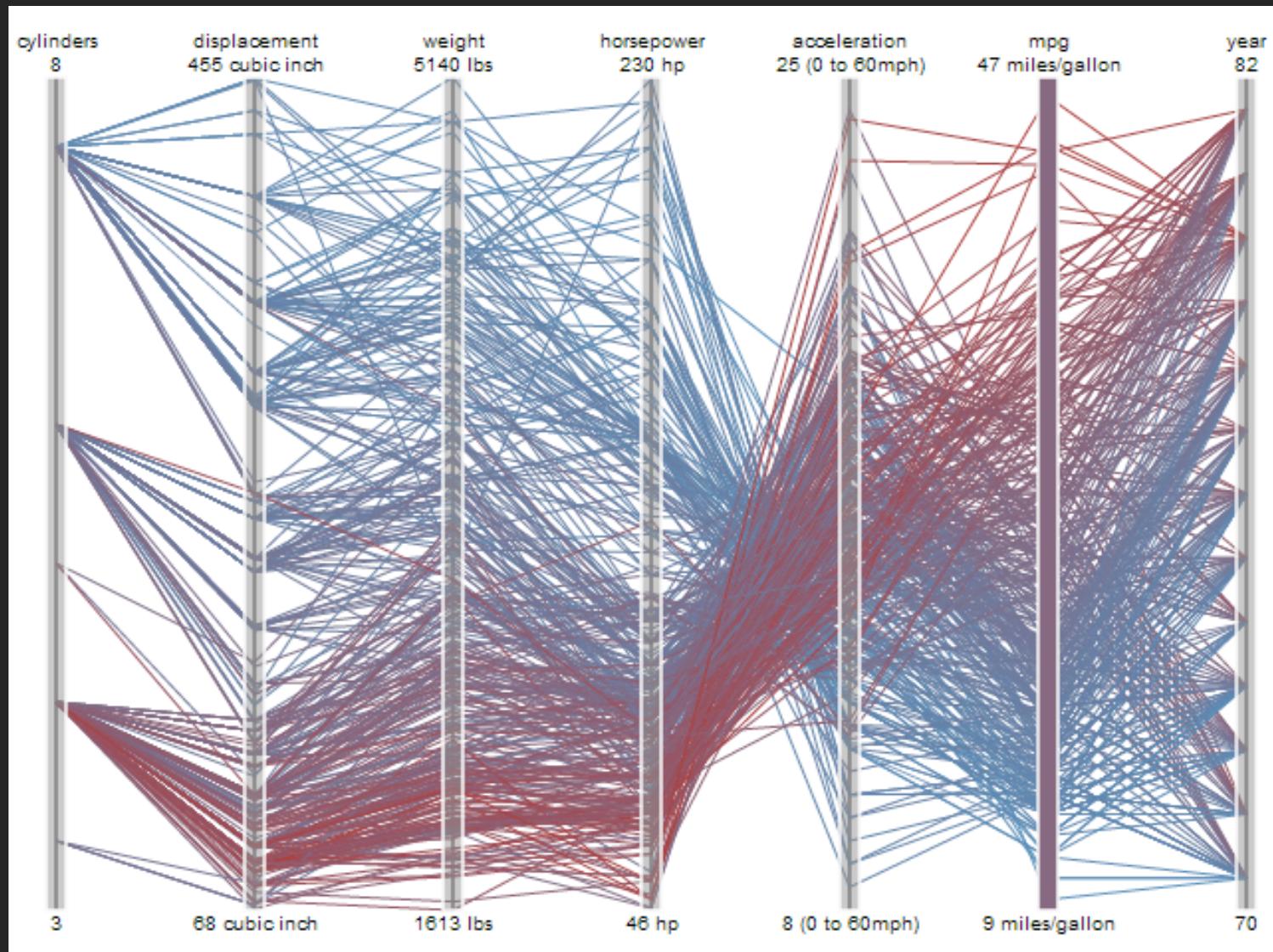


Source: Tim Dwyer (2005) Two and a Half Dimensional Visualization of Relational Networks. PhD Dissertation.

3D

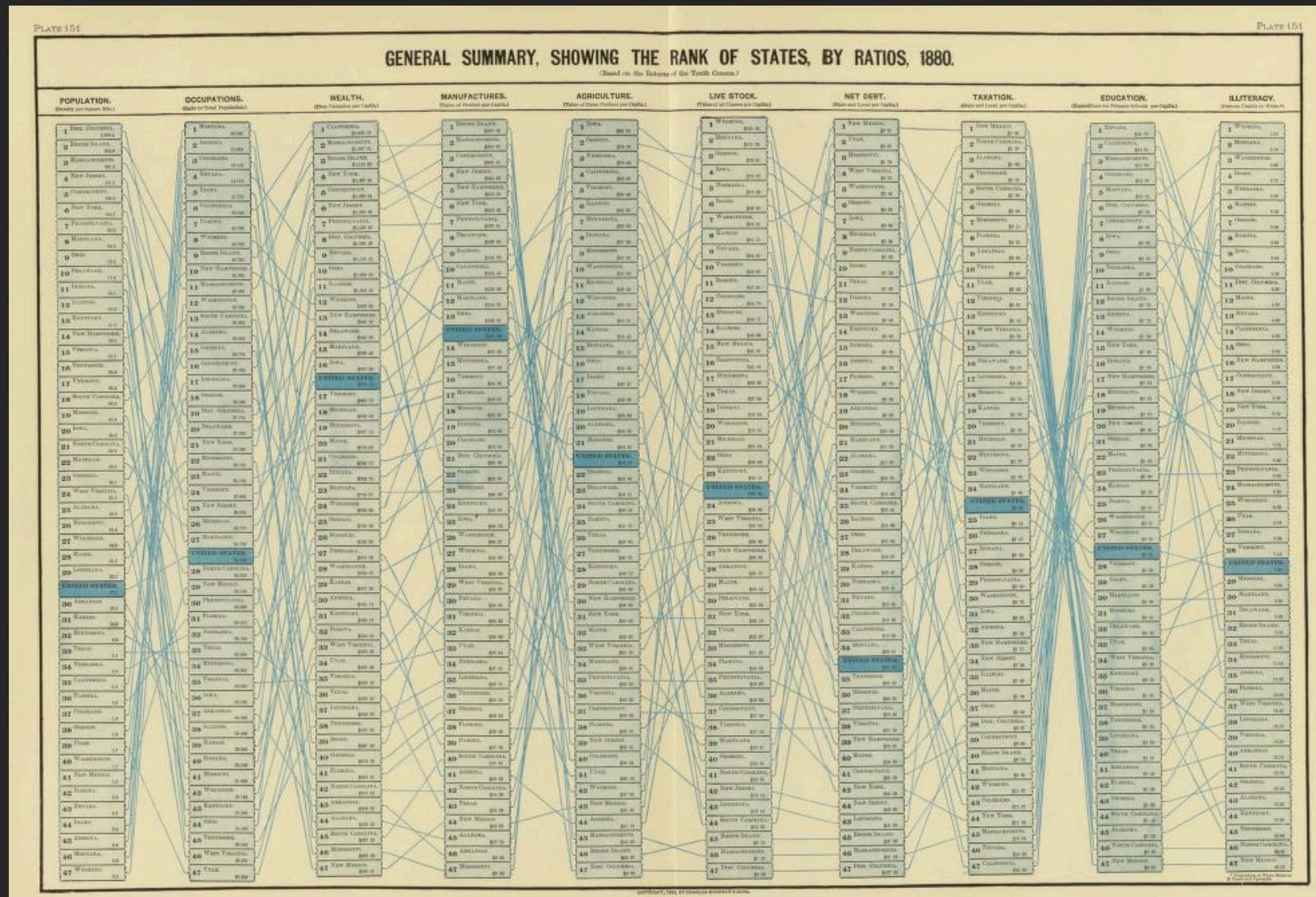


nD – Données multidimensionnelles



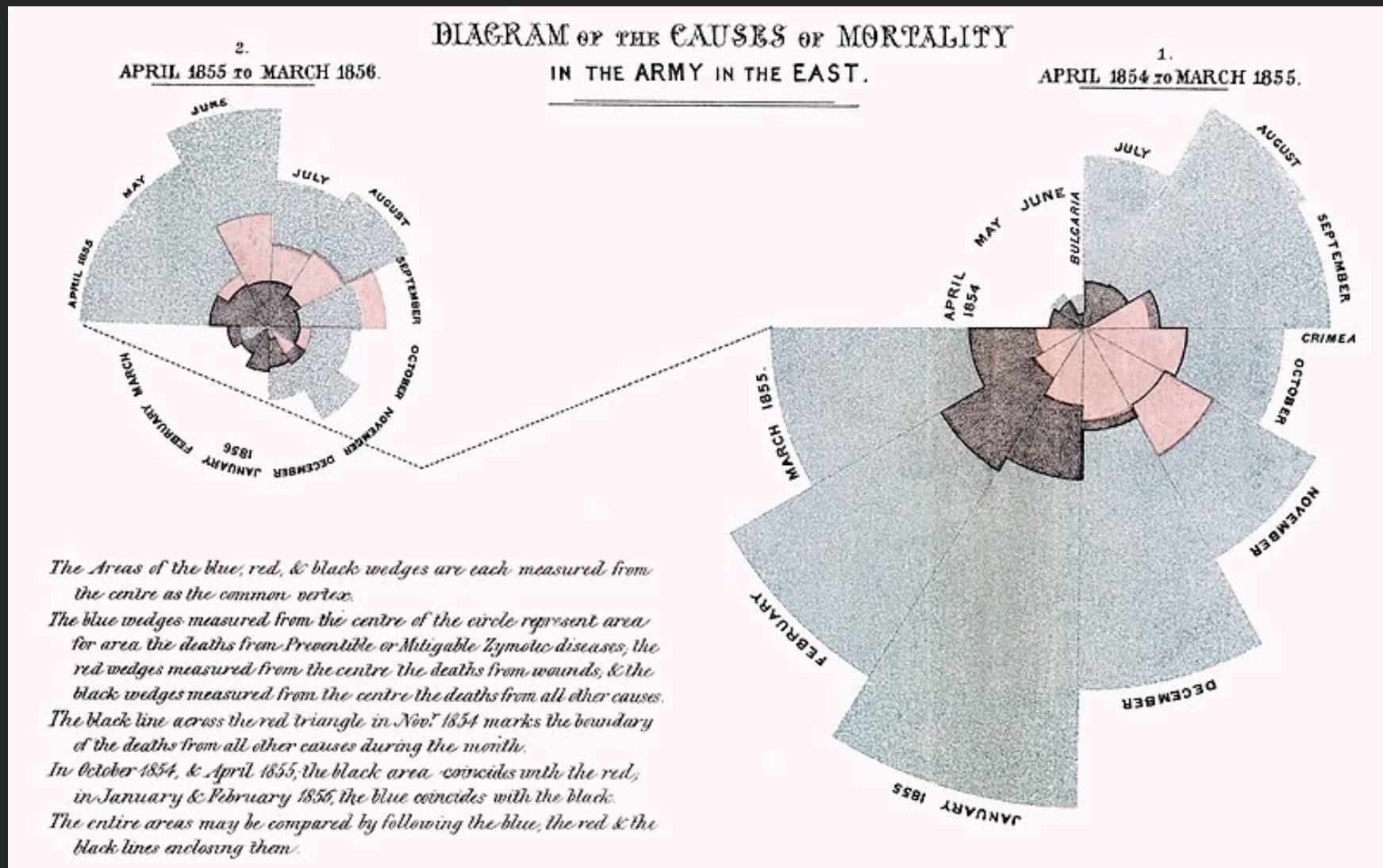
Source: A tour through the Visualization Zoo, by J. Heer, M. Bostock and V. Ogievetsky

nD – Données multidimensionnelles



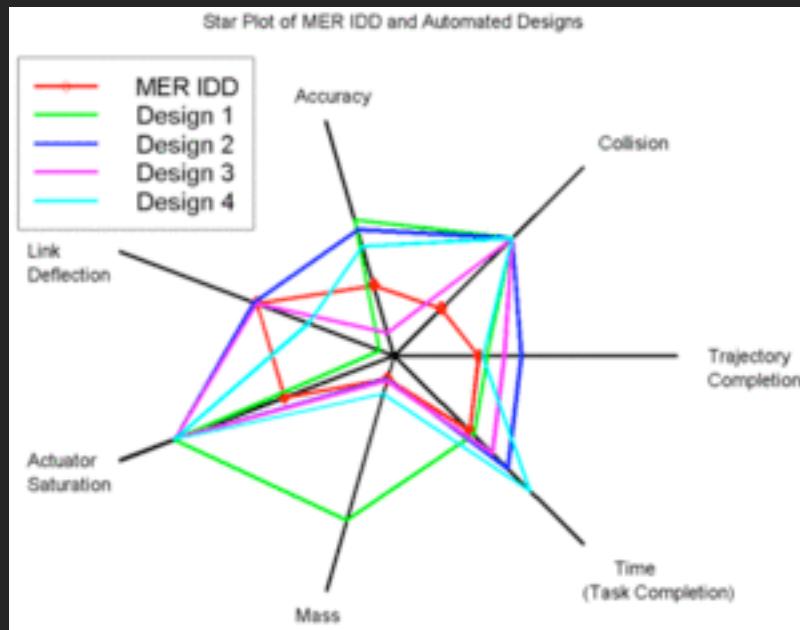
Gannett, Henry. "General Summary Showing the Rank of States by Ratios 1880"

nD – Données multidimensionnelles



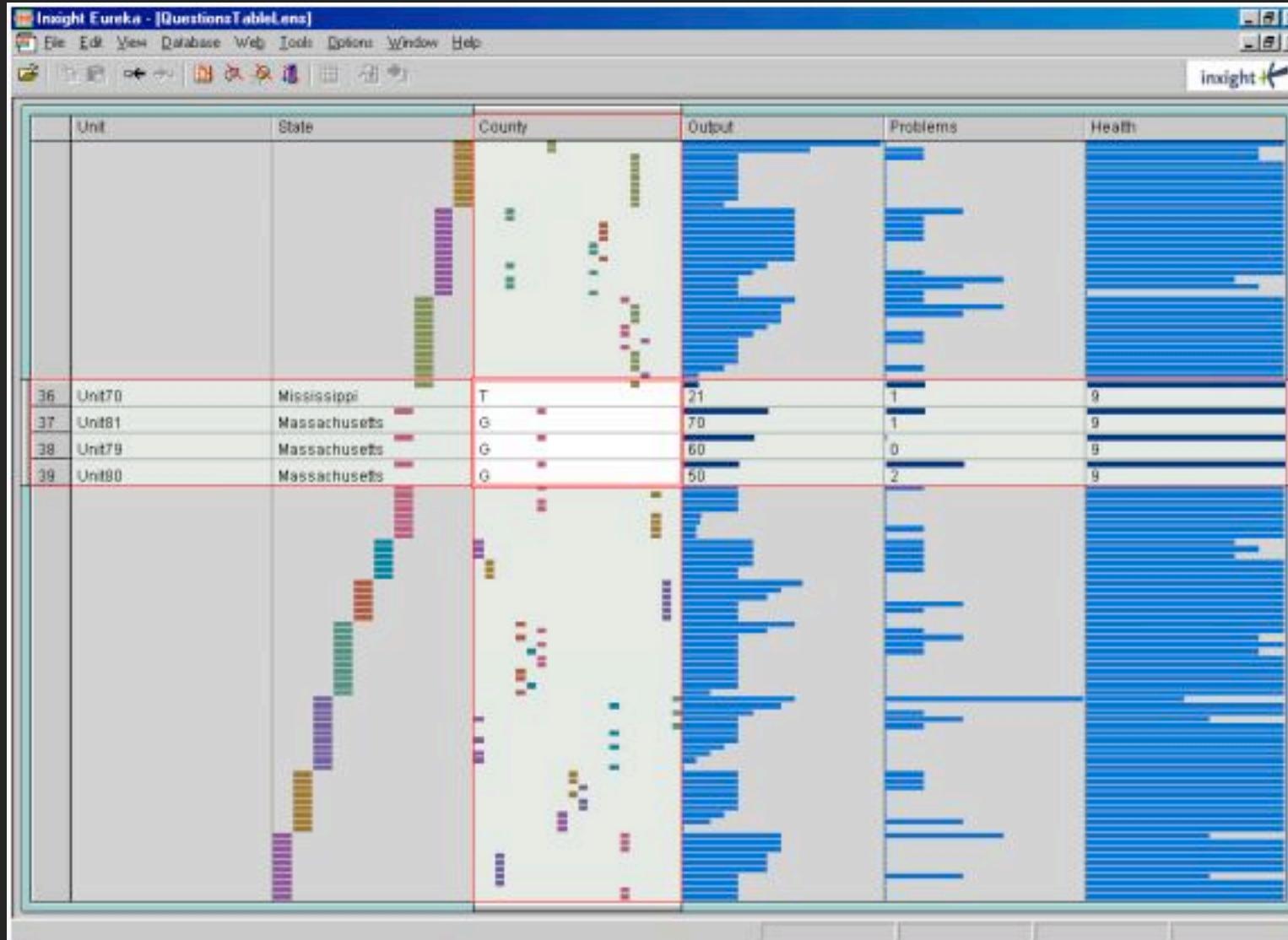
Rose / Polar Area Diagrams [Florence Nightingale, 1850's]

nD – Données multidimensionnelles



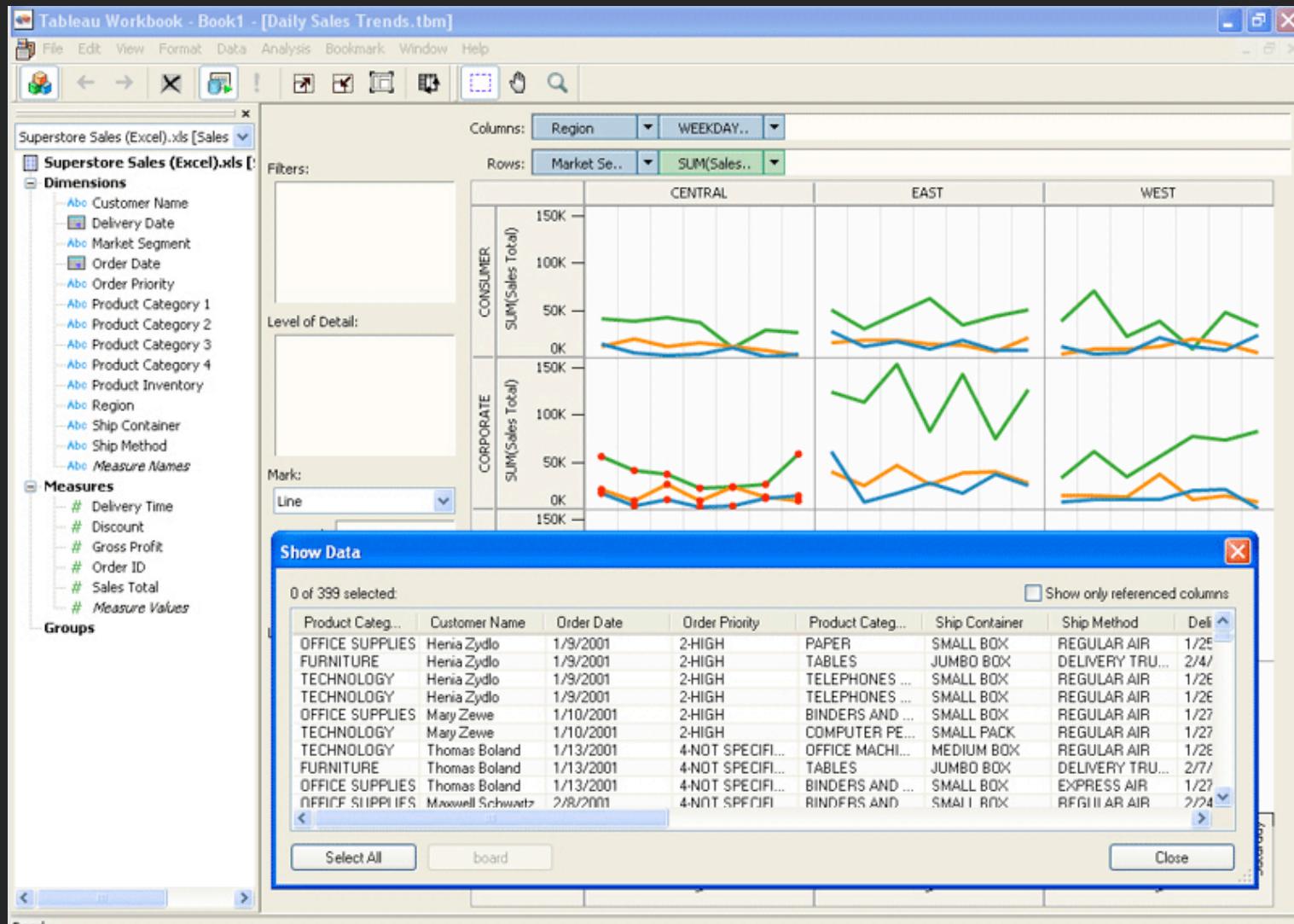
Star Plots, or Radar Charts

nD – Données multidimensionnelles

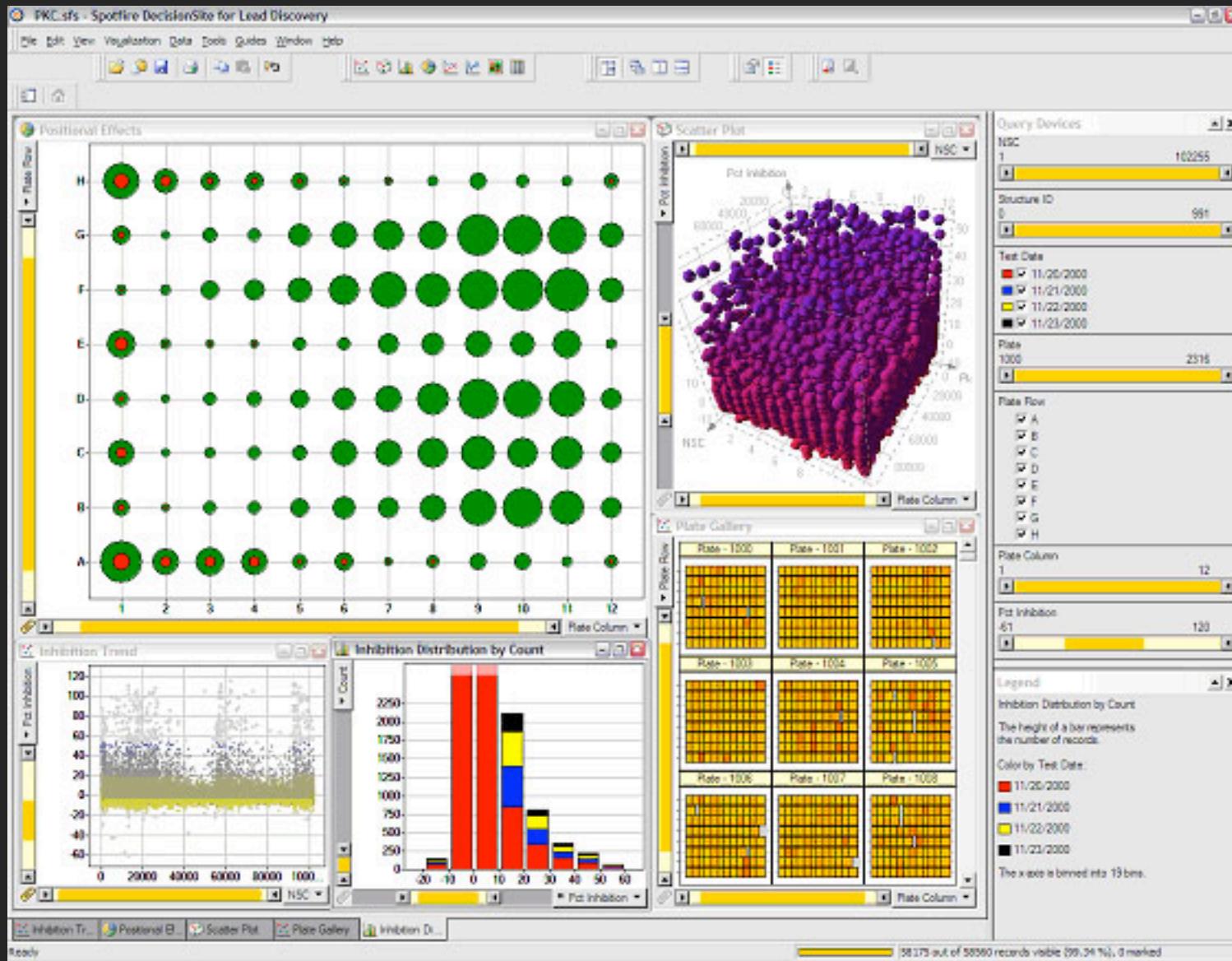


TableLens [Rao & Card, CHI'94]

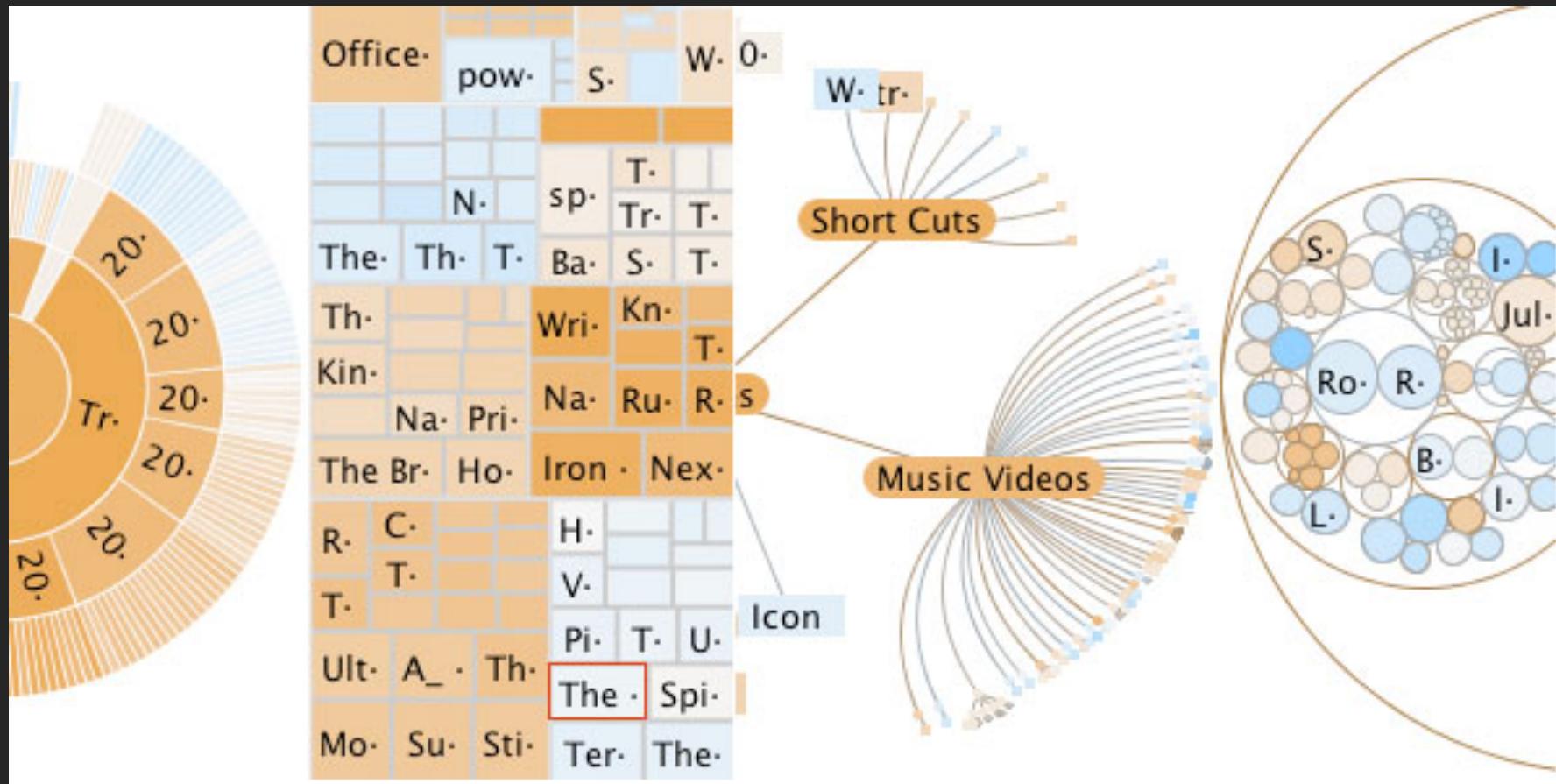
nD – Données multidimensionnelles



nD – Données multidimensionnelles

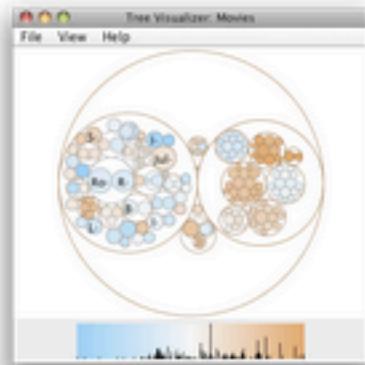


Arbres – Hiérarchies



Arbres – Hiérarchies

Circular Treemap:



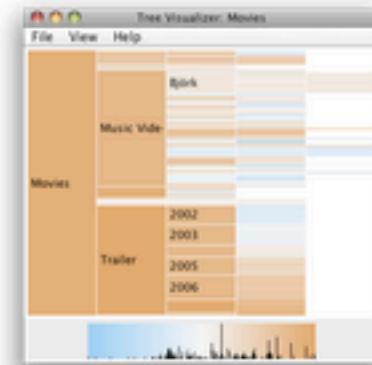
Rectangular Treemap:



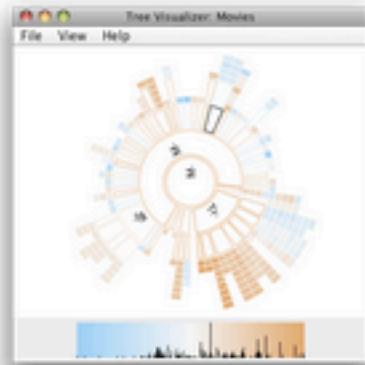
Sunburst Tree:



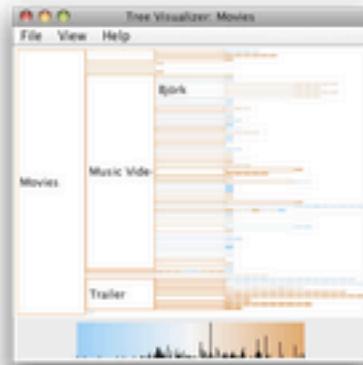
Icicle Tree:



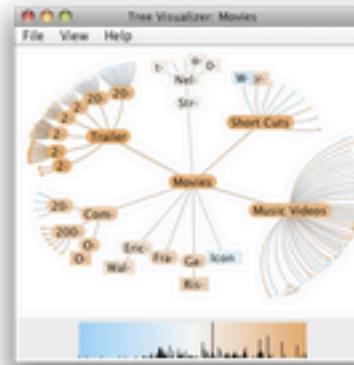
Sunray Tree:



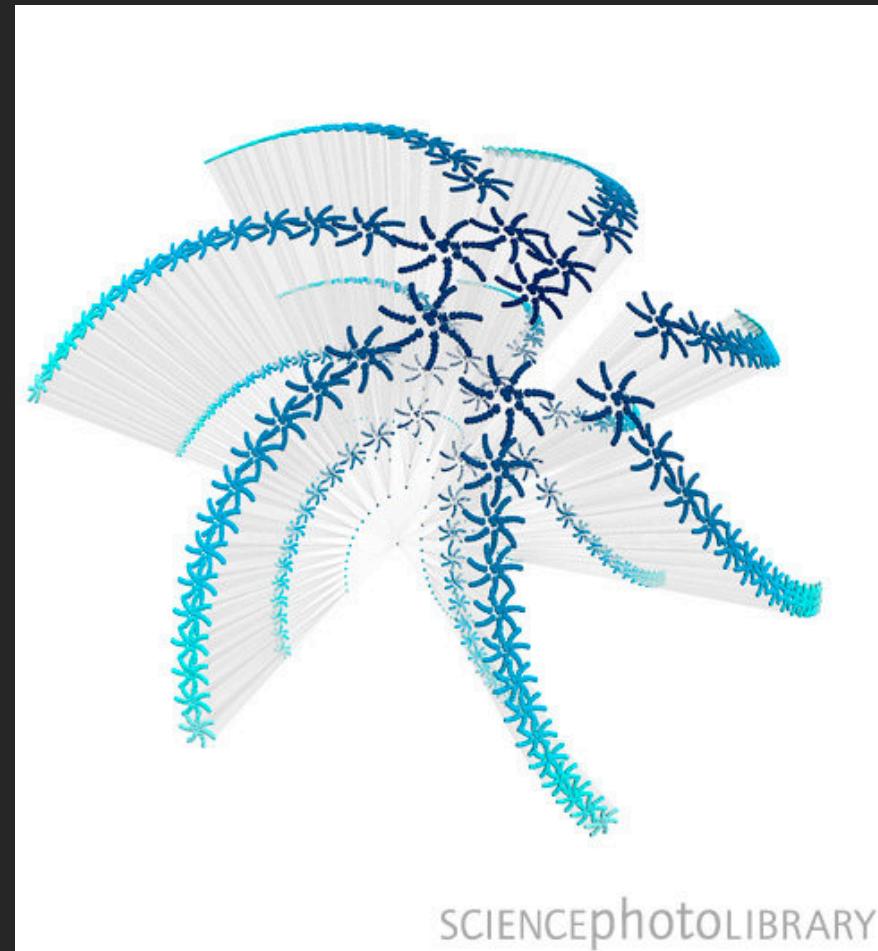
Iceray Tree:



Hyperbolic Tree:



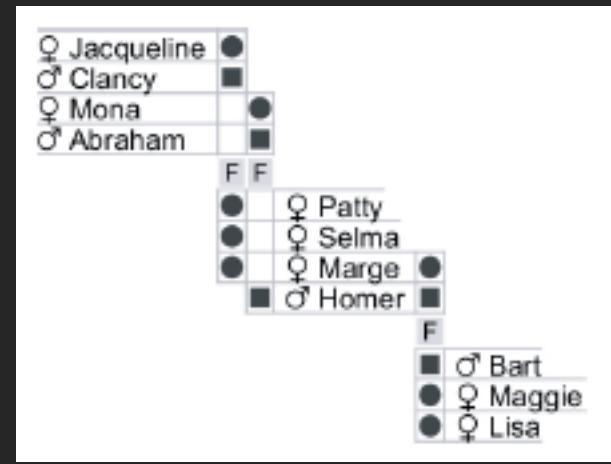
Arbres – Hiérarchies



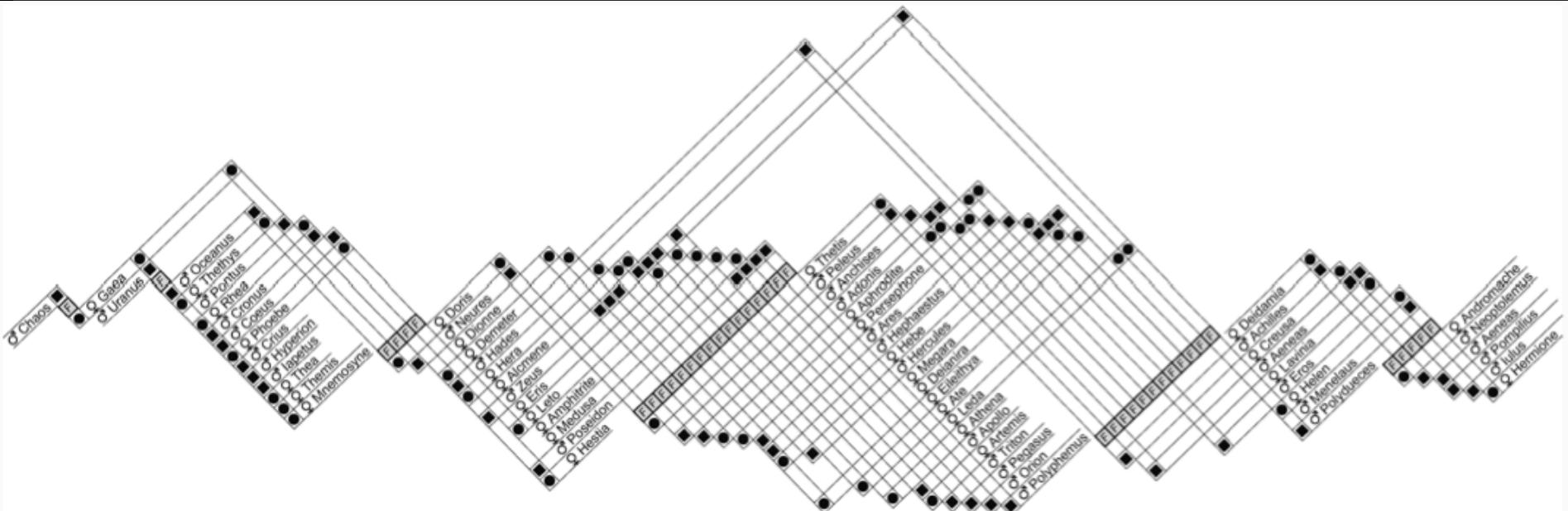
SCIENCEphotOLIBRARY

PhyloTrees, Neuman et al. EuroVis'06

Arbres – Hiérarchies



Arbres – Hiérarchies



GeneaQuilts

A System for Exploring
Large Genealogies

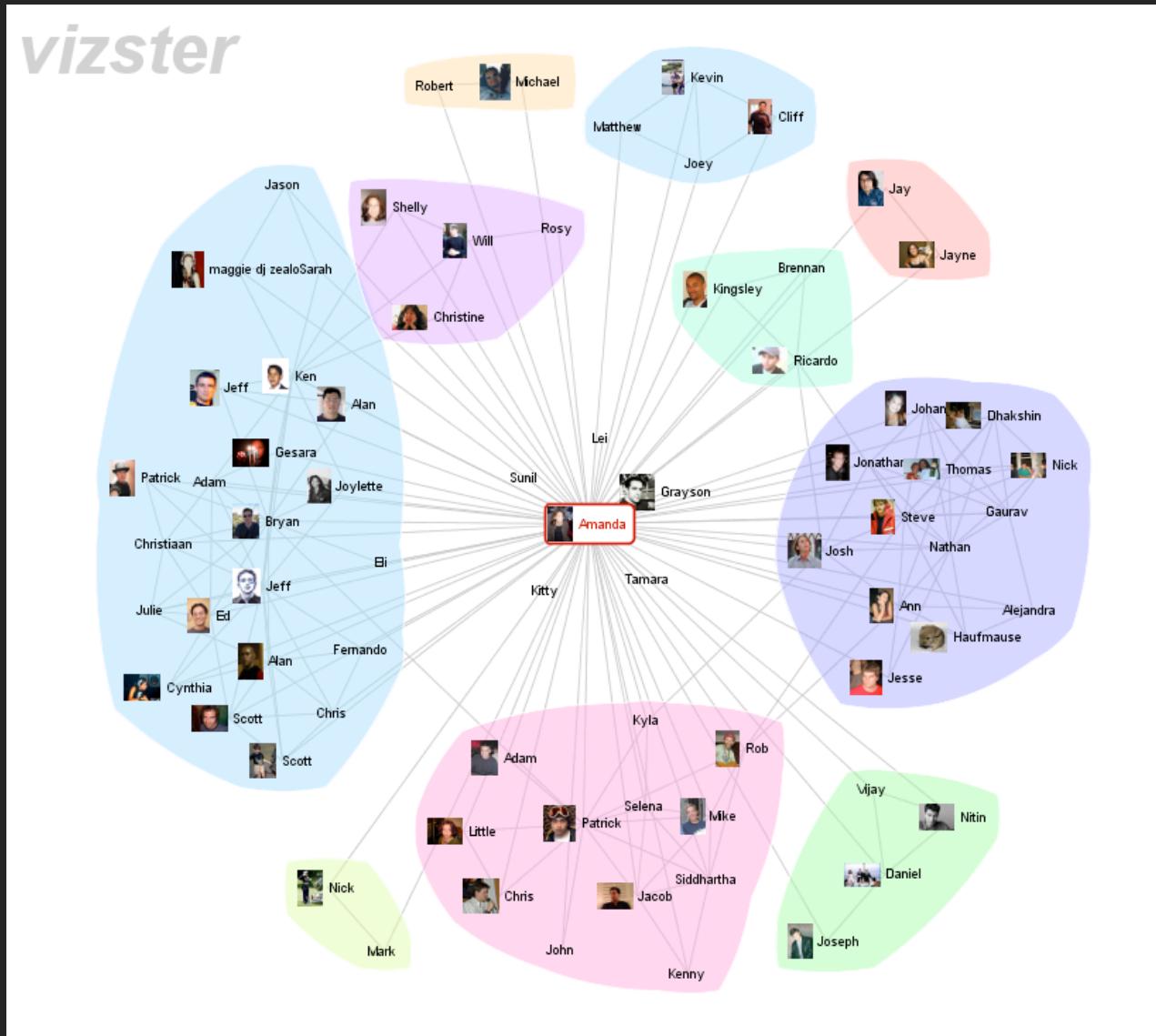
A. Bezerianos P. Dragicevic J.-D. Fekete J. Bae B. Watson

Visualisation d'arbres: Survey

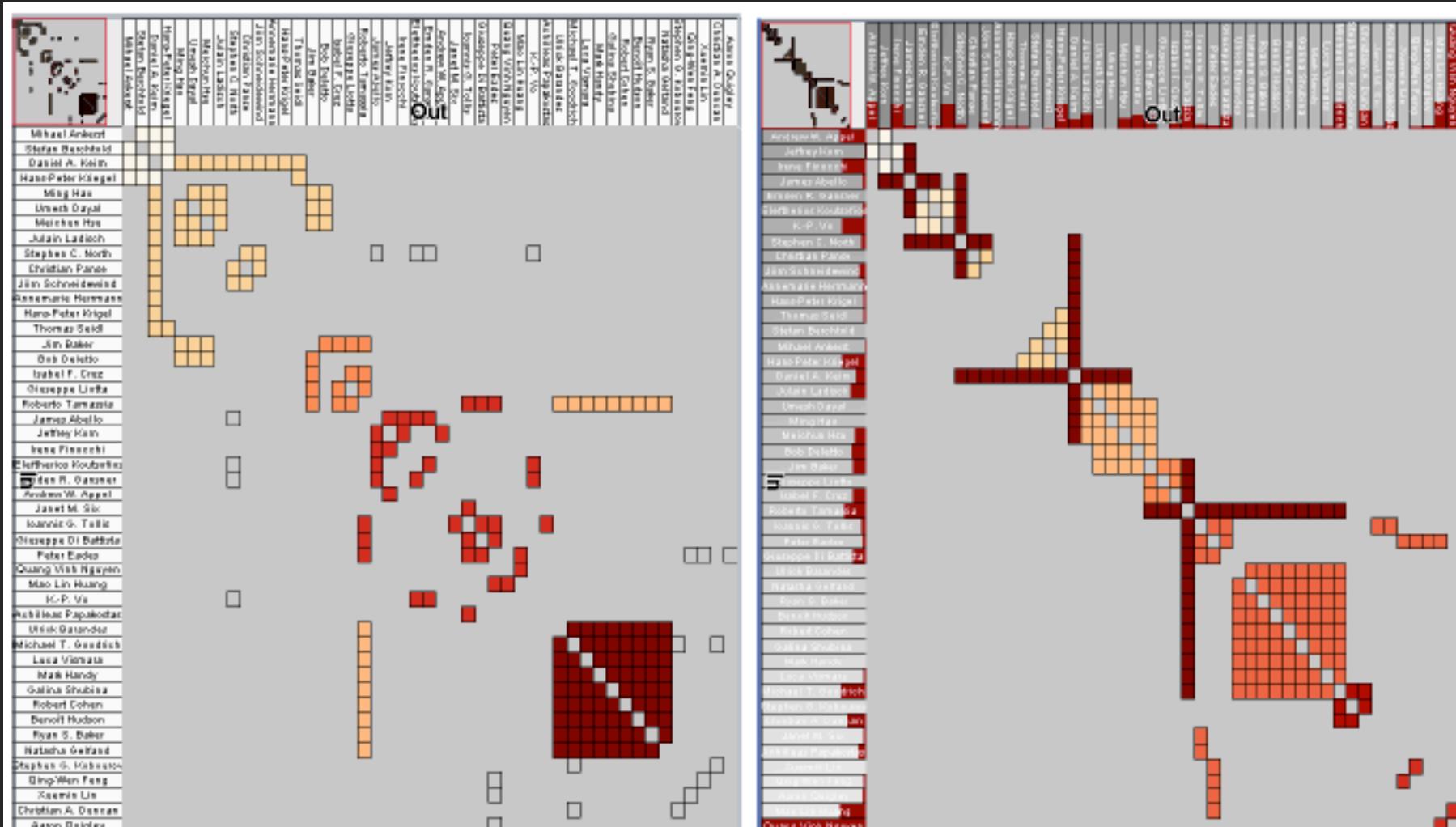


<http://vcg.informatik.uni-rostock.de/~hs162/treeposter/oldposter/poster.html>

Réseaux

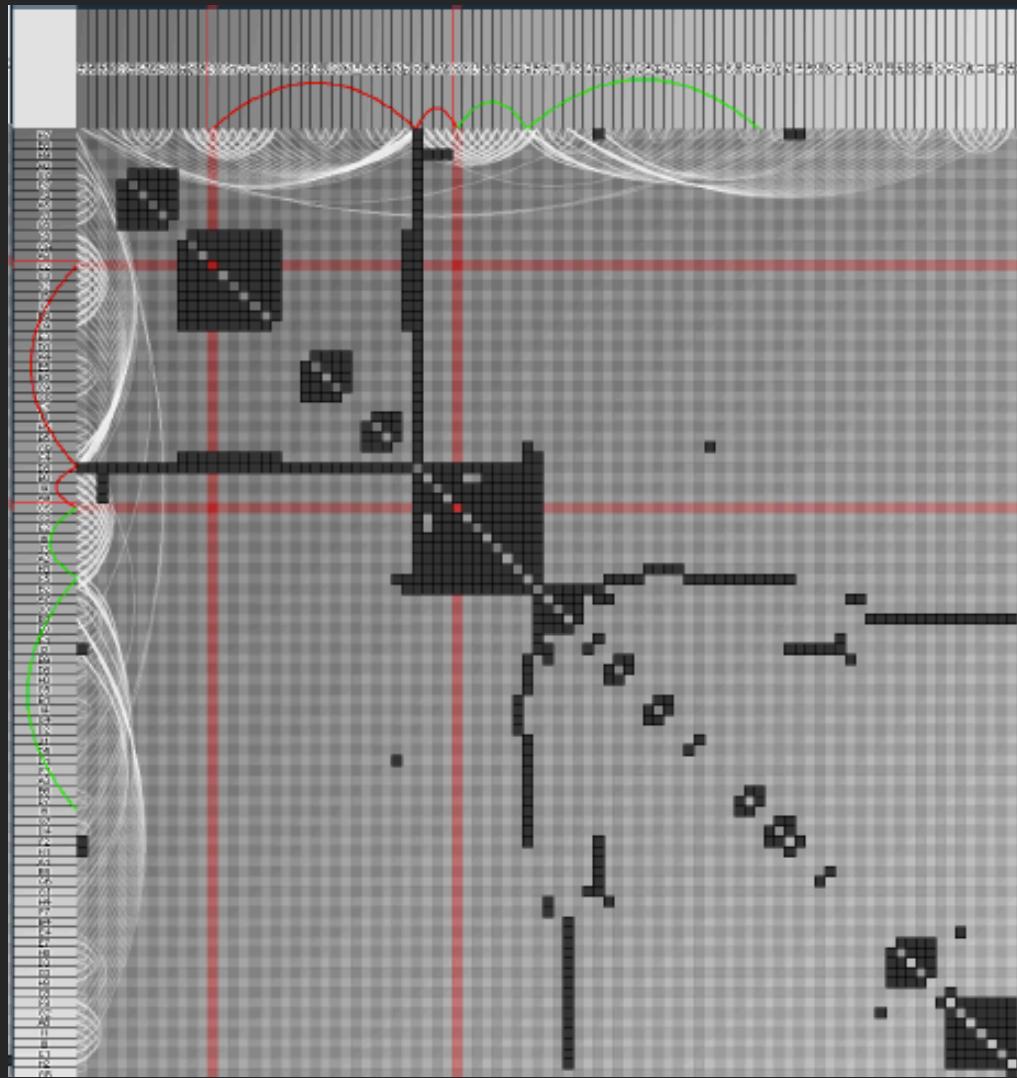


Réseaux



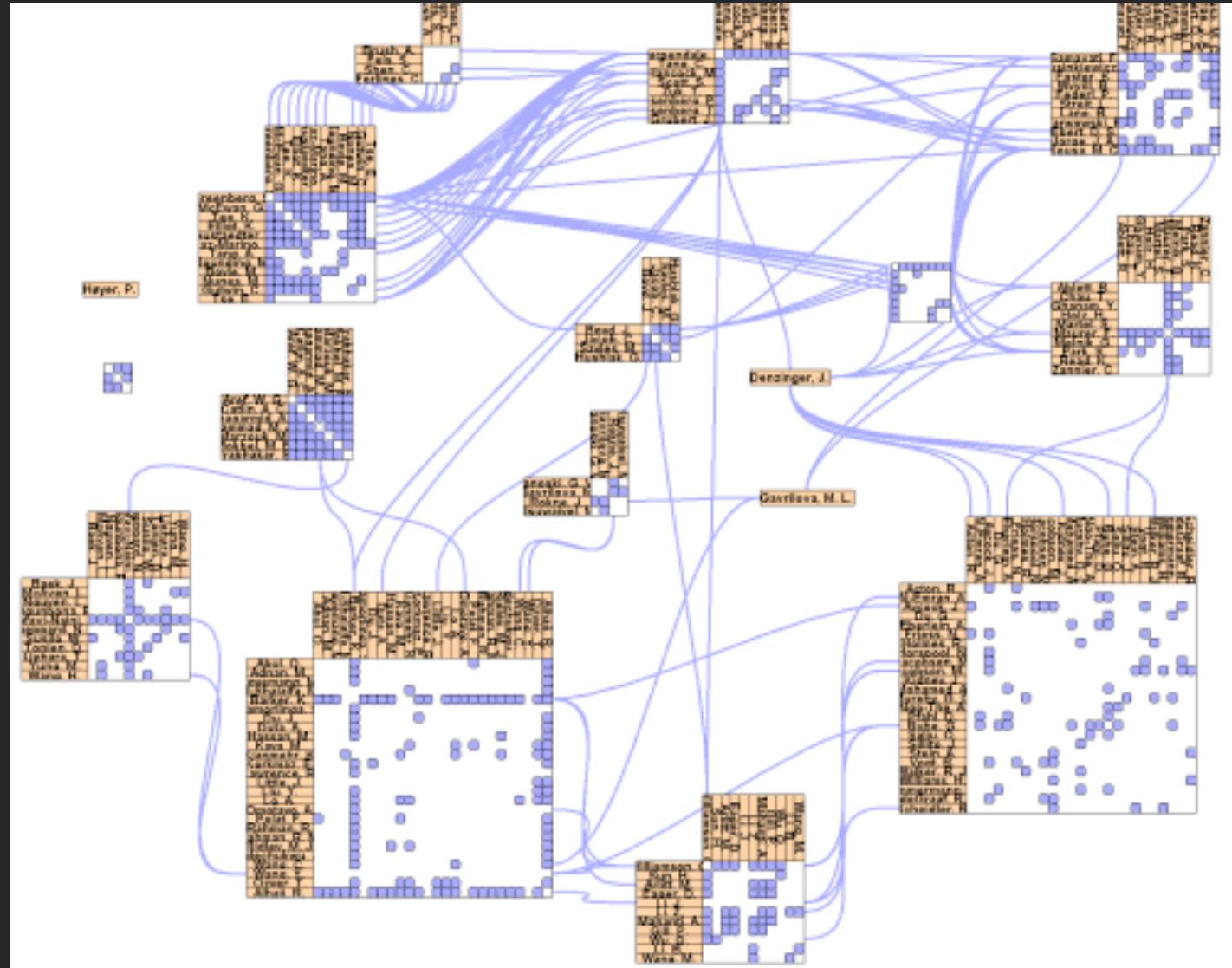
MatrixExplorer [Henry & Fekete, Infovis'06]

Réseaux



MatLink [Henry & Fekete, INTERACT'07]

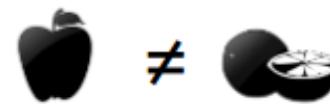
Réseaux



Données nominales, ordinaires et quantitatives

- **Nominales** (étiquettes)

- Opérations: $=, \neq$



- **Ordinaires**

- Opérations: $=, \neq, <, >$



- **Quantitatives** : Intervalle

- Opérations: $=, \neq, <, >, -, +$ $[1989 - 1999] + [2002 - 2012]$

- Mesure de distance possible

- **Quantitatives** : Ratio

$10\text{kg} / 5\text{kg}$

- Opérations: $=, \neq, <, >, -, +, \times, \div$

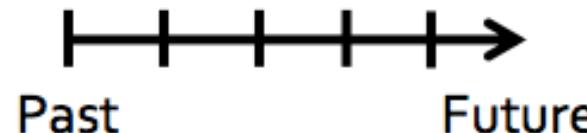
- Mesure de ratios ou proportions possible

Types de données: taxonomie

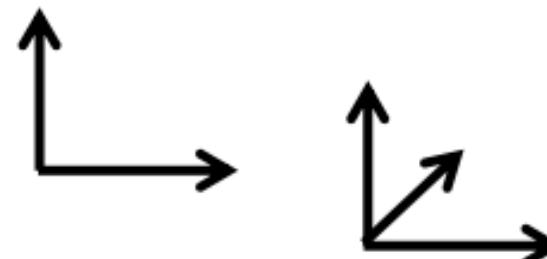
- 1D (linéaire)



- Temporelles



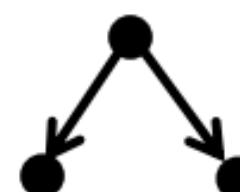
- 2D (carte)



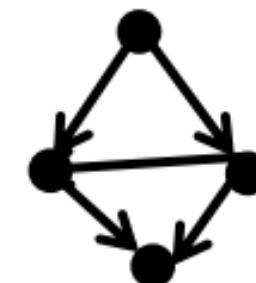
- 3D

- nD (relationnelles)

- Arbres (hiérarchies)



- Réseaux (graphes)

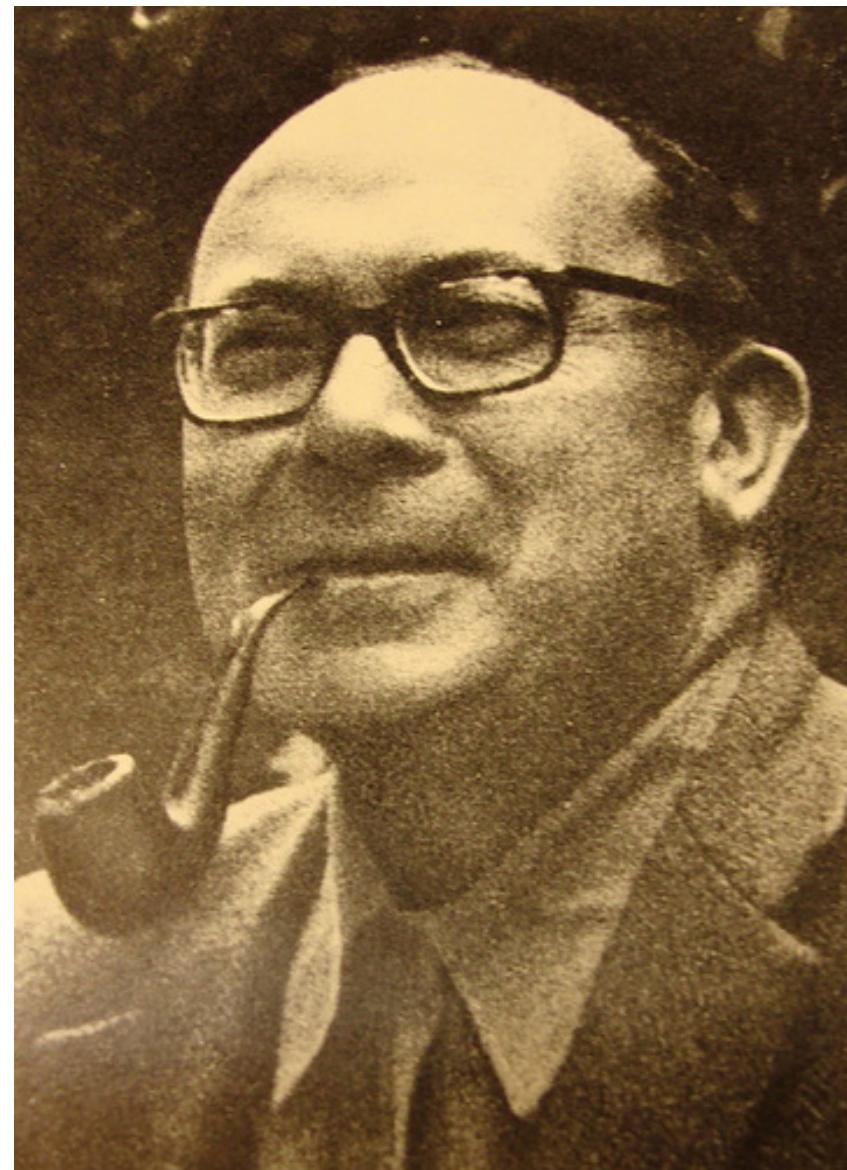
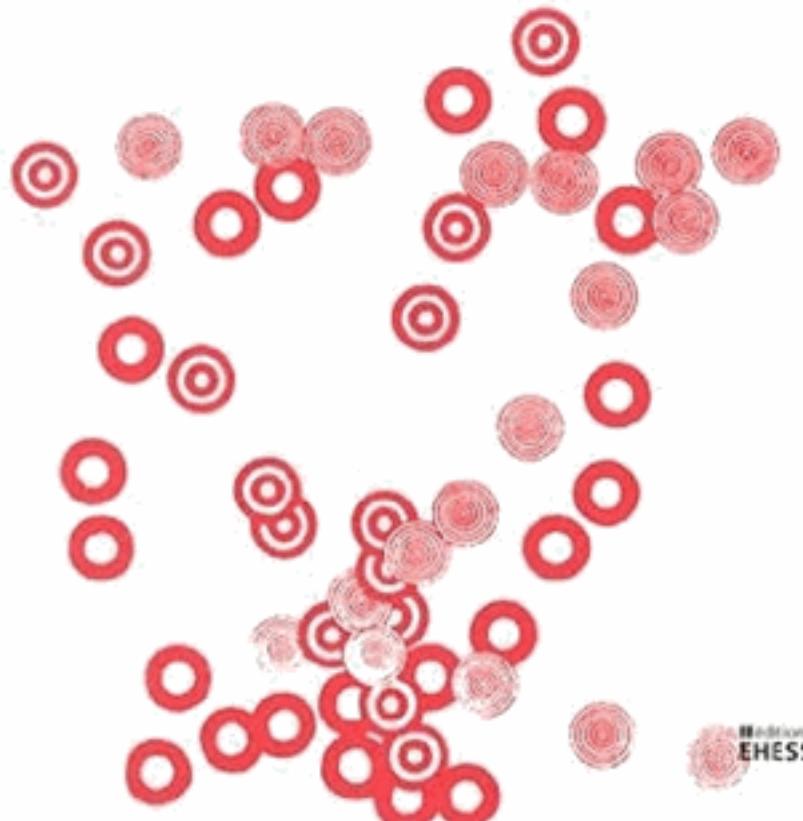


Les blocs de constructions de la visualisation

Jacques Bertin

Sémiologie graphique

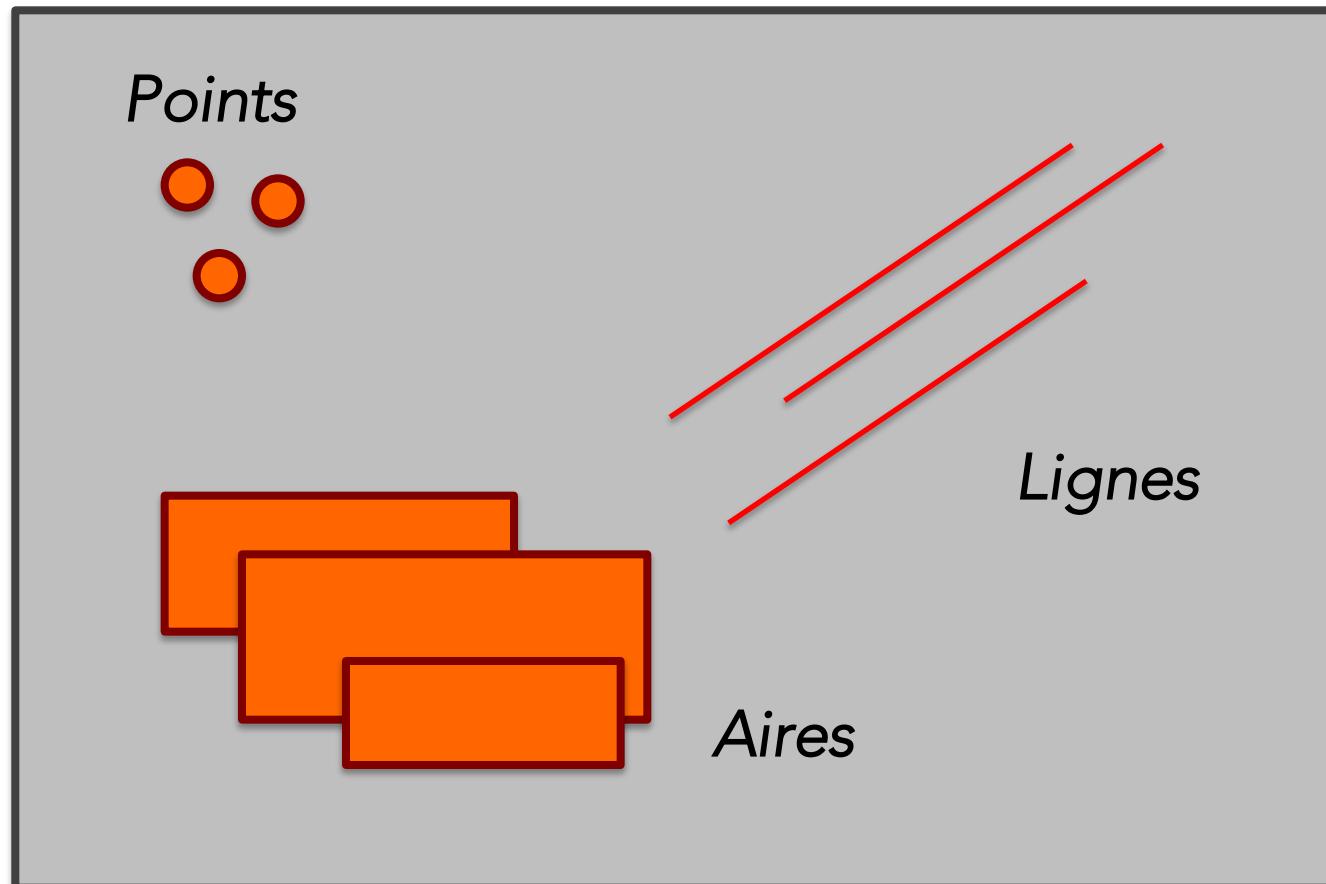
Les diagrammes · Les réseaux · Les cartes



Jacques Bertin (1918-2010)

Les blocs de construction de la visualisation

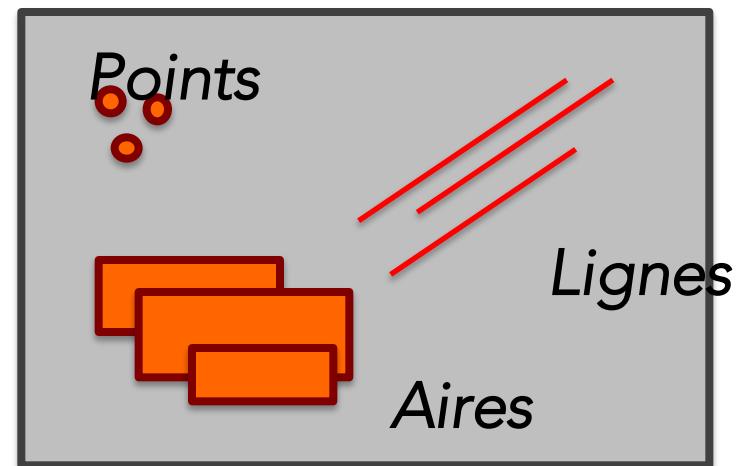
Marques



Points

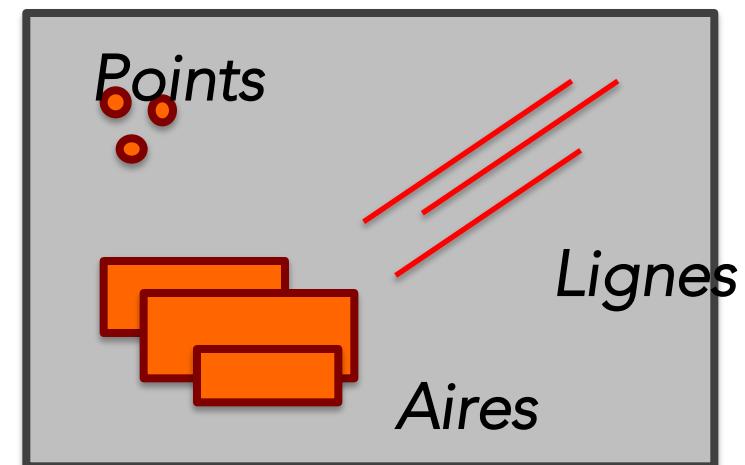
“Un point représente une position dans le plan et n'a ni longueur ni aire théorique. Sa signification est indépendante de la taille et du caractère de la marque qui le rend visible.”

- Une position
- La marque qui indique le point peut varier selon toutes ses variables visuelles (couleur, forme, taille, ...)



Lignes

“Une ligne correspond à un phénomène dans le plan qui a une longueur mesurable mais pas d'aire. Sa signification est indépendante de l'épaisseur et des caractéristiques de la marque qui la rend visible.”

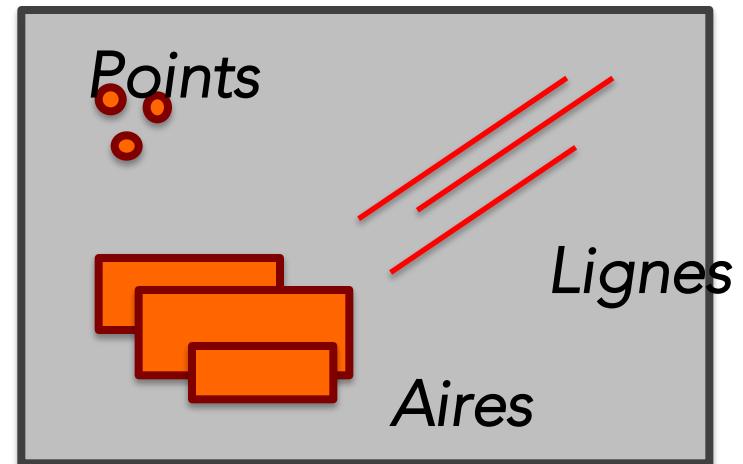


- Une frontière, une route, une connection

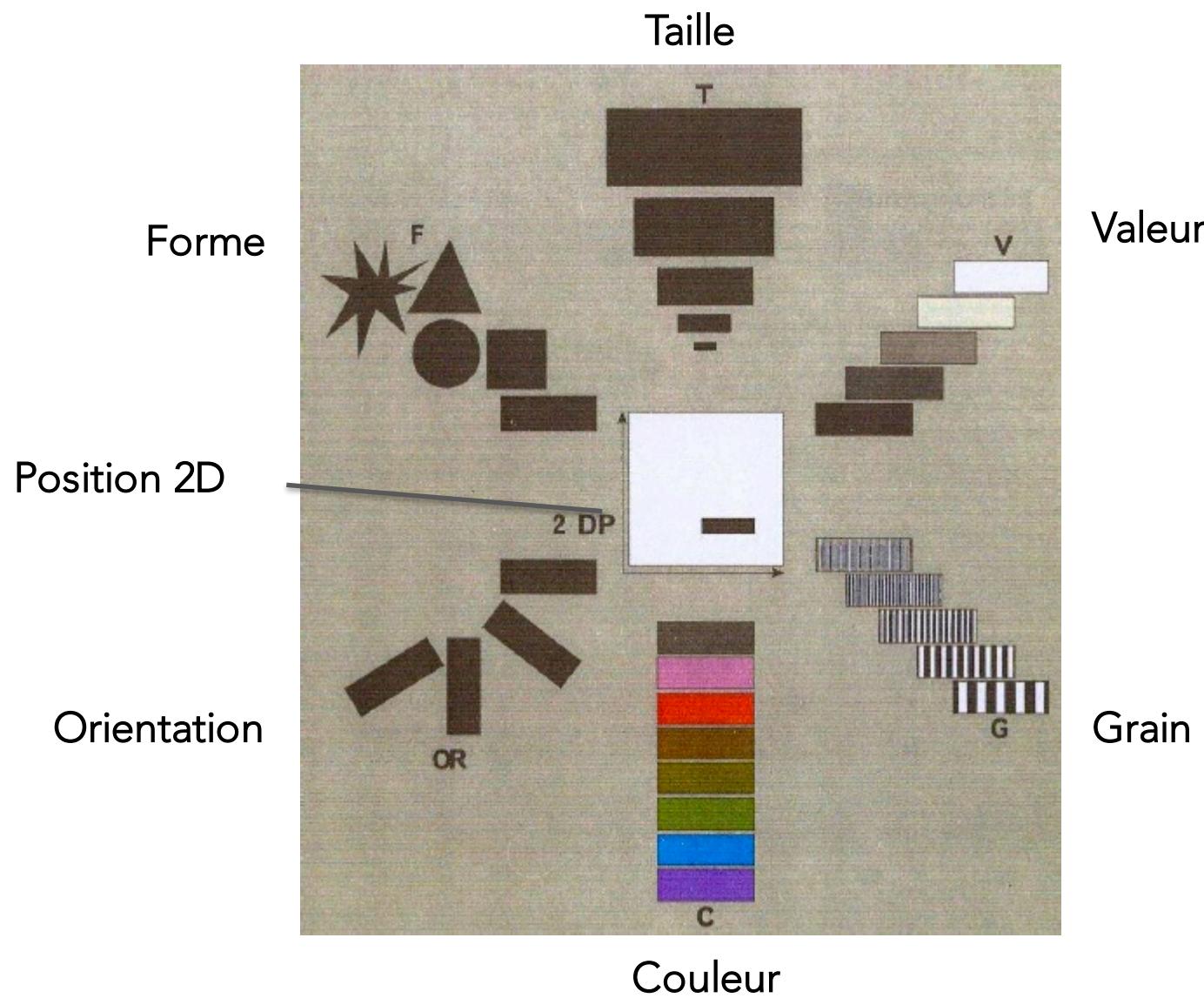
Aires

“Une aire signifie quelque chose dans le plan qui a une taille mesurable. Sa signification s’applique à l’intégralité de l’aire recouverte par la marque qui la rend visible.”

- Une aire peut varier en position, mais pas en taille, forme ou orientation sans que l’aire elle-même n’ait une signification différente



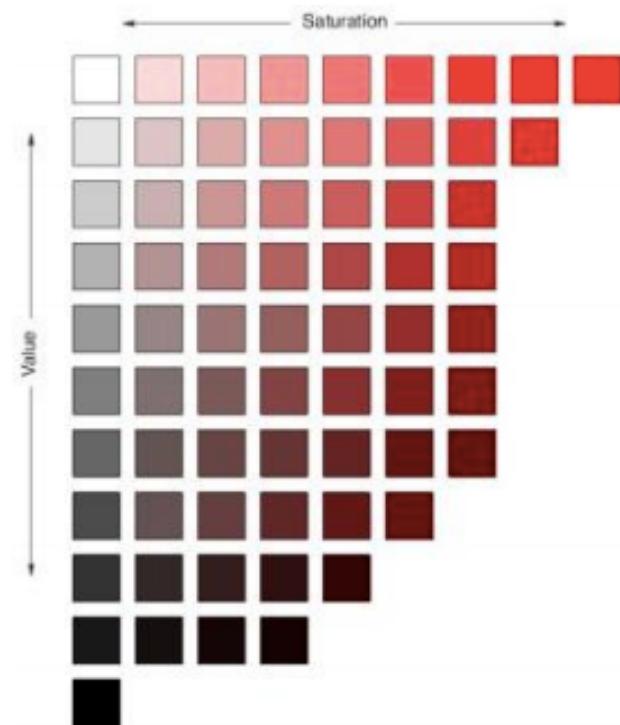
Variables rétiniennes appliquées aux marques



Autres variables en informatique

- **Mouvement**
 - Direction, accélération, vitesse, fréquence, décalage, "personnalité"

- **Saturation**
 - Les couleurs telles qu'utilise Bertin font référence à la teinte et saturation \neq valeur



Caractéristiques des variables rétiniennes

- **Sélective**

Est-ce que cette variable permet de différencier/isoler les éléments des groupes spontanément ?

- **Associative**

Est-ce que cette variable permet de grouper spontanément les éléments d'un même groupe ?

- **Ordinal**

Est-ce que cette variable permet de percevoir un ordre?

- **Quantitative**

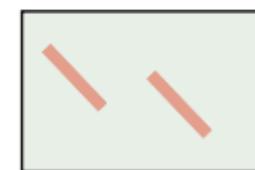
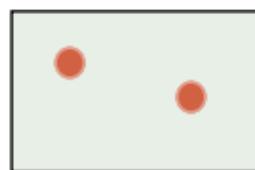
Est-ce qu'une lecture numérique est possible à partir des variations de cette variable ?

- **Longeur (résolution)**

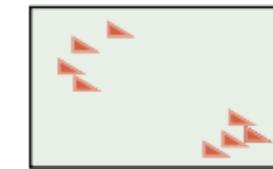
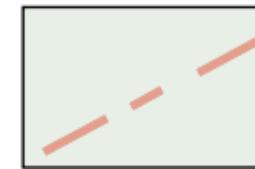
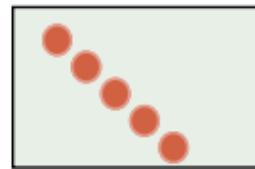
Combien de niveaux distincts est-il possible de percevoir ?

Variable rétinienne: position

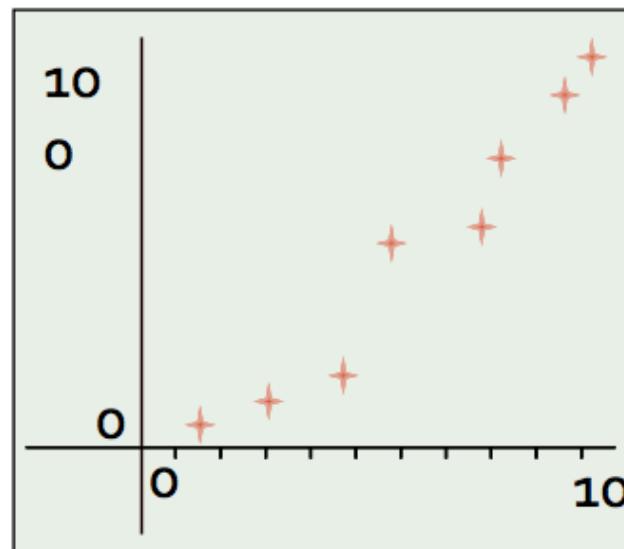
- sélective



- associative



- quantitative



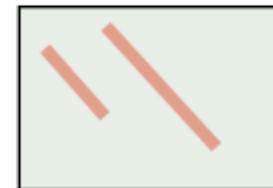
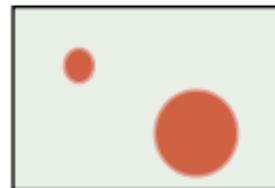
- ordinaire

- longueur

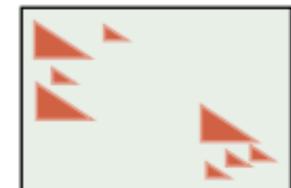
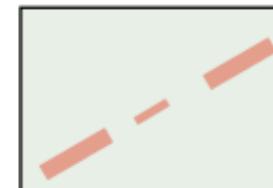
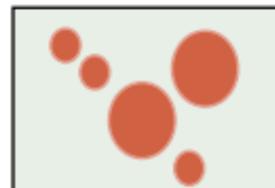
Variable rétinienne: taille



- sélective



- associative

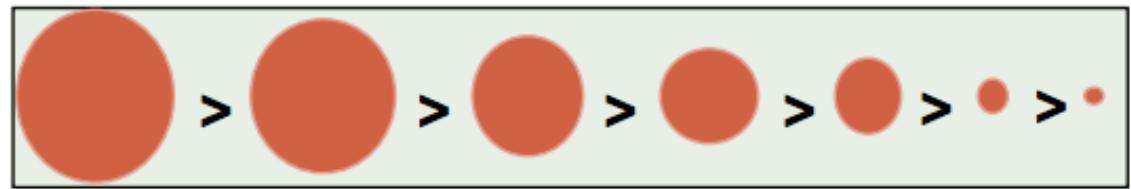


- quantitative

$$4 \times \blacksquare = \square \text{ ?}$$



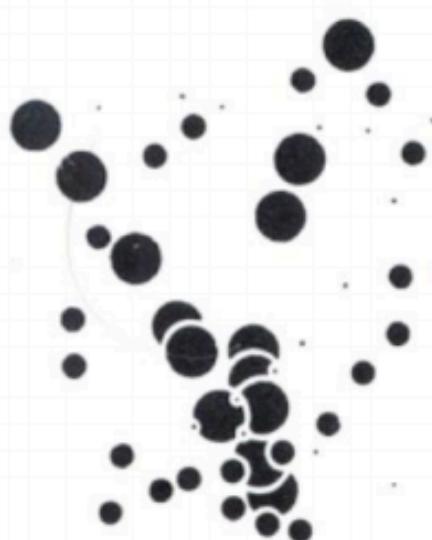
- ordinale



- longueur

- théoriquement infini mais limité en pratique

Taille



Points



Lignes

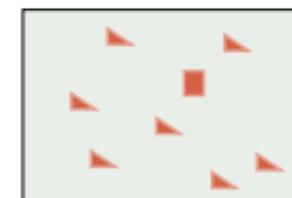
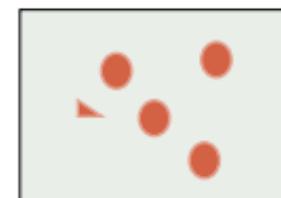
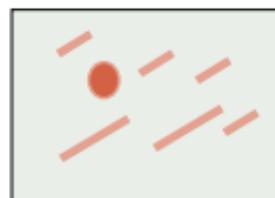


Aires

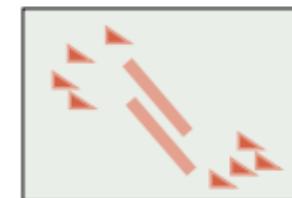
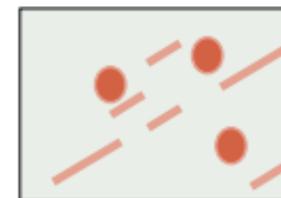
Variable rétinienne: forme



- sélective



- associative



- ordinale

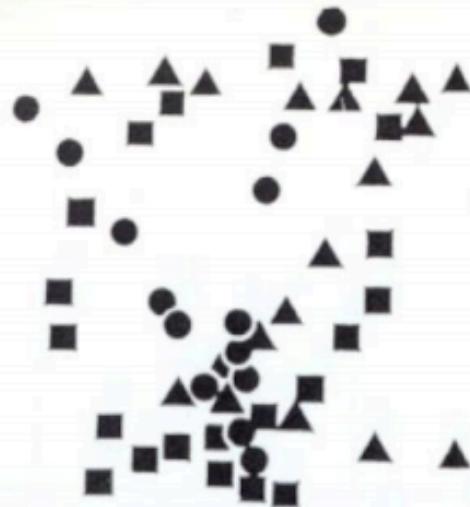


- quantitative

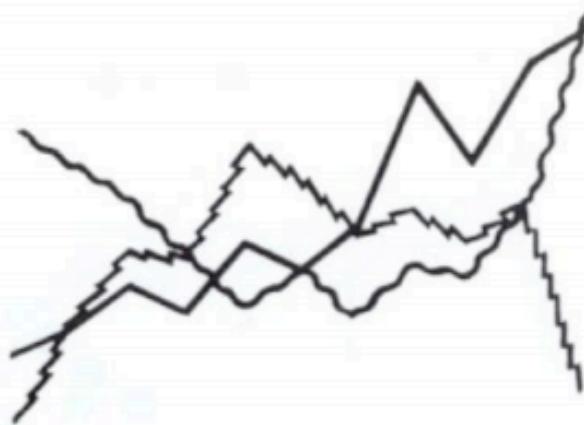


- longueur

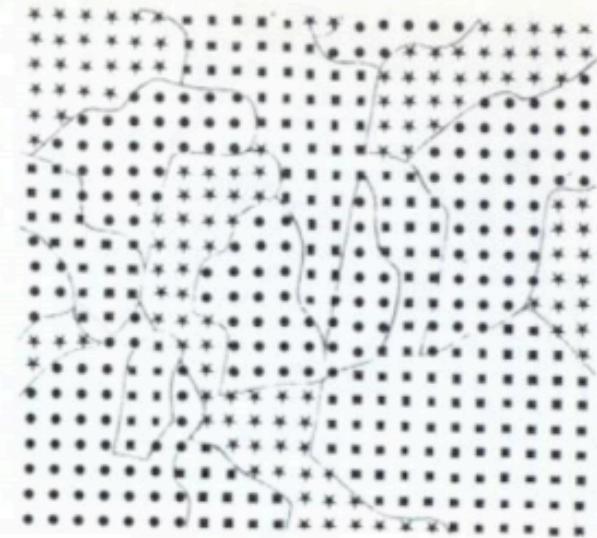
Forme



Points



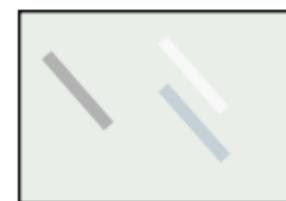
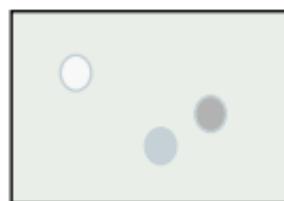
Lignes



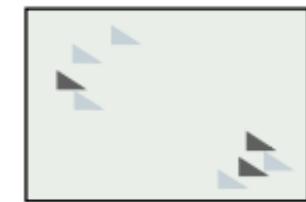
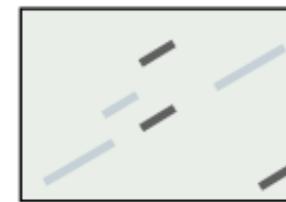
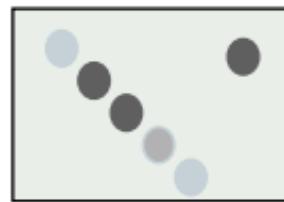
Aires

Variable rétinienne: valeur

- ✓ • sélective



- ✓ • associative



- ✗ • quantitative

- ✓ • ordinaire



- ✓ • longueur

- théoriquement infini mais limité en pratique

Valeur



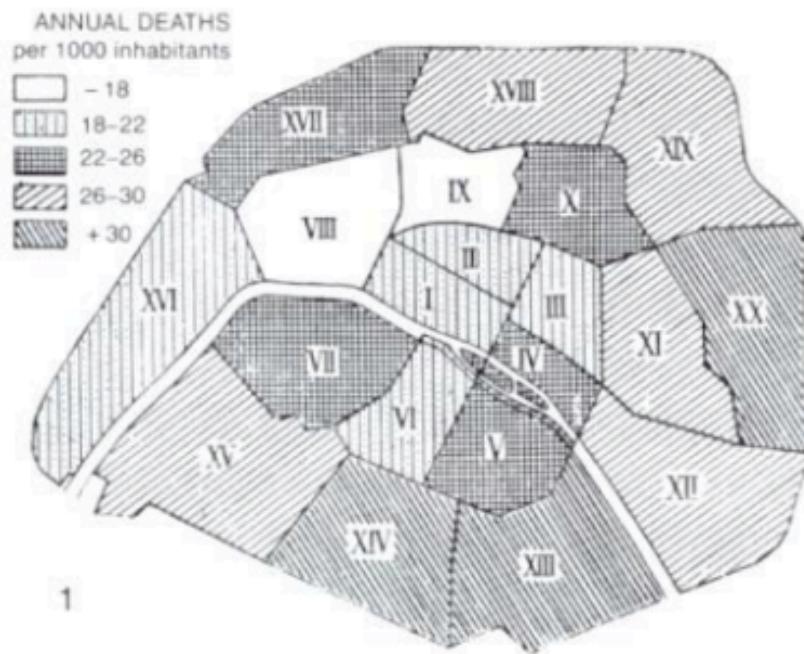
Points

Lignes

Aires

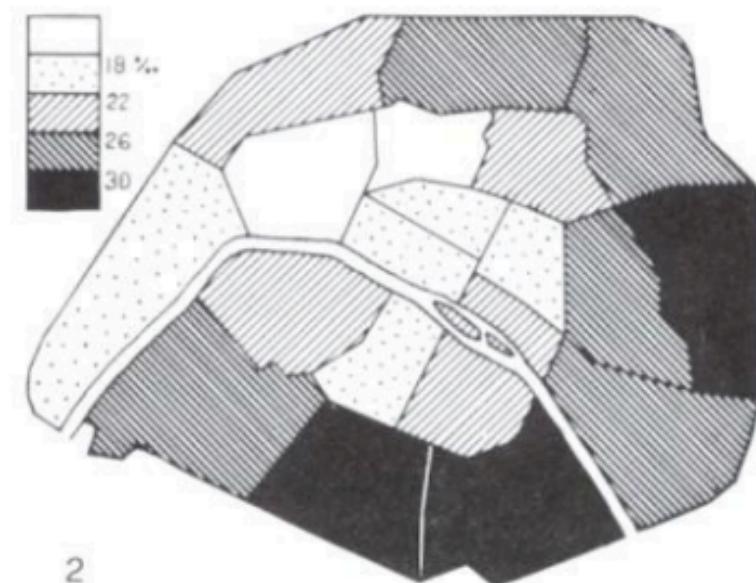
Valeur

- Ordinale, ne peut pas être réordonnée



Les valeurs qui ne sont pas ordonnées correctement par rapport à l'échelle doivent être lues point par point

Décès par 1000 habitants, Paris

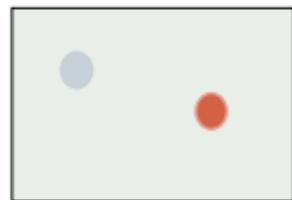


Les valeurs correctement ordonnées sont beaucoup plus utiles

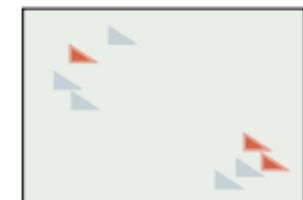
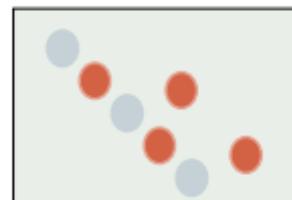
Sémiologie Graphique (Bertin)

Variable rétinienne: couleur

- ✓ • sélective



- ✓ • associative



- ✗ • quantitative

- ✗ • ordinaire



- ✓ • longueur

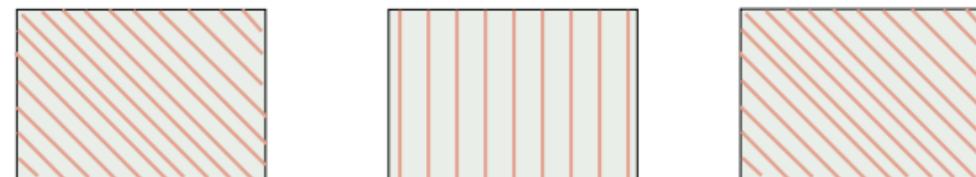
- théoriquement infini mais limité en pratique

Variable rétinienne: orientation

- ✓ • sélective



- ✓ • associative



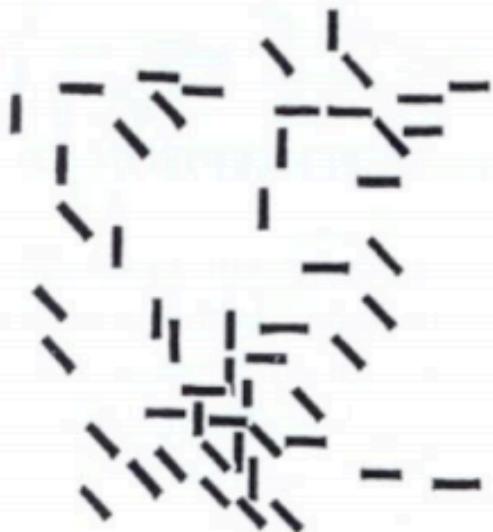
- ✗ • quantitative

- ✗ • ordinale



- ✓ • longueur
 - ~ 5 en 2D ?

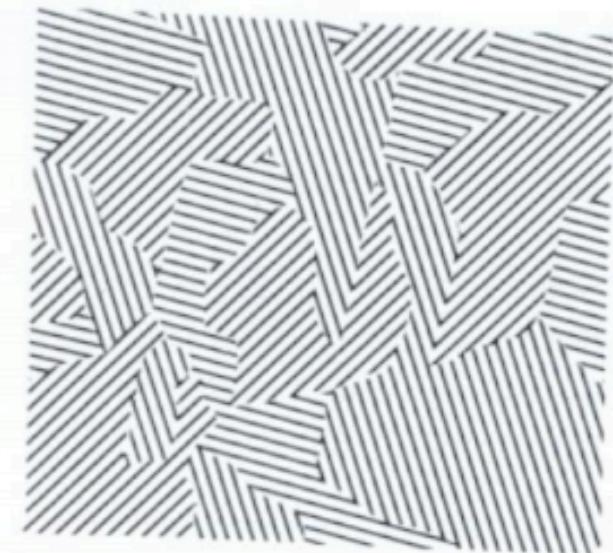
Orientation



Points



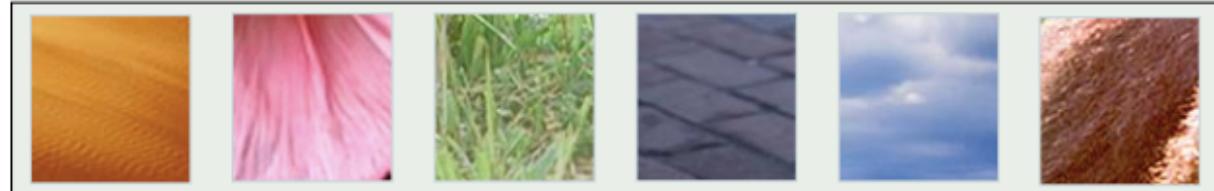
Lignes



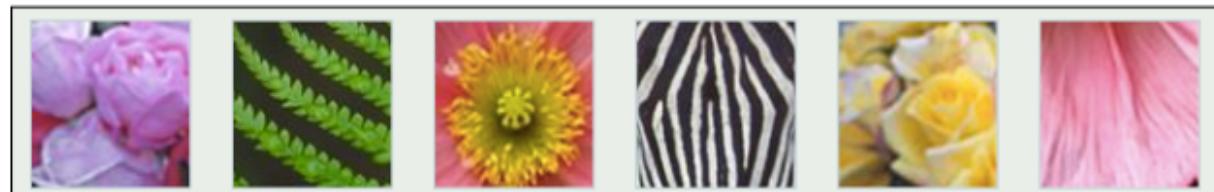
Aires

Variable rétinienne: texture

- ✓ • sélective



- ✓ • associative



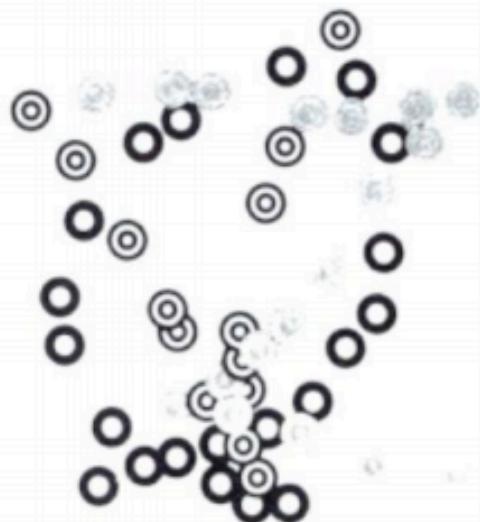
- ✗ • quantitative

- ✗ • ordinaire

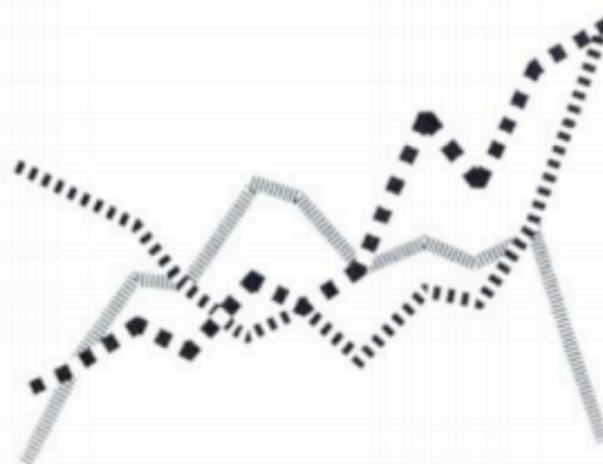


- ✓ • longueur
 - Théoriquement infini

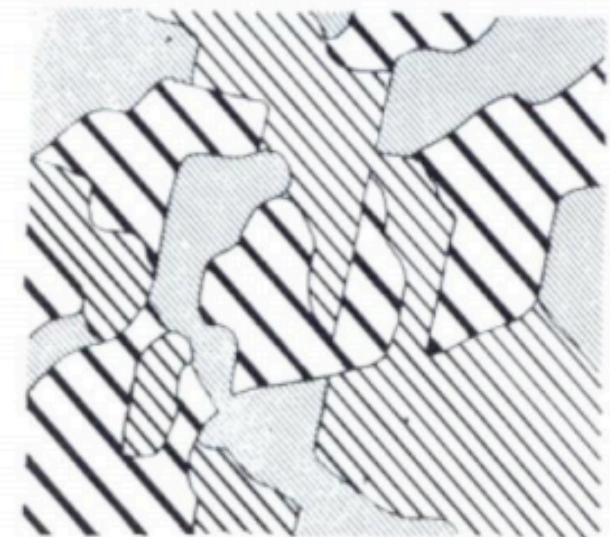
Texture



Points



Lignes



Aires

Variable rétinienne: mouvement

- ✓ • sélective
 - Le mouvement est l'un des capteur d'attention les plus puissants
- ✓ • associative
 - Les mouvements à l'unisson groupent les objets efficacement
- ✗ • quantitative
 - perception subjective
- ✗ • ordinaire
- ? • longueur
 - Types de mouvement distincts ?

Variables rétiniennes

Visual Variable	Selective	Associative	Quantitative	Order	Length
Position	Yes	Yes	Yes	Yes	Dependant on resolution
Size	Yes	Yes	Approximate	Yes	Association: 5; Distinction: 20
Shape	With Effort	With Effort	No	No	Infinite
Value	Yes	Yes	No	Yes	Association: 7; Distinction: 10
Hue	Yes	Yes	No	No	Association: 7; Distinction: 10
Orientation	Yes	Yes	No	No	4
Grain	Yes	Yes	No	No	5
Texture	Yes	Yes	No	No	Infinite
Motion	Yes	Yes	No	Yes	Unknown

Résumé

	Quantitative	Ordinal	Nominal
More Accurate	Position Length Angle Slope Area Density Saturation Hue Shape	Position Density Saturation Hue Length Angle Slope Area Shape	Position Hue Density Saturation Shape Length Angle Slope Area
Less Accurate	• •	• • •	• •

Résumé

- Désormais vous savez que les blocs de construction de visualisation sont des **marques**
- Les marques peuvent changer de par leurs **variables rétiniennes** (ou variables visuelles)
- Les variables rétiniennes ont des **caractéristiques spécifiques**
- Ces caractéristiques influencent la façon dont on perçoit les données