

CNAM - Département Informatique

RCP216 Ingénierie de la fouille et de la visualisation de données massives
M. Crucianu, R. Fournier, P. Cubaud

Visualisation d'information (5)

Masses de {textes, images, livres}

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juin 2015

le **cnam**

Plan de l'exposé

1. Masses de textes : bibliométrie, scientométrie
2. Masses d'images : albums photos
3. Masses de livres : bibliothèques numériques

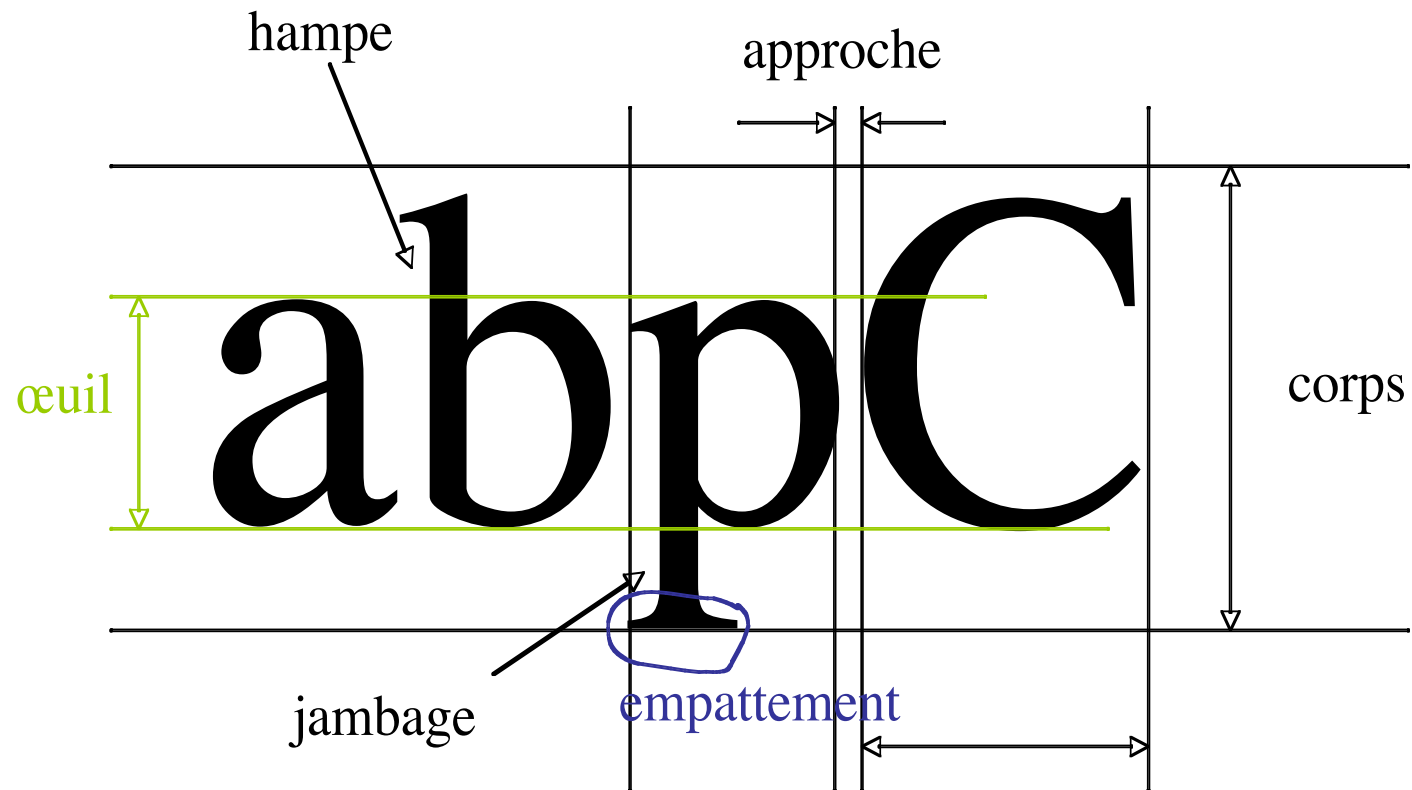
1. Masses de textes

Afficher du texte (avec Processing)

```
typo
size(400,100);
PFont f = loadFont("Serif-48.vlw");
textFont(f);
fill(0);
text("bonjour Monde !", 30,50);
stroke(255,0,0);
line(30,0, 30,100);
line(0,50, 400,50);
```



Attention à
l'origine du tracé
≠ rect, ellipse, etc.



Unité de mesure : le point typographique

Point Didot = 0,3579mm

Point pica = 1/72 pouce = 0,35135mm

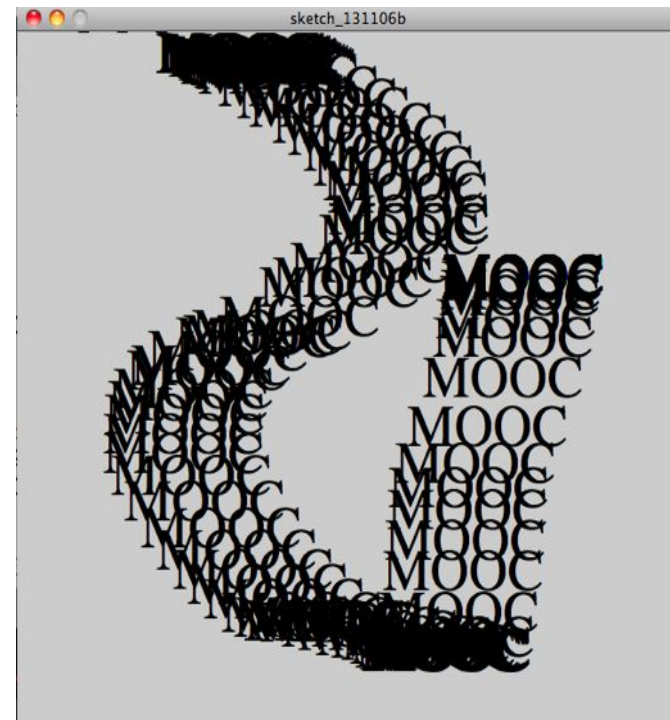
Point métrique = 0,4 mm

typomouse

```
void setup(){
  size(600,600);
  PFont f = loadFont("Serif-48.vlw");
  fill(0);|
  textFont(f);
}
void draw(){
  text("MOOC", mouseX,mouseY);
}
```



etudier quelques
variantes pour le
placement du texte
(aléa, etc)



Tracé de taille variable

```
typozoom
void setup(){
  size(800,500);
  PFont f = loadFont("Serif-48.vlw");
  textFont(f);
}
void draw(){
  background(200);
  float s=map(mouseX,0,width,0,500);
  fill(0);
  textSize(s);
  text("MOOC", 50, 400);
  fill(255);
  textSize(500-s);
  text("MOOC", 50, 400);
}
```

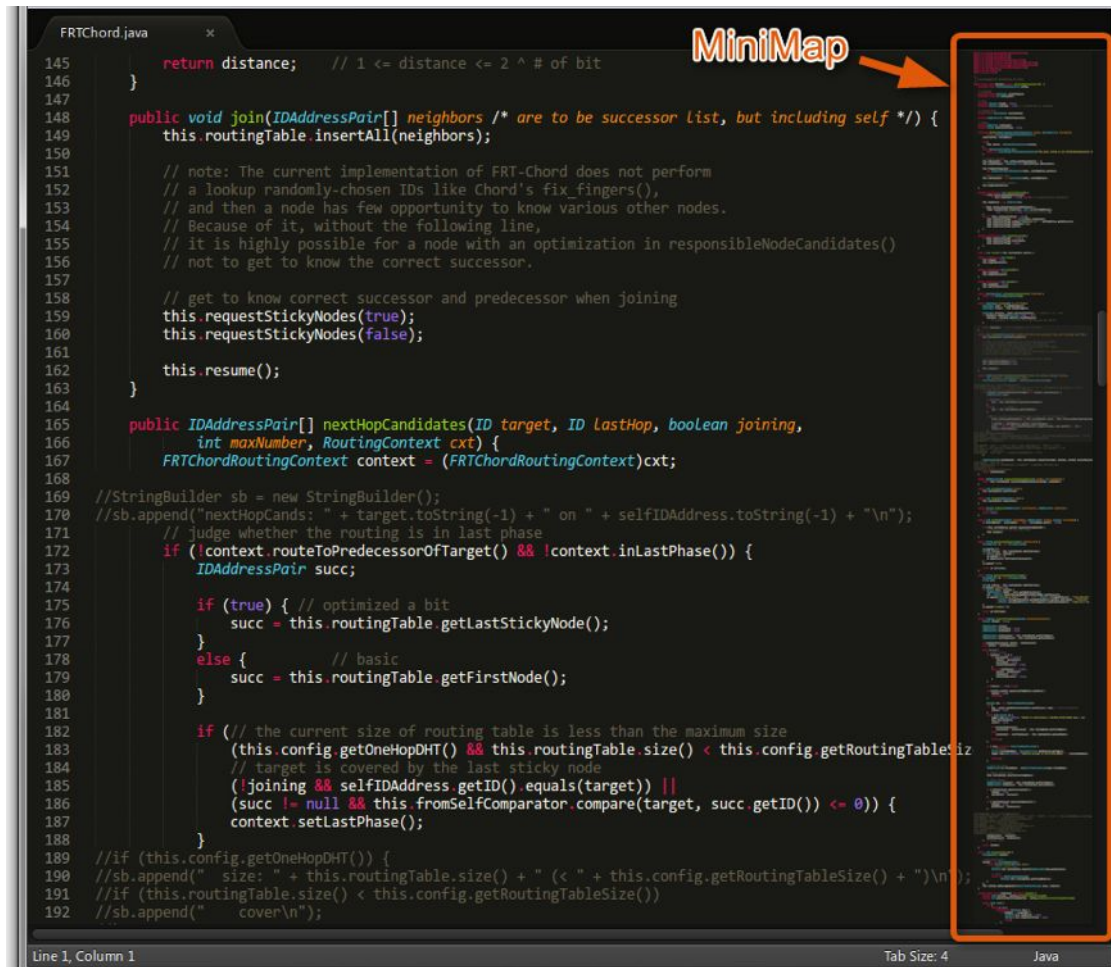


Réduction extrême

```
textured ▼  
String lines[] = loadStrings("methodeWRAP40.txt");  
PGraphics pmp = createGraphics(600,lines.length*20, JAVA2D);  
  
pmp.beginDraw();  
pmp.textSize(20);  
pmp.fill(10);  
pmp.background(250);  
  
int y=0;  
for (int i=0;i<lines.length;i++){  
  pmp.text(lines[i], 10,y);  
  y += 20;  
}  
  
pmp.endDraw();  
pmp.save("resu.png");  
println("done");
```



Exemple : éditeur Sublime Text



<http://did2memo.net/wp-content/uploads/2013/01/minimap-in-sublime-text-2.png>

idem avec notepad++

```
D:\source\notepad++\trunk\PowerEditor\src\EncodingMapper.cpp - Notepad++
File Edit Search View Encoding Language Settings Macro Run Plugins Window ?
langs.model.xml change.log EncodingMapper.cpp new 2 Document Map
66 {932, "Shift_JIS MS_Kanji csShiftJIS csWindows31J"},
67 {949, "windows-949 korean"},
68 {51949, "euc-kr csEUCKR"},
69 {874, "tis-620"},
70 {10007, "x-mac-cyrillic xmaccyrillic"},
71 {21866, "koi8_u"},
72 {20866, "koi8_r csKOI8R"}
73 };
74
75 EncodingMapper * EncodingMapper::_pSelf = new EncodingMapper;
76
77 bool isinListA(const char *token, const char *list) {
78     if ((!token) || (!list))
79         return false;
80     char word[64];
81     int i = 0;
82     int j = 0;
83     for (; i <= int(strlen(list)) ; i++)
84     {
85         if ((list[i] == ' ') || (list[i] == '\0'))
86         {
87             if (j != 0)
88             {
89                 word[j] = '\0';
90                 j = 0;
91
92                 if (!strcmp(token, word))
93                     return true;
94             }
95         }
96     }
97 }
```

C++ source file length : 8257 lines : 145 Ln: 74 Col: 1 Sel: 0 Dos\Windows ANSI INS

<https://notepad-plus-plus.org/assets/images/docMap.png>

Et encore



<http://www.davidsmall.com/talmud.html>

<http://acg.media.mit.edu/projects/thesis/DSThesis.pdf>

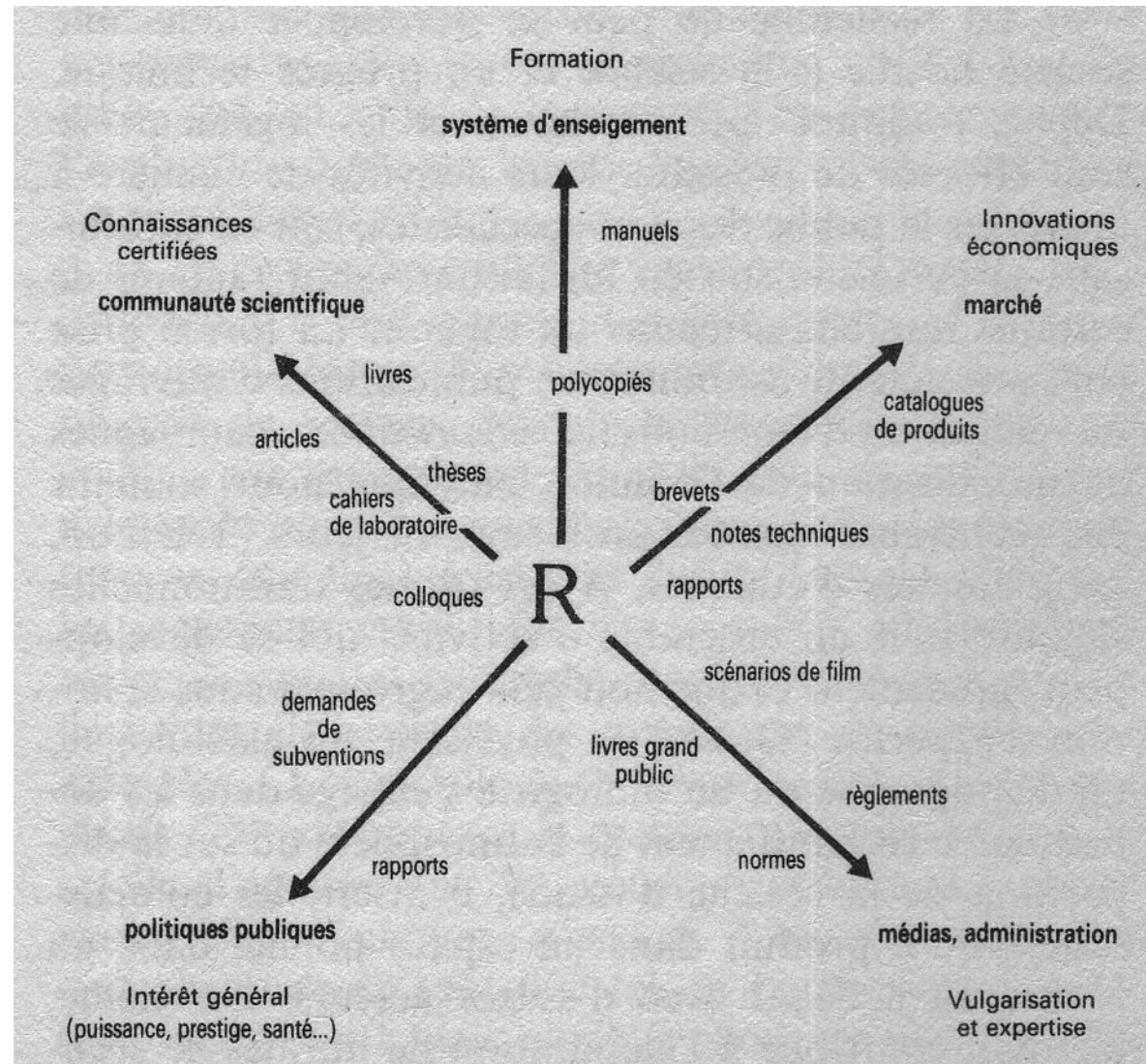
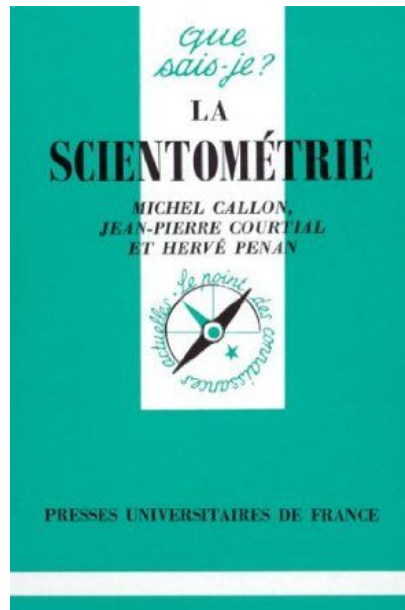
Article : <http://www.research.ibm.com/journal/sj/353/sectiond/small.pdf>

bibliométrie / scientométrie

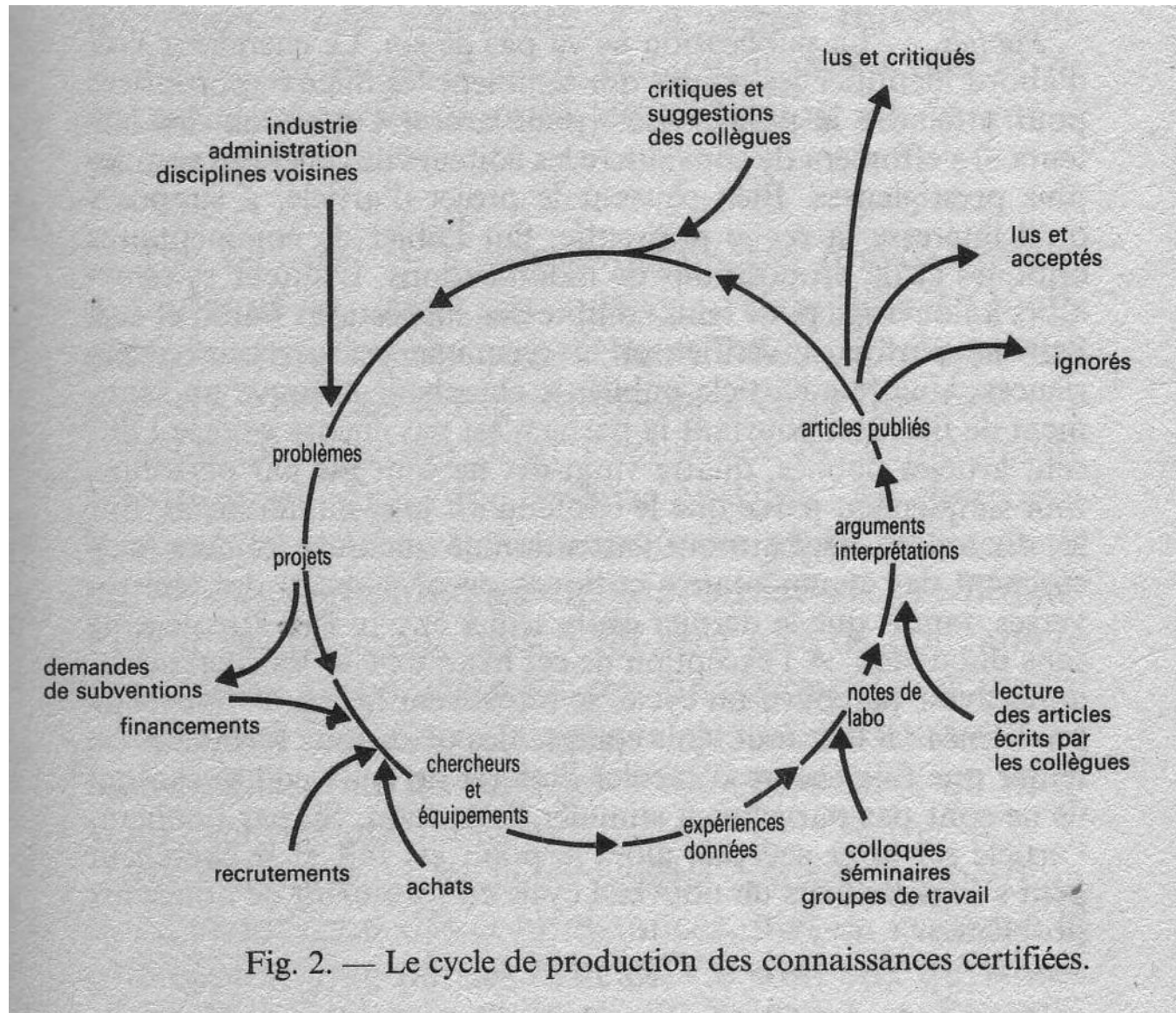


Paul Otlet : un internet de papier ?

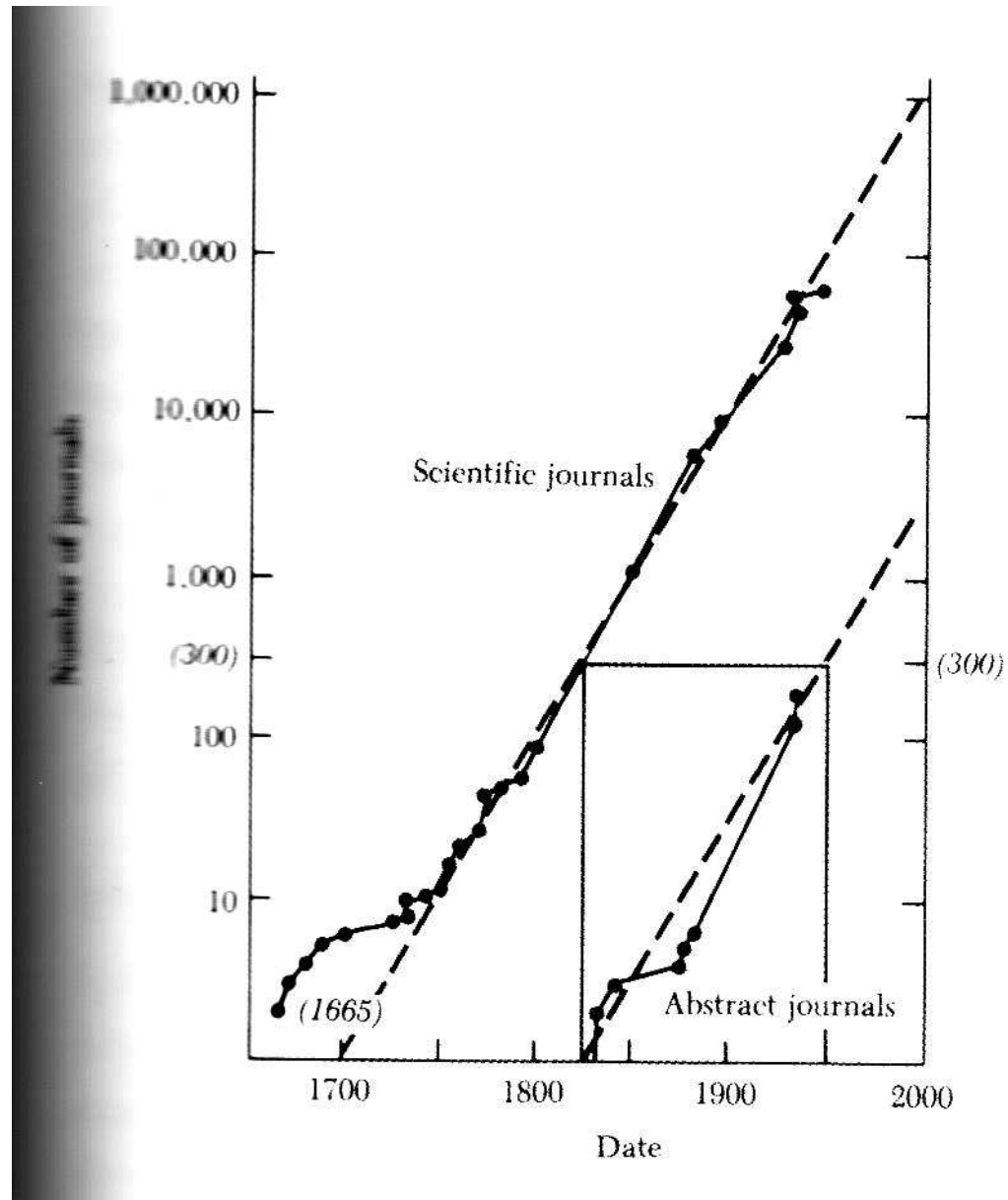
productions de la recherche



les "connaissances certifiées"



croissance des publications et pb de l'evaluation





publish or perish

Web

Images

Maps

Shopping

Plus ▾

Outils de recherche

Environ 1 410 000 résultats (0,40 secondes)

Les cookies assurent le bon fonctionnement de nos services. En utilisant ces derniers, vous acceptez l'utilisation des cookies.

OK

[En savoir plus](#)

[Articles universitaires correspondant aux termes **publish or perish**](#)

[Publish or perish](#) - [Parchomovsky](#) - Cité 125 fois

[Publish or perish](#) - [Clapham](#) - Cité 30 fois

[Publish or perish](#) - [Hackathorn](#) - Cité 12 fois

une spirale infernale ??? => automatisation

bases bibliographiques

le grand ancêtre : MEDLINE (1964)

^F File	^E Edit	^A Search	^L Limit	^V View	^T Tools	^O Options	^Y Help
1		primordial dwarfism.mp. [mp=ti, sh, ab, it, hw, tn, mf, rw]					90
2		remove duplicates from 1					51
3		(children and nutrition).mp. [mp=ti, sh, ab, it, hw, tn, mf,					7819
4		(children and nutrition).ft.					154
5		remove duplicates from 4					152
Ovid - CINAHL & EMBASE & MEDLINE							
[To select option hold Ctrl and letter indicated. Press ^Y for Help.] Enter subject, then press <Enter> _:							
^U Author	^J Journal	^G Limit Set	^M Combine	^B Save			
^R Textword	^D Database	^K View Set	^P Print Set	^X Exit			

1,6 G requetes en 2011 sur pubMED

The screenshot shows the PubMed website interface. On the left, the logo for PubMed.gov is displayed, along with the text "US National Library of Medicine" and "National Institutes of Health". In the center, there is a search bar with a dropdown menu set to "PubMed" and a "Search" button. Below the search bar, the word "Advanced" is visible. On the right side, there is a "Help" link. At the bottom of the page, a blue banner contains a status message: "PubMed is open, however it is being maintained with minimal staffing due to the lapse in government funding. Information will be updated to the extent possible, and the agency will attempt to respond to urgent operational inquiries. For updates regarding government operating status see USA.gov."

index de citations

<http://www.garfield.library.upenn.edu/>



Eugene Garfield

From Wikipedia, the free encyclopedia

This article is about the scientist. For the lawyer and railroad executive, see [Eugene K. Garfield](#).

Eugene Garfield (born September 16, 1925) is an American [scientist](#), one of the founders of [bibliometrics](#) and [scientometrics](#).^[1] He received a PhD in Structural Linguistics from the [University of Pennsylvania](#) in 1961. Dr. Garfield was the founder of the Institute for Scientific Information (ISI), which was located in Philadelphia, Pennsylvania. ISI now forms a major part of the science division of Thomson Reuters company. Garfield is responsible for many innovative bibliographic products, including *Current Contents*, the *Science Citation Index* (SCI), and other citation databases, the *Journal Citation Reports*, and *Index Chemicus*. He is the founding editor and publisher of *The Scientist*, a news magazine for life scientists. In 2007, he launched [HistCite](#), a bibliometric analysis and visualization software package.

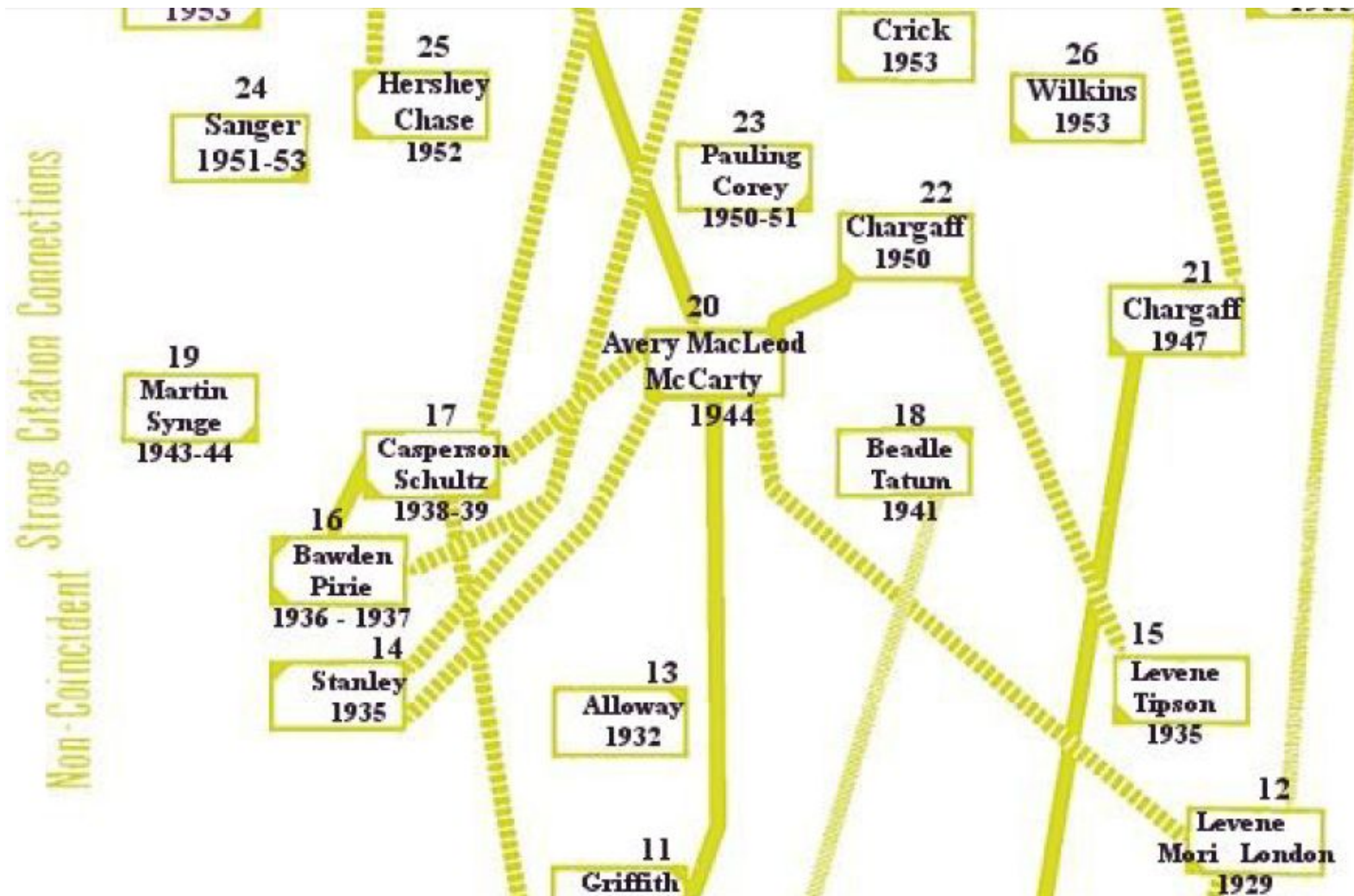
Following ideas inspired by [Vannevar Bush](#)'s famous 1945 article "[As We May Think](#)", Garfield undertook the development of a comprehensive [citation index](#) showing the propagation of scientific thinking; he started the [Institute for Scientific Information](#) in 1955. The creation of the *Science Citation Index* made it possible to calculate [impact factor](#),^[2] which measures the importance of scientific journals. It led to the unexpected discovery that a few journals like *Nature* and *Science* were core for all of [hard science](#). The same pattern does not happen with the humanities or the social sciences.^[*citation needed*]

Garfield's work led to the development of several [Information Retrieval](#) algorithms, like [HITS](#) and [Pagerank](#). Both use the structured citation between websites through hyperlinks.

Contents [\[hide\]](#)

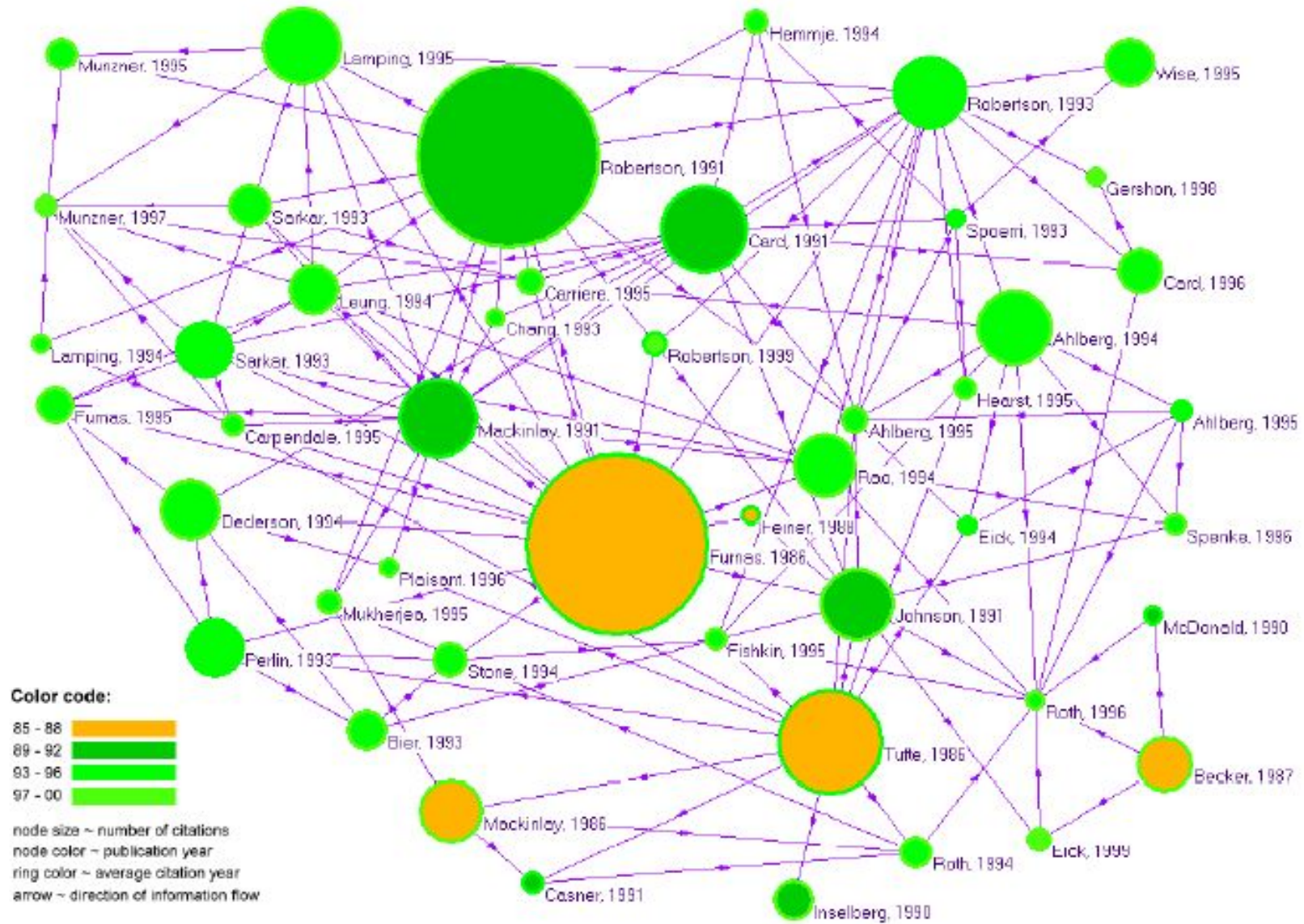
	Eugene Garfield
Born	September 16, 1925 (age 88) New York City, New York, United States
Education	Ph. D., University of Pennsylvania (1961)
Occupation	Scientist
Known for	One of the founders of bibliometrics and scientometrics Science Citation Index Institute for Scientific Information
	Website
	http://www.garfield.library.upenn.edu/

graphes de citation



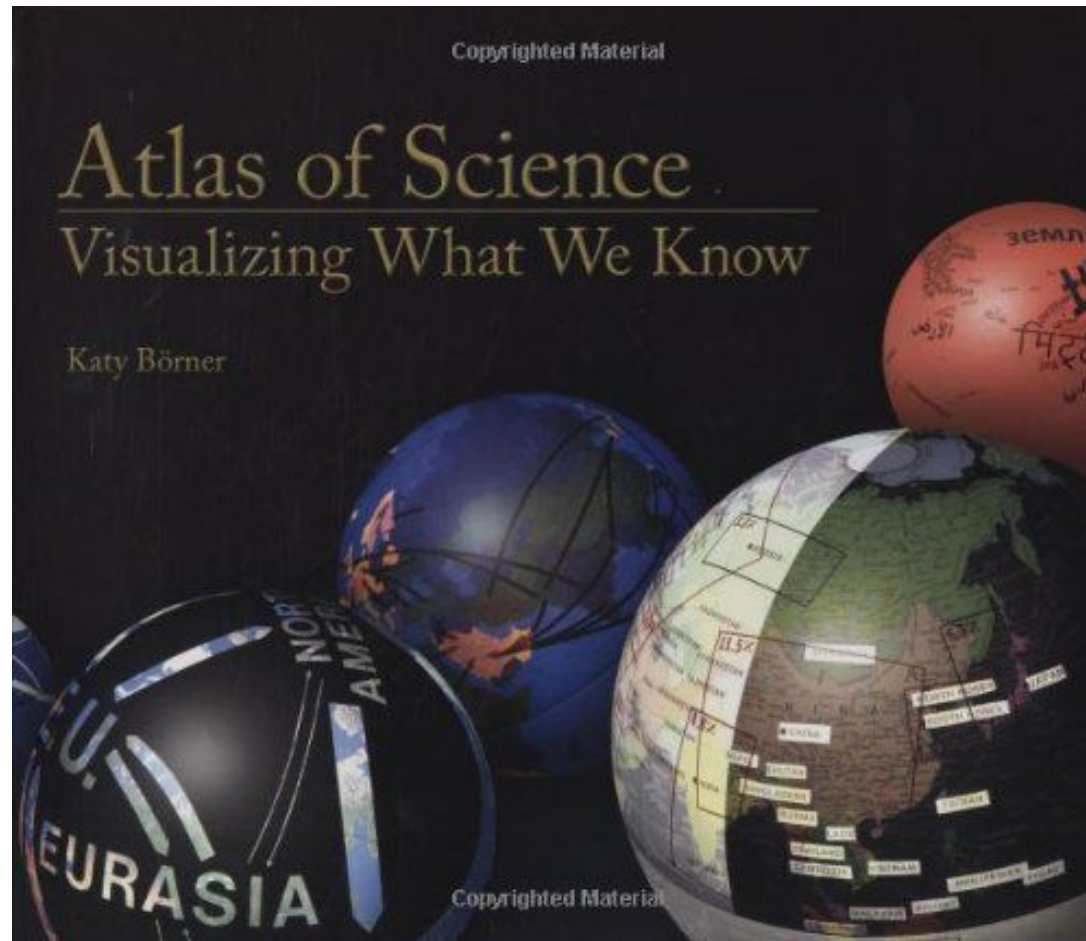
Garfield et al. 1964 (avec Asimov !)

<http://www.garfield.library.upenn.edu/papers/useofcitdatawritinghistofsci.pdf>



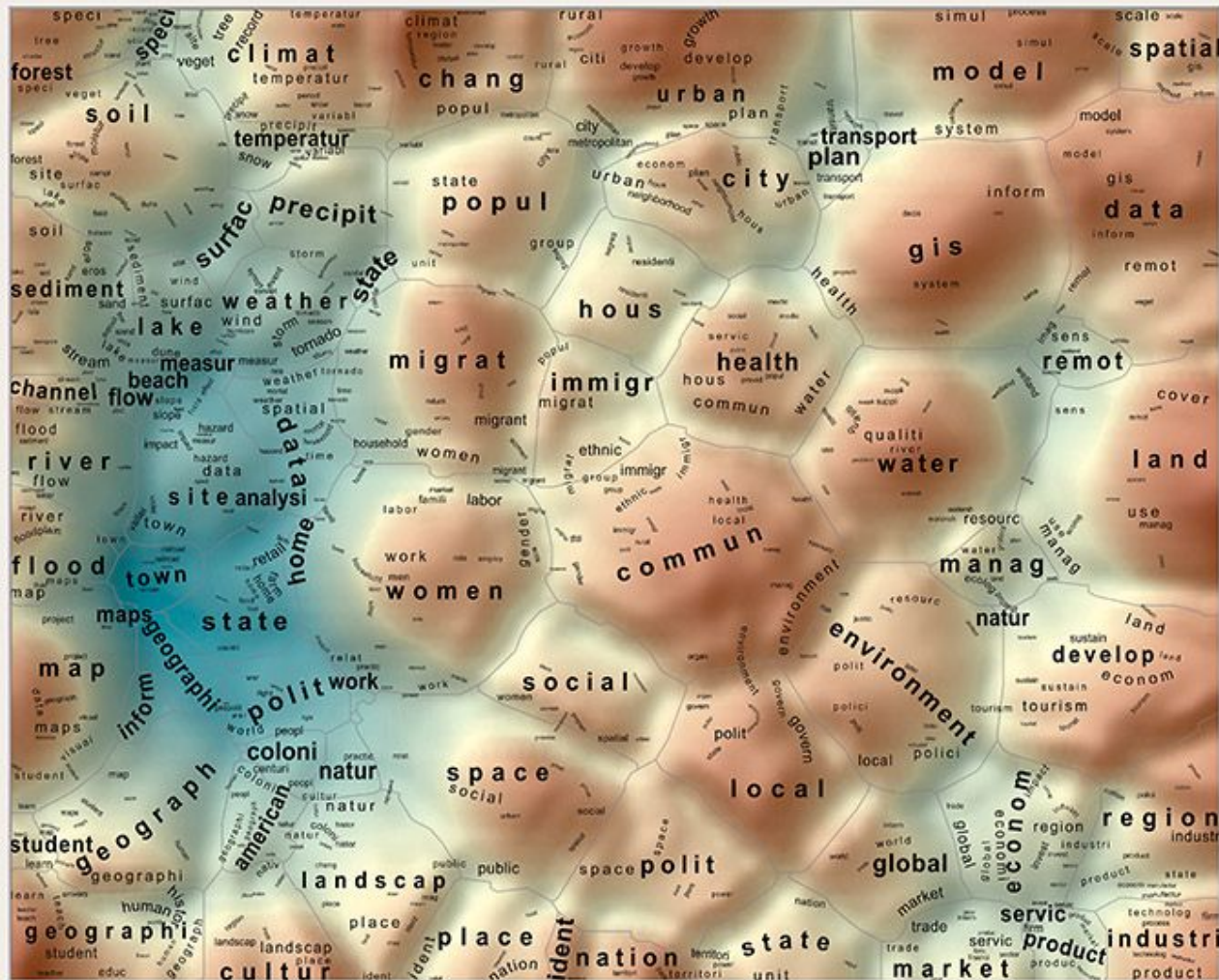
Major Information Visualization Authors, Papers and Topics in the ACM Library
Weimao Ke, Katy Börner and Lalitha Viswanat

cartographie de la connaissance



livre magnifique (gd format) et pas trop cher (MIT Press, 30€)

www.scimaps.org/atlas



A. Skupin - In terms of geography (2005)

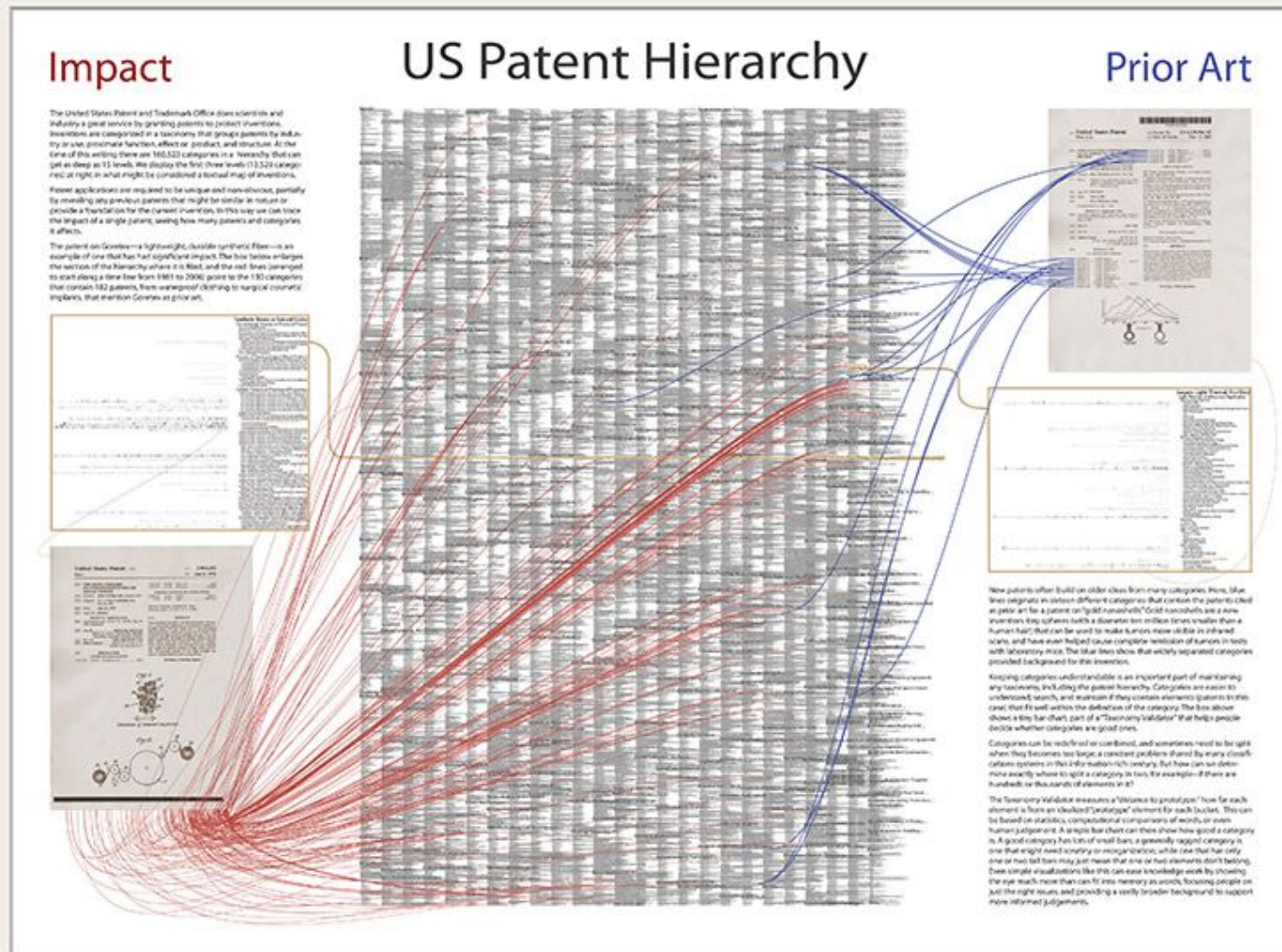
+22000 abstracts des articles
de la conf. de l'AAG (1993-2002)



carte de Kohonen (SOM) :
-entrée : vecteur n-dim occurrences
des mots de l'abstract
-sortie : vecteur dim 2

altitude liée à la définition des sujets

<http://geography.sdsu.edu/People/Pages/skupin/>

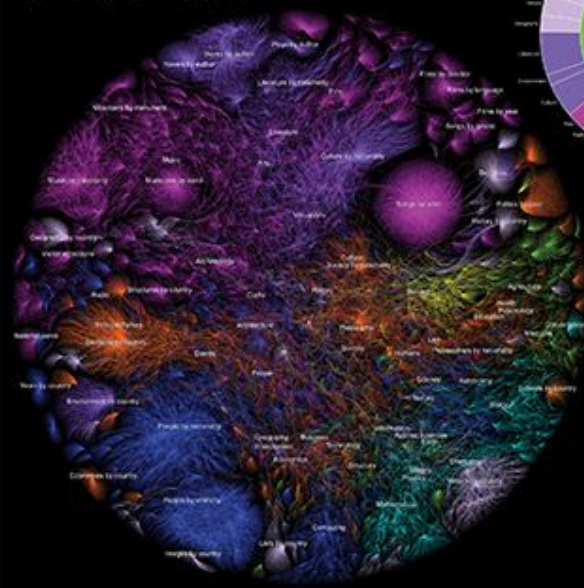


K. Börner et al. Taxonomy visualisation of Patent Data, 2006
 3,17M brevets + 160K catégories

DESIGN VS. EMERGENCE: VISUALIZATION OF KNOWLEDGE ORDERS

WIKIPEDIA'S CATEGORY STRUCTURE

The Wikipedia category structure was extracted from the January 2008 dump by WebCrawler4.com. Wikipedia has two different types of pages: article and category pages. Only category pages are used here. To get the main structure, we based the original category structure, which began with a conventional single, nested using "Category: Main topic classification", at a root and extending it into that did not agree with the article structure. The resulting category structure is 24,000 categories organized in 14 levels of 12 with the root node being 42 (human) nodes. The original visualization is titled as the first part of the hierarchy containing of 81,708 nodes and 40,714 edges. Detail version can be accessed using DOI: 10.1002/vis.1002. The first level node, selected using the first level of the right hand of the chart.

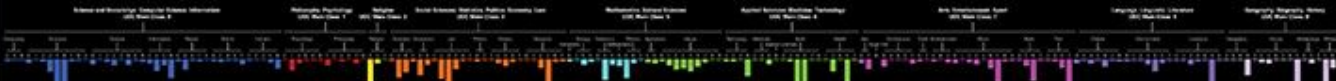
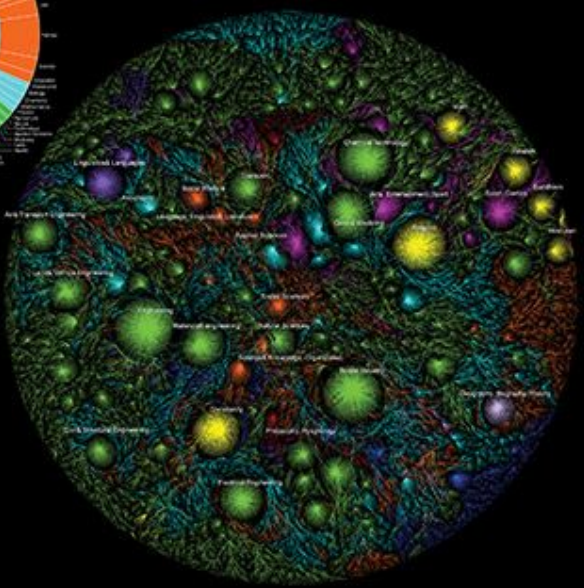


CATEGORY DISTRIBUTION OF WIKIPEDIA & UDC

This chart shows the distribution of the main UDC categories (see ring) and the 42 top Wikipedia categories (see ring). Wikipedia categories are further grouped as compared to UDC classes and related accordingly. About 72% of UDC categories belong to 10 Wikipedia UDCs: Natural Sciences and 50% Applied Sciences. Wikipedia's 42 top categories (see ring) are organized in a hierarchical structure, with many categories (see ring) being sub-categories of the main UDC classes. The chart is organized by Science, Knowledge, Engineering and Social Sciences. A large part (37% of Wikipedia categories) are related to engineering.

UNIVERSAL DECIMAL CLASSIFICATION

The UDC was created in 1908 by Paul Otlet and Henri La Fontaine in an attempt to organize all existing knowledge. The early version of the UDC was much more detailed in the distribution of the subclasses it covered in the attempt of being. Our data comes from a 2008 Update document by the UDC, as there is a total of 40,000 classes organized in a tree level branching, but to the depth of nine, organized under nine main classes. The visualization shows the main UDC classes (see ring) and related accordingly. About 72% of UDC categories belong to 10 Wikipedia UDCs: Natural Sciences and 50% Applied Sciences. Wikipedia's 42 top categories (see ring) are organized in a hierarchical structure, with many categories (see ring) being sub-categories of the main UDC classes. The chart is organized by Science, Knowledge, Engineering and Social Sciences. A large part (37% of Wikipedia categories) are related to engineering.



WIKIPEDIA TO UDC: BAR CHART

This bar chart compares the distribution of Wikipedia's top categories with the UDC classes. The length of a bar corresponds to how many times a category term is found in a UDC main class. Some terms have strong connections with a large UDC class. For example, "Mathematics" appears only in class 5, whereas some terms like "History" are distributed among all classes. The organization process starts with mapping the terms in the UDC categories of Wikipedia to the main UDC main classes. Instead of searching for UDC, the main terms in Wikipedia categories are used by connecting the content of terms through their meaning. To this end, we built a network structure of Wikipedia terms in the UDC's main classes and mapped the terms to their main categories. Each one of the 42 top categories of Wikipedia is mapped to UDC, main class, and is of multiple classes.

VISUALIZING TRENDS AND DYNAMICS

30 YEARS OF SCIENTIFIC DEVELOPMENT



Social sciences

Health & medical sciences

Biomedical sciences

Life & earth sciences

Chemistry

Physics & engineering

Mathematics & computer sciences

A lire sur le sujet

Visualization of Text Streams: A Survey

Artur Šilić

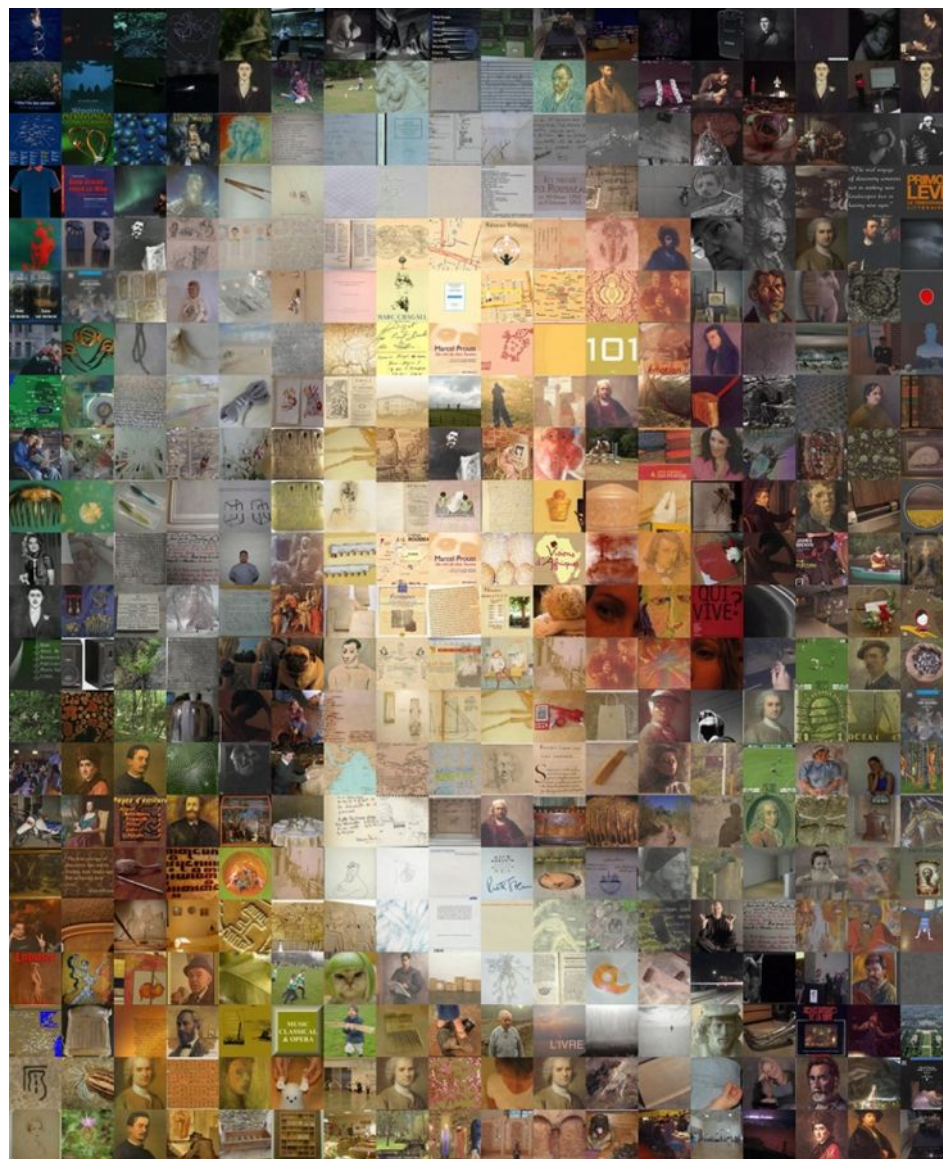
Department of Electronics, Microelectronics, Computer and Intelligent Systems
University of Zagreb, Faculty of Electrical Engineering and Computing
Unska 3, 10000 Zagreb, Croatia

Abstract—This work presents related areas of research, types of data collections that are visualized, technical aspects of creating visualizations, and evaluation methodologies. Existing methods are structured and explained from the aspect of the visualization process. Successful applications are noted and some future trends in the field are anticipated.

Keywords—Information Visualization, Visual Analytics, Topic Detection and Tracking, Text Mining, Trend Discovery, Visualization Evaluation, Dimensionality Reduction, Text Representation, Information Extraction, User Interaction.

Another field of study that relates to text visualization is Topic Detection and Tracking (TDT) [7], a DARPA-sponsored initiative to investigate the state-of-the-art in finding and following new events in a stream of broadcast news stories. Pilot phase started in 1998 and final phase of the project ended in 2004. The developed methods for detection and tracking of stories are elaborate and data-specific. They can be used as a background tool for text stream visualization in which the foreground drawing methods need not be complex. However, the visualizations can still be highly informative. An ex-

2. Masses d'images



Robert Silvers, Photomosaic, 1995

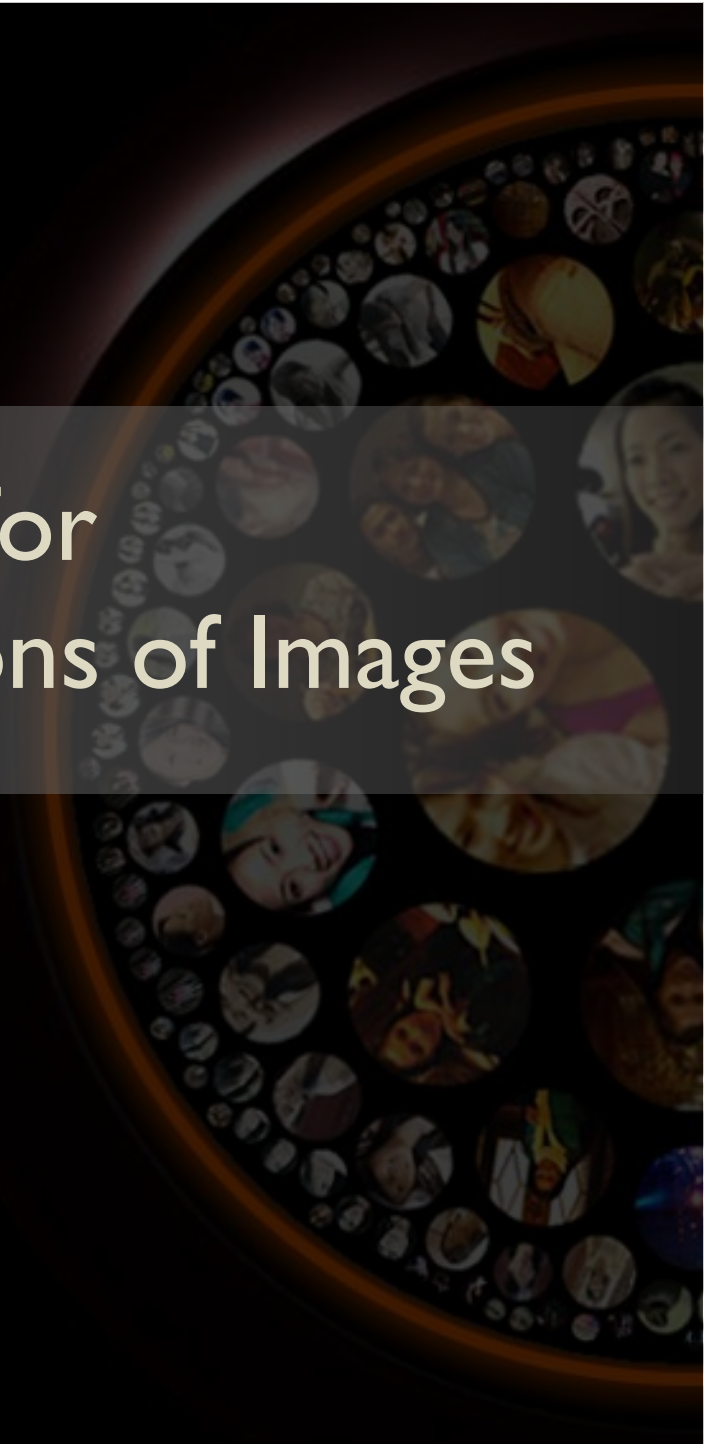
Serendipité ?



Mobile Interface Design for Browsing Large Collections of Images

Shuo-Hsiu HSU

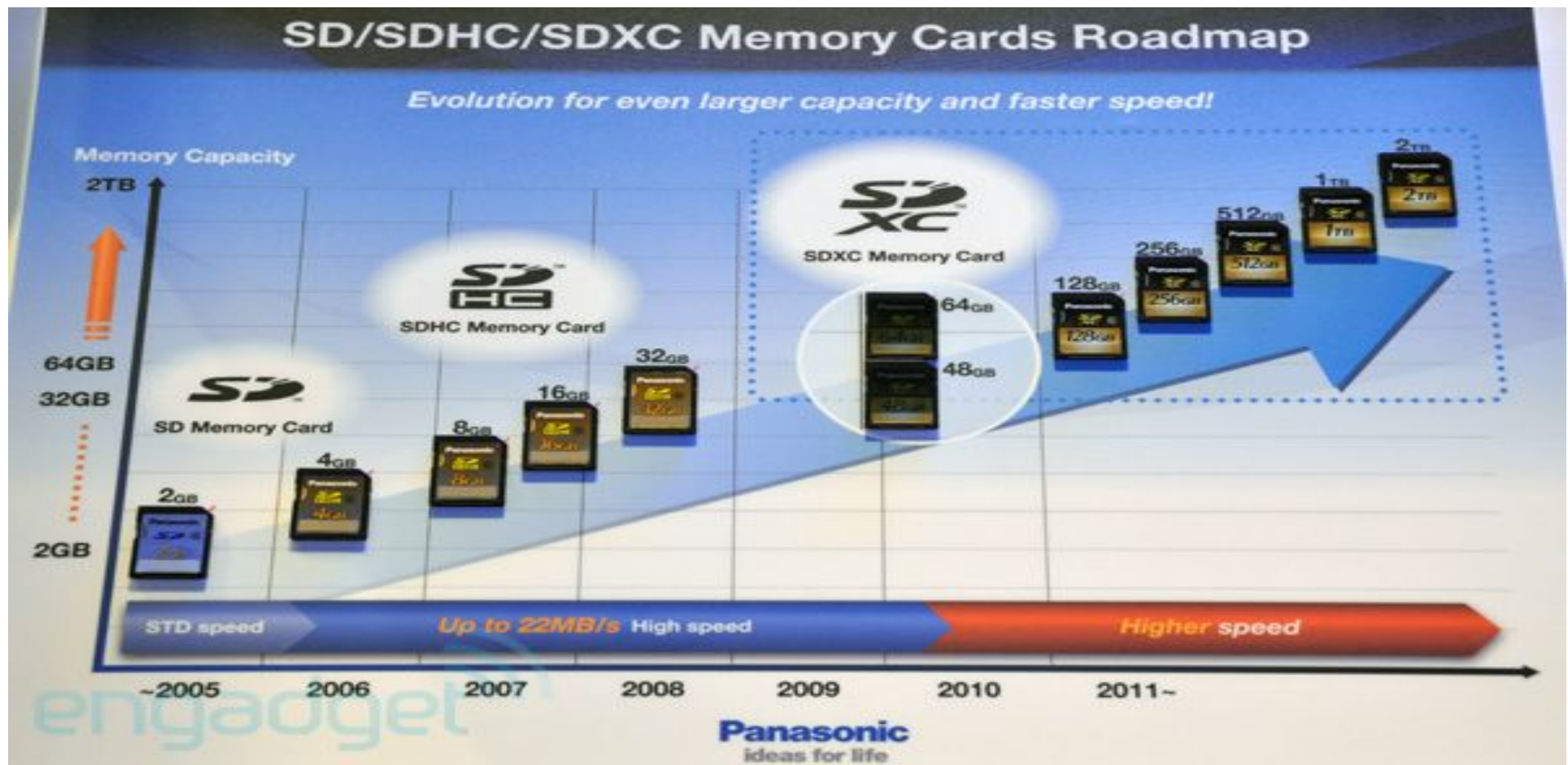
12. 01. 2011



(Context of subject)

Digital photos in the context of mobility

- Availability of the image-capturing devices (low price, variation in products)
- The growth of the storage device



(Photo Categorization)

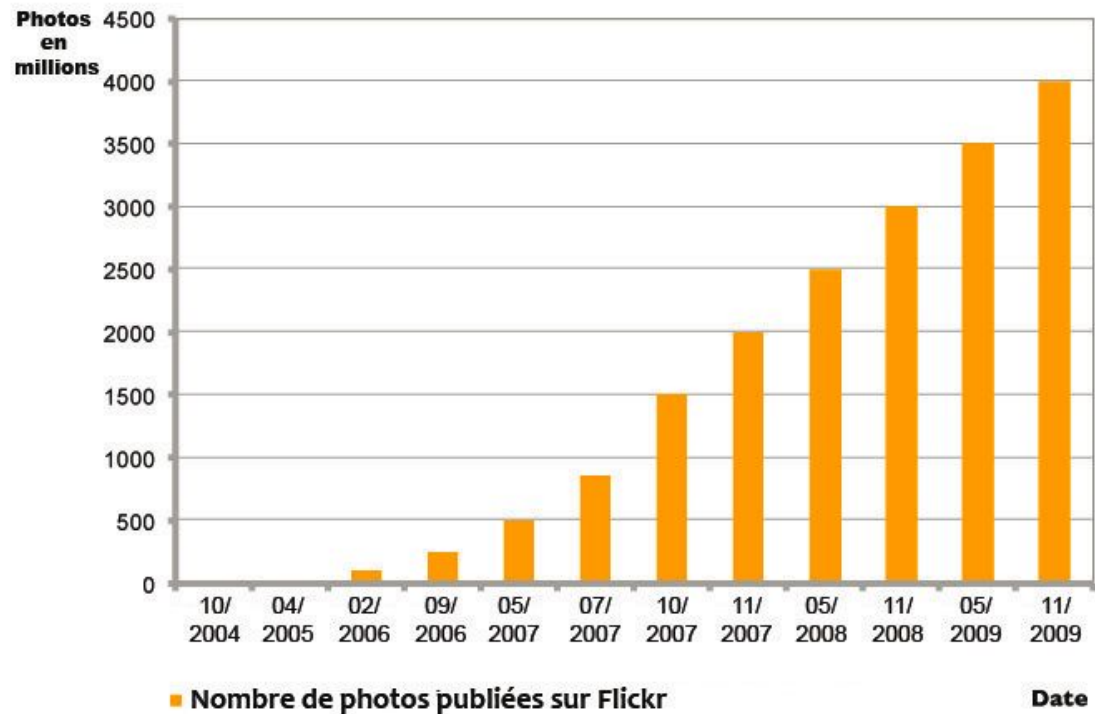


*Great photos are more than pictures;
they are “**stories**”*

Canon

(Context of subject)

- Online service facilitates the storage and encourage the sharing of photos
 - Google Picassa
 - Yahoo Flickr
 - Orange
 - Facebook*
(the biggest one)
 - Amazon web service
 - Apple iCloud



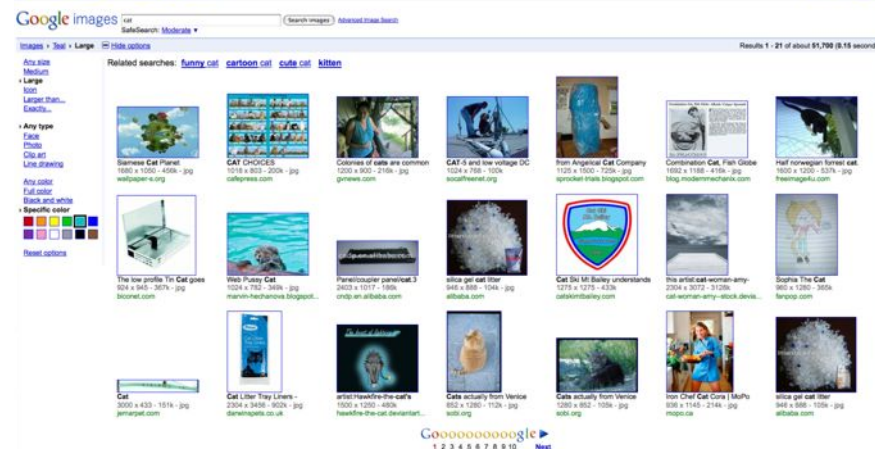
(Context of subject)

Definition of the keywords in this subject :

- Photo albums = personal photo albums
- InfoVis = Casual Infovis
- Small screen
- Mobile device
- Unconventional interaction model (instead of mouse, joystick, keyboard)

(Problematic)

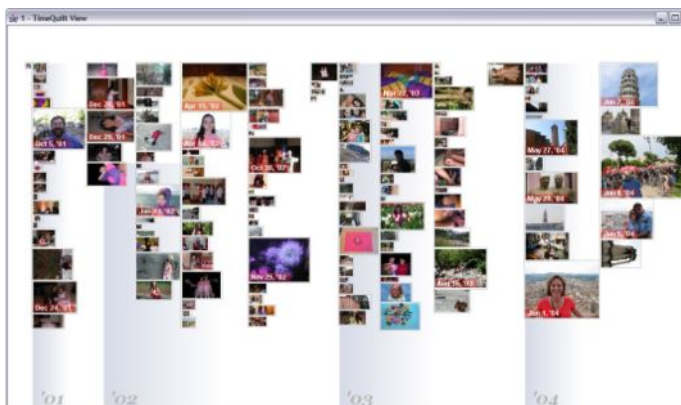
- Conventional image browsers implemented with clustering algorithms are often **query-based**.



- Single** usage to deal with **various** types of photos within conventional system tools, rarely integrated.



Photo tourism (Snavely et al., 2005)



Time Quilt (Huynh et al., 2005)

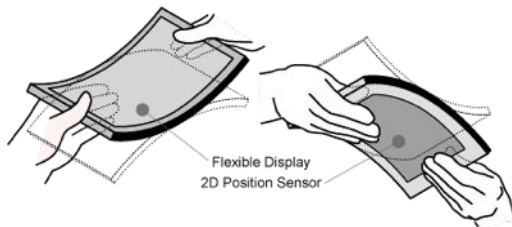


Face Bubble (Xiao et al., 2008)

(Interaction Techniques)

What kind of natural interaction techniques for mobiles?

Haptic manipulation



Gummi [Schwesig et al., 2003]



TWEND
[Herkenrath et al., 2008]

Remote gesture



Mitsubishi 3D control panel, 2009



Toshiba Qosmio 55, 2009

Touch-based gesture



Apple iPad, 2010

(Interaction Techniques)

What kind of natural interaction techniques for mobiles?

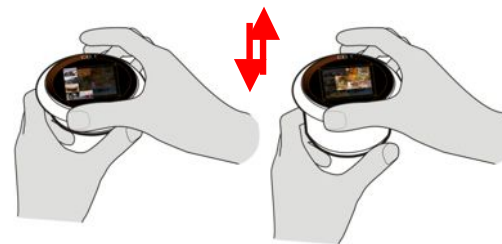
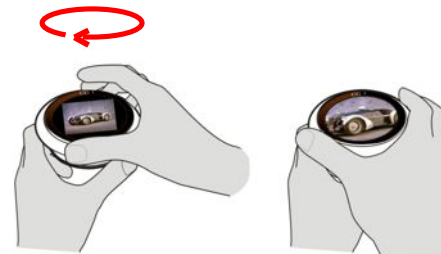
Haptic manipulation – upcoming news



Nokia kinetic future: flexible screen and twisted interface
[Nokia, 2011]

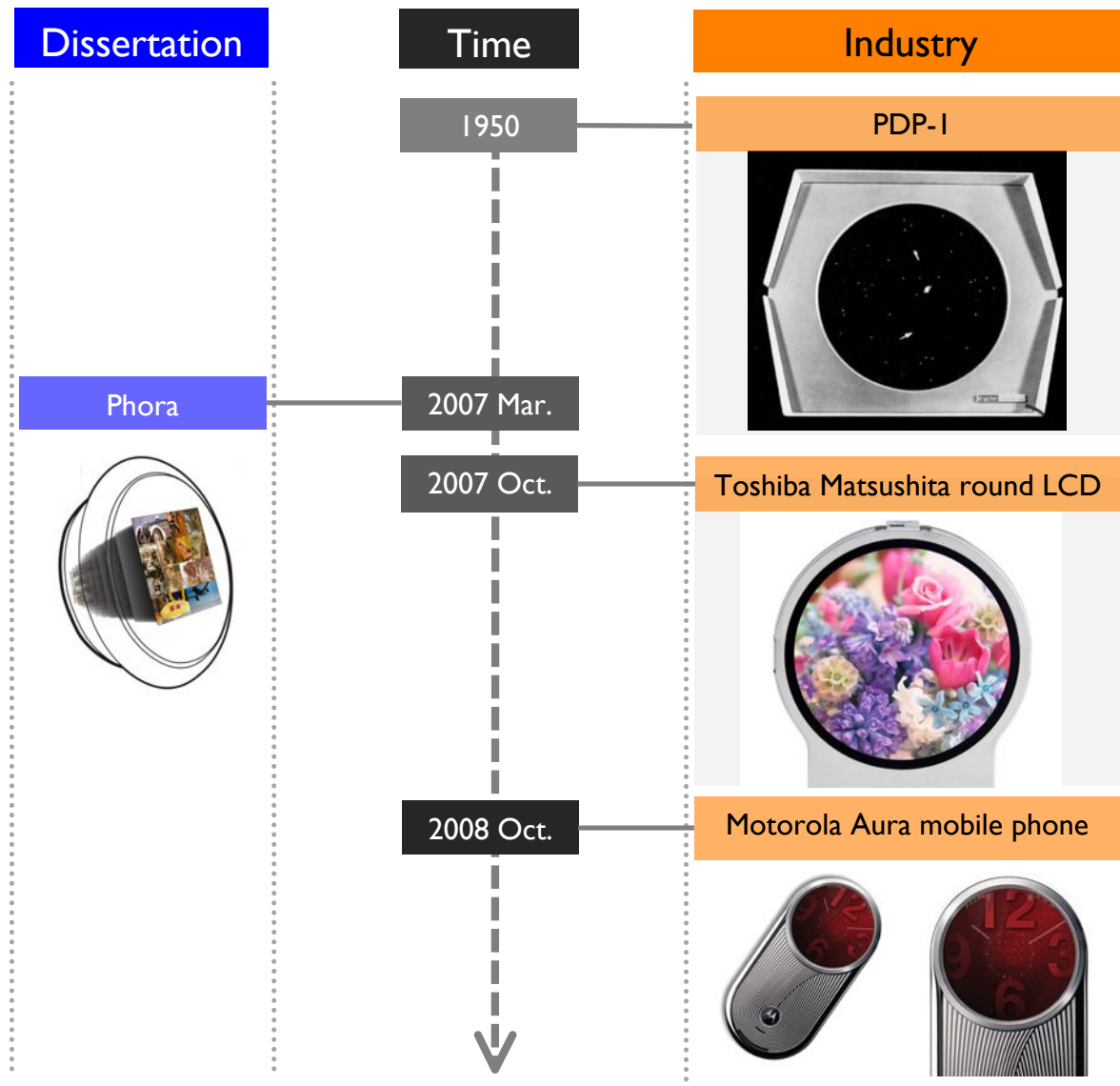
(Device Design - Phora)

Design & 3 gestures



* Phora is inspired from french noun « forage », which means digging.

(Round screen)



(Device Design - Phora)

Prototype

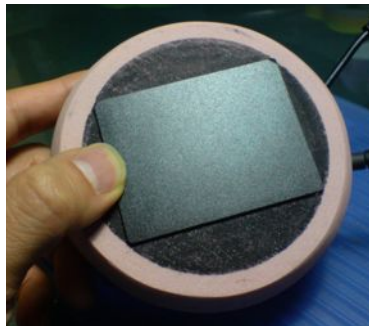


[demo]



SpaceNavigator

Small scale user study



Substitute of
round touch screen:
TouchPad



SpaceNavigator in
Phora

- 6 participants
- Evaluation of haptic manipulation
- Tasks simulating the usage in everyday scenario
- Involving different size of albums (300/1000P)

(Device Design – Phora II)

Two potential tasks of casual usage of photos on mobile devices

- Simple photo retrieval on mobiles (the album size is not large)
- Shuffling photos for reminiscing (recalling memories)

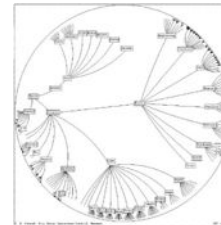
Trends of mobile browsers

- Usage on mobile image browser is casual, users only need basic functions.
- As function requirements is low, the visual presentation dominates the interaction.

Overview of circular visualization / interface



Fisheye
(Furnas, 1986)



Hyperbolic tree
(Lamping, 1995)



Fotofile
(Kuchinsky et al., 1999)



Circular interface
(Shen et al., 2003)



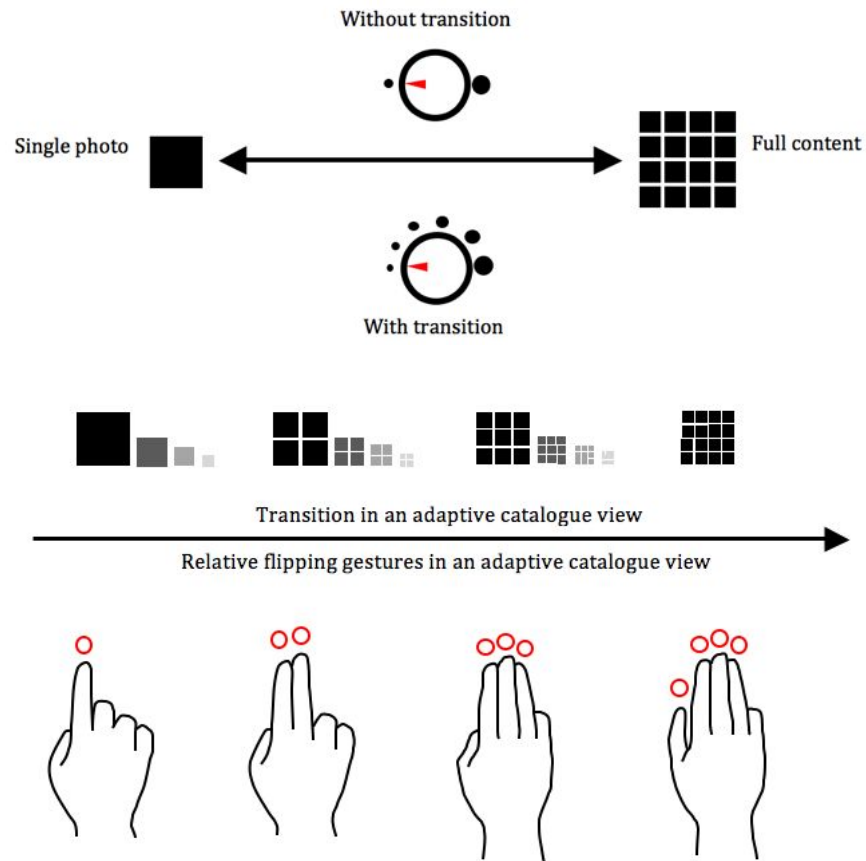
Face Bubble
(Xiao & Zhang, 2008)



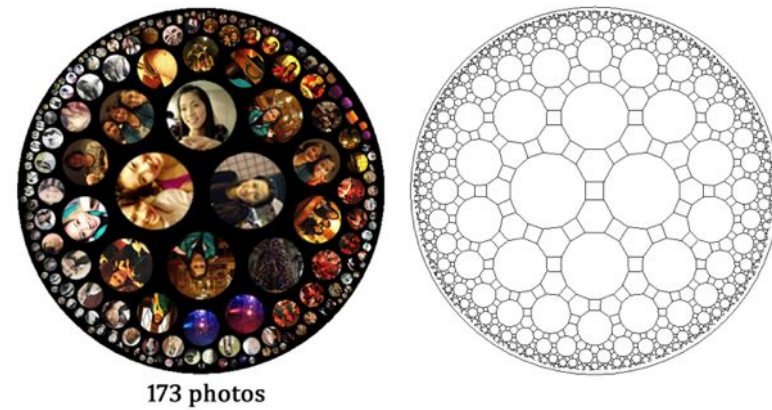
MyPhotoEgg
(2008)

(Device Design – Phora II)

Potential mechanism in image browser



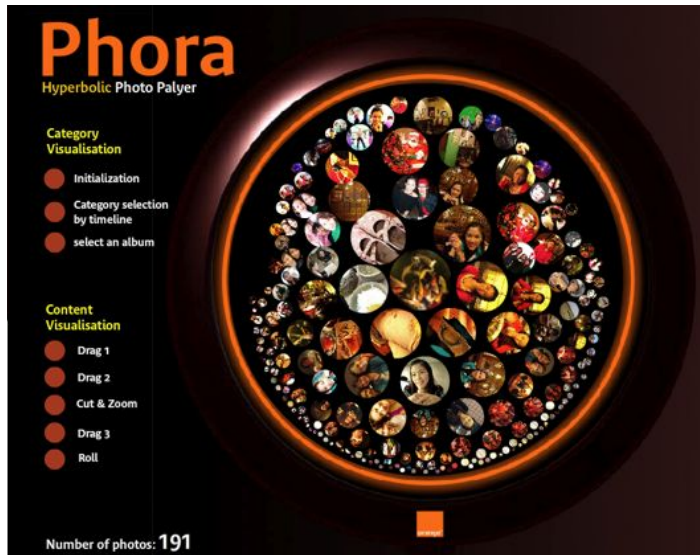
Phora based on hyperbolic tree



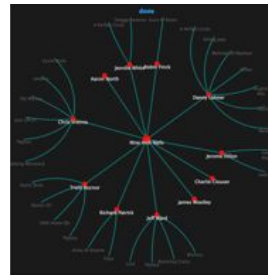
Look & feel : Analogic to Church rosette

(Device Design – Phora II)

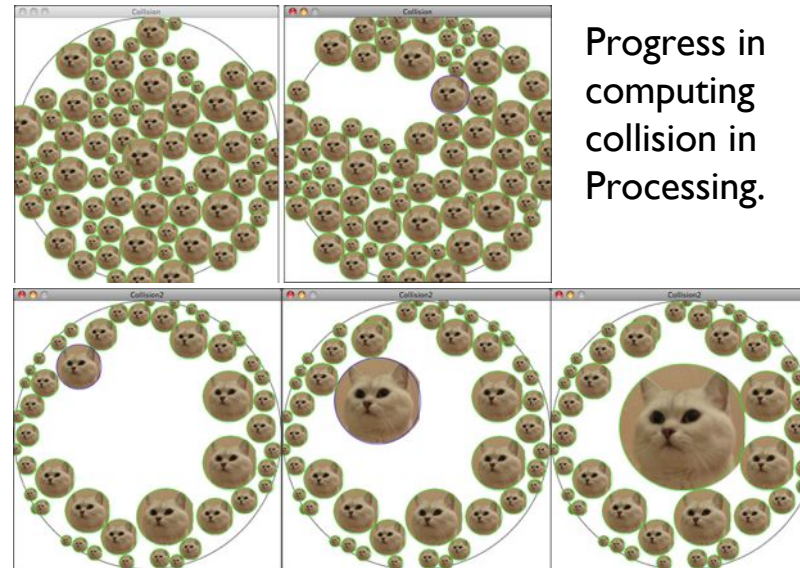
Design



Prototyping problem



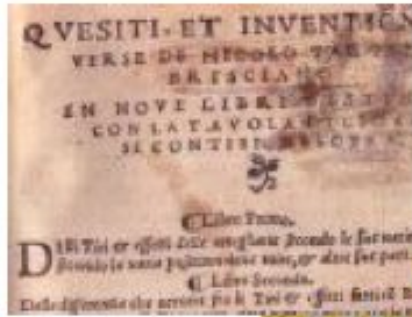
Hypertree by Javascript InfoVis toolkits



3. Masses de livres (les bibliothèques numériques)

machines à lire

LIVRE



AUXILIAIRES



lutrín



roue à livre



SUBSTITUTS



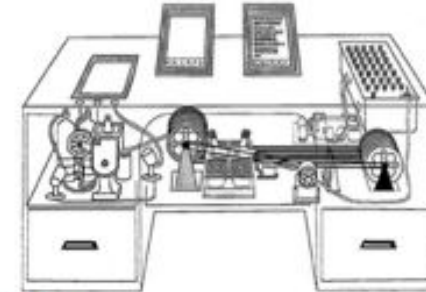
Microfilm



A. Korn, FAX, 1907



P. Otlet, livre téléphoté, 1930



V. Bush, MEMEX, 1945



JCR Licklider, Library of the future, 1965



Vanevar BUSH : MEMEX

The screenshot shows a web browser window with the URL <http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm>. The page title is "The Atlantic | July 1945 | As We May Think | ...". The browser interface includes navigation buttons like "Précédente", "Suivante", "Arrêter", "Actualiser", "Démarrage", "Remplissage automatique", "Imprimer", and "Courrier". The page content features the Atlantic logo with the tagline "ACCELERATED INTELLIGENCE starts here!" and a search bar. The article title "AS WE MAY THINK" by VANNEVAR BUSH is prominently displayed. The text of the article discusses the role of science in warfare and the development of modern scientific instruments. A sidebar on the left contains navigation links such as "Home", "Current Issue", "Back Issues", "The Archive", "Forum", "Site Guide", "Feedback", "Search", "Subscribe", "Renew", "Gift Subscription", and "Subscriber Help". A vertical sidebar on the right contains various promotional banners for audiobooks and other content.

The Atlantic Monthly | July 1945

AS WE MAY THINK

BY VANNEVAR BUSH

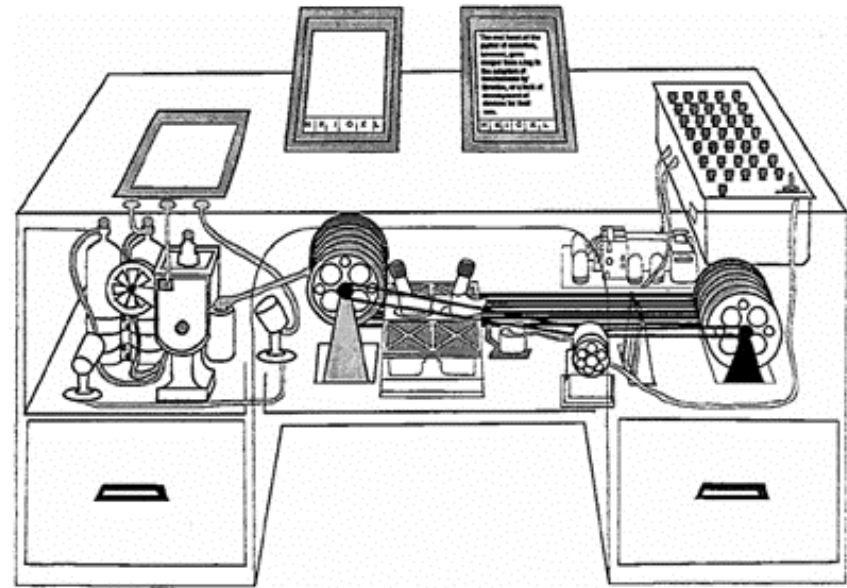
.....

As Director of the Office of Scientific Research and Development, Dr. Vannevar Bush has coordinated the activities of some six thousand leading American scientists in the application of science to warfare. In this significant article he holds up an incentive for scientists when the fighting has ceased. He urges that men of science should then turn to the massive task of making more accessible our bewildering store of knowledge. For years inventions have extended man's physical powers rather than the powers of his mind. Trip hammers that multiply the fists, microscopes that sharpen the eye, and engines of destruction and detection are new results, but not the end results, of modern science. Now, says Dr. Bush, instruments are at hand which, if properly developed, will give man access to and command over the inherited knowledge of the ages. The perfection of these pacific instruments should be the first objective of our scientists as they emerge from their war work. Like Emerson's famous address of 1837 on "The American Scholar," this paper by Dr. Bush calls for a new relationship between thinking man and the sum of our knowledge. —THE EDITOR

This has not been a scientist's war; it has been a war in which all have had a part. The scientists, burying their old professional competition in the demand of a common cause, have shared greatly and learned much. It has been exhilarating to work in effective partnership. Now, for many, this appears to be approaching an end. What are the scientists to do next?

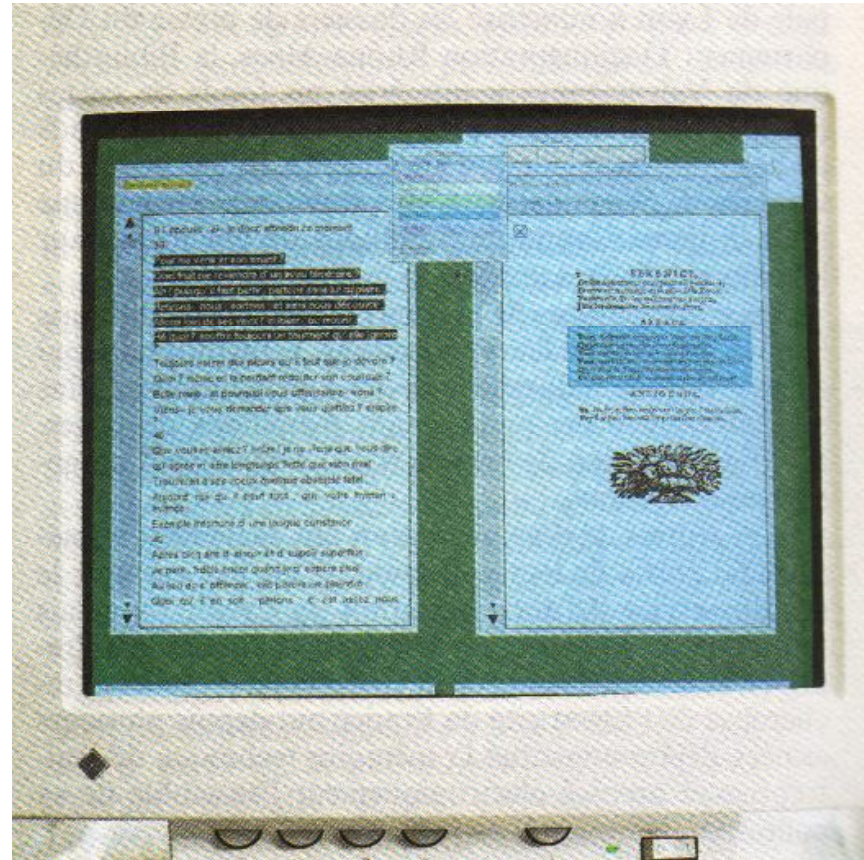
For the biologists, and particularly for the medical scientists, there can be little indecision, for their war has hardly required them to leave the old paths. Many indeed have been able to carry on their war research in their familiar peacetime laboratories. Their objectives remain much the same.

It is the physicists who have been thrown most violently off stride, who have left academic pursuits for the making of strange destructive gadgets, who have had to devise new methods for their unanticipated assignments. They have done their part on the devices that made it possible to turn back the enemy, have worked in combined effort with the physicists of our allies. They have felt within themselves the stir of achievement. They



<http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm>

MEMORIA : Le PLAO (1988 - 1997)

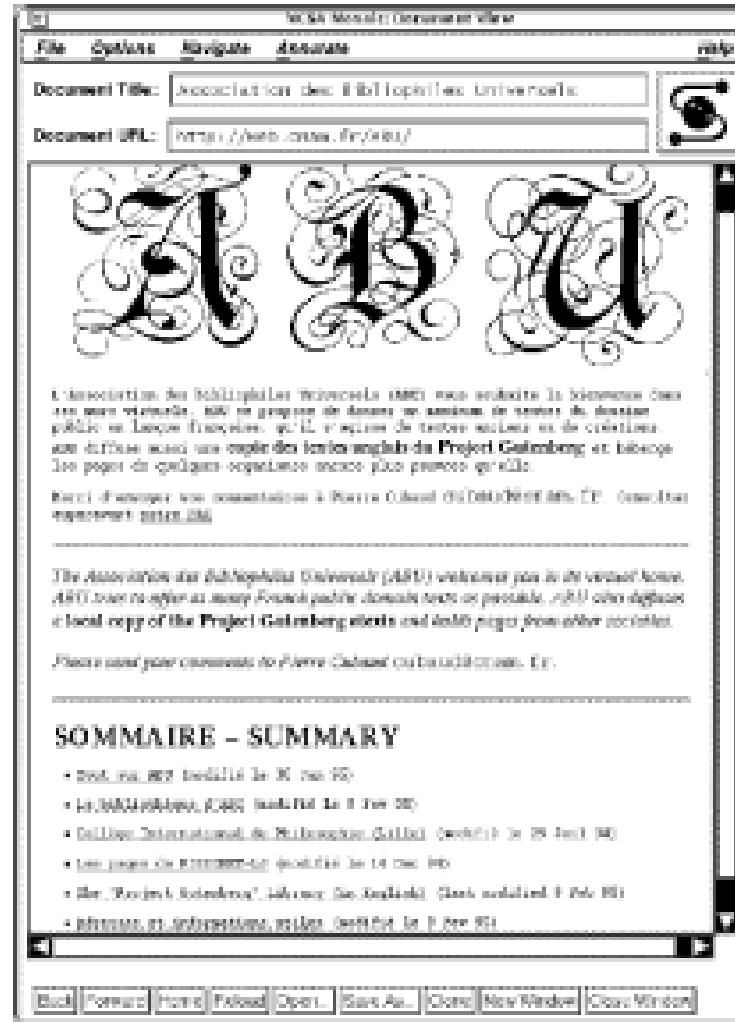


J. VIRBEL. Reading and managing texts on the Bibliothèque de France station. in G.P. Landow, P. Delany (eds.) The digital word. Text-based computing in the humanities. MIT Press, 1993

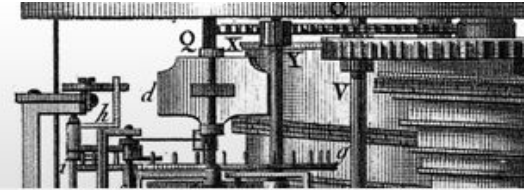
Y. MAIGNIEN. Chronique partielle d'une bibliothèque virtuelle. Doc. numérique vol. 2 (3-4), pp. 281-290

A. PELFRENE. Les postes de lecture assistée par ordinateur (PLAO) in C. PAGANELLI (dir.) Interaction homme-machine et recherche d'information. Hermes, 2002.

1993 : first web site for digital library (French classics)



<http://abu.cnam.fr> (still online)



Le site du Cnum fait peau neuve ! Merci d'adresser vos remarques et questions à cnum@cnam.fr

Thématiques

<p>Catalogues de constructeurs 217 titres</p>	<p>Expositions universelles 426 titres</p>	<p>Technologies de l'information et de la communication 217 titres</p>
<p>Construction 117 titres</p>	<p>Histoire du Cnam 18 titres</p>	<p>Transports 158 titres</p>
<p>Énergie 102 titres</p>	<p>Machines et instrumentation scientifique 236 titres</p>	<p>Généralités scientifiques et vulgarisation 13 titres</p>

Nouveautés

LES DÉBUTS DE LA PHOTOGRAPHIE

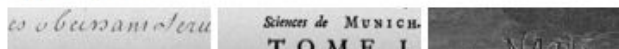
Voir les dernières mises en ligne

Expositions

PROCHAINEMENT

Palais, pavillons et galeries : les bâtiments des expositions universelles en représentation (1798-1900)

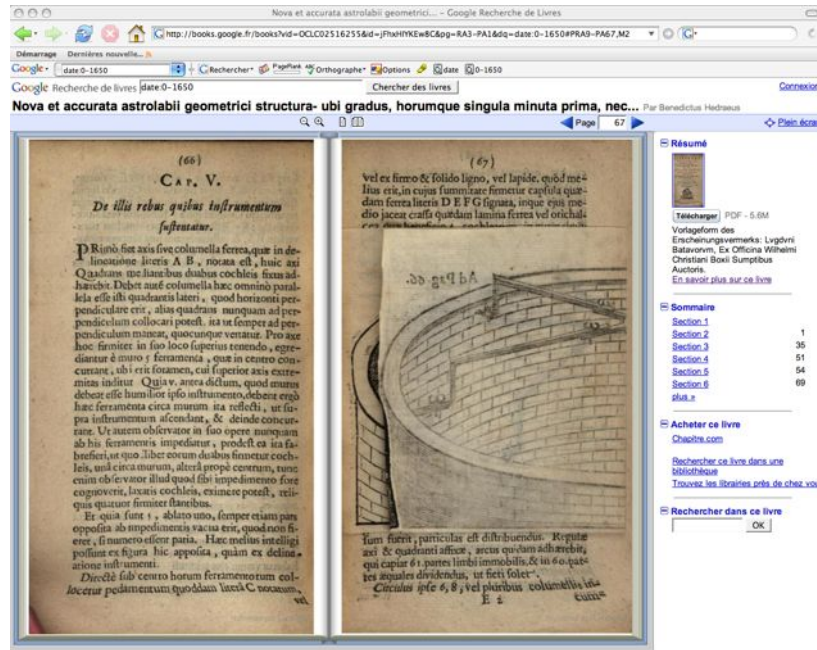
Typologies



≥ 1998 : <http://cnum.cnam.fr>

± 1Mpages

Research challenges ?

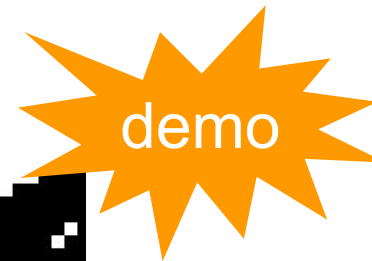
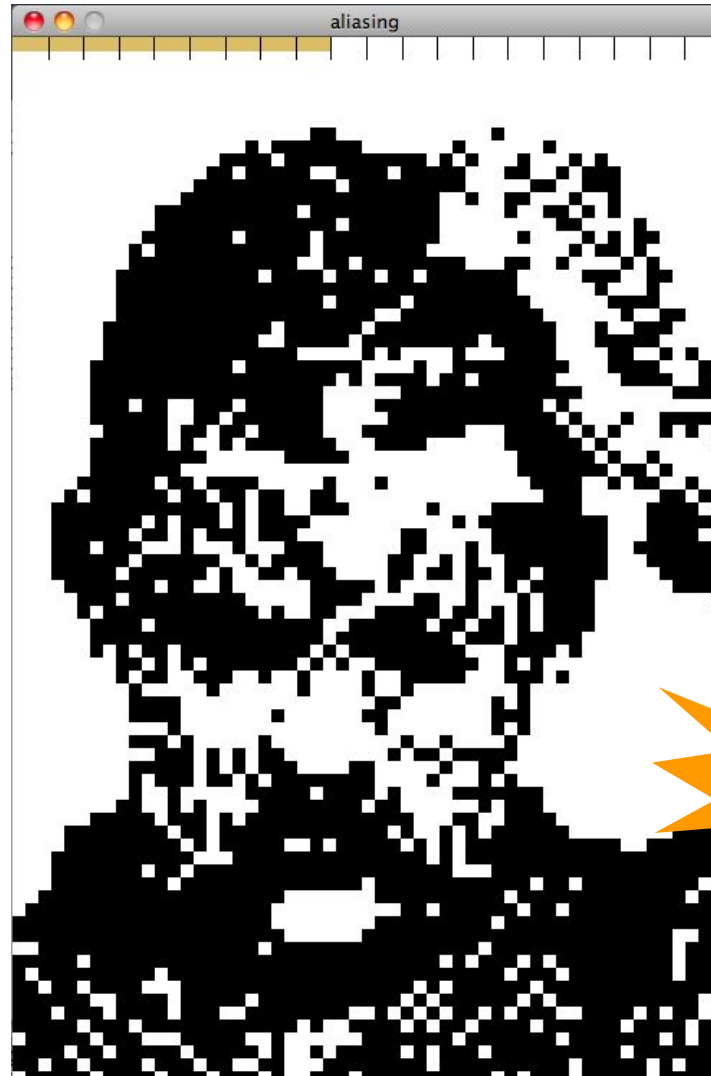


2005 : google books



2010 : Apple ipad

Digitization ?



strolling ?





<http://www.rauzier-hyperphoto.com/voyages-extraordinaires/>

Au Xerox Parc

Stuart K. Card, George G. Robertson, and William York

The WebBook and the Web Forager: An Information Workspace for the World-Wide Web

ACM CHI'1996

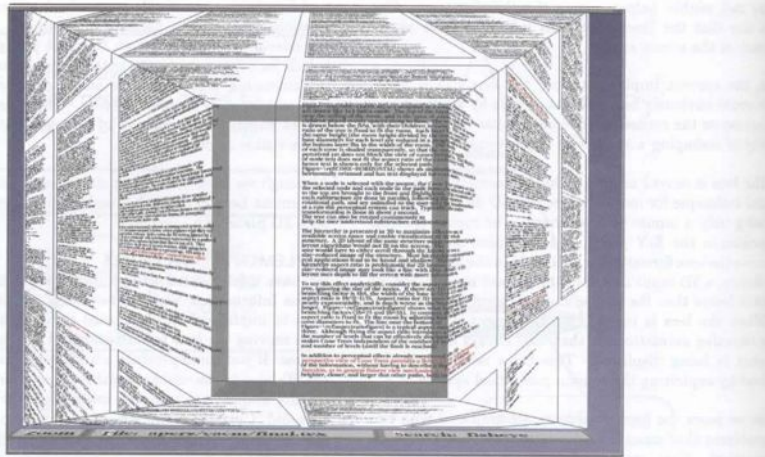
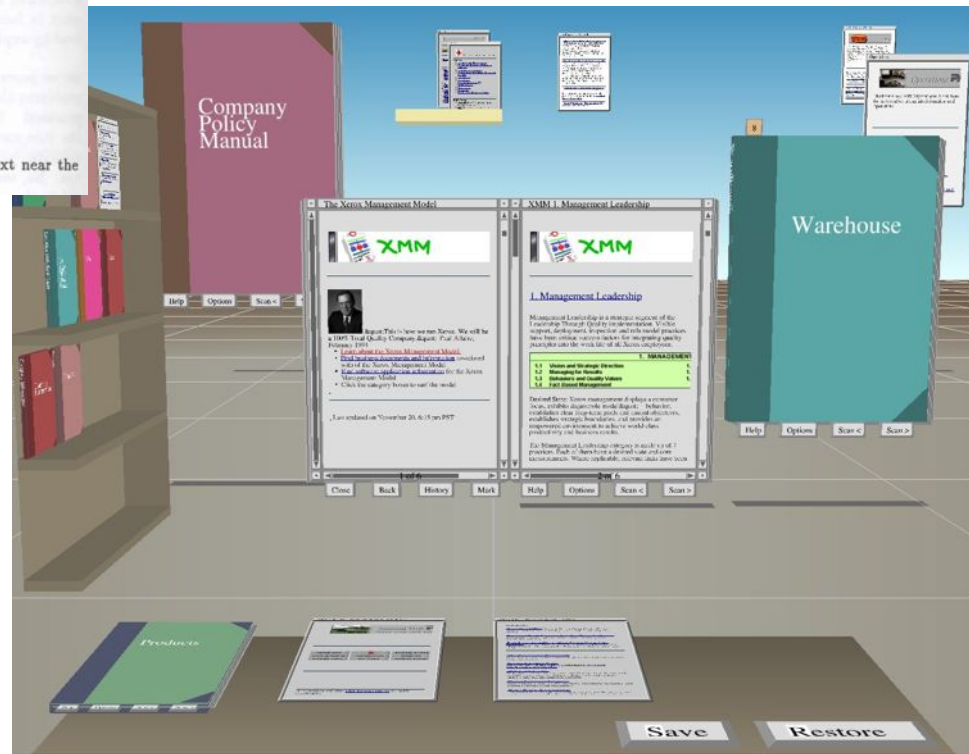
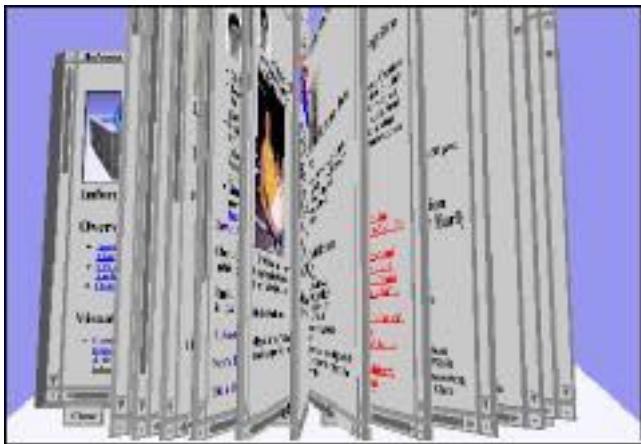


Figure 3: Document Lens with lens pulled toward the user. The resulting truncated pyramid makes text near the lens' edges readable.



Et Microsoft

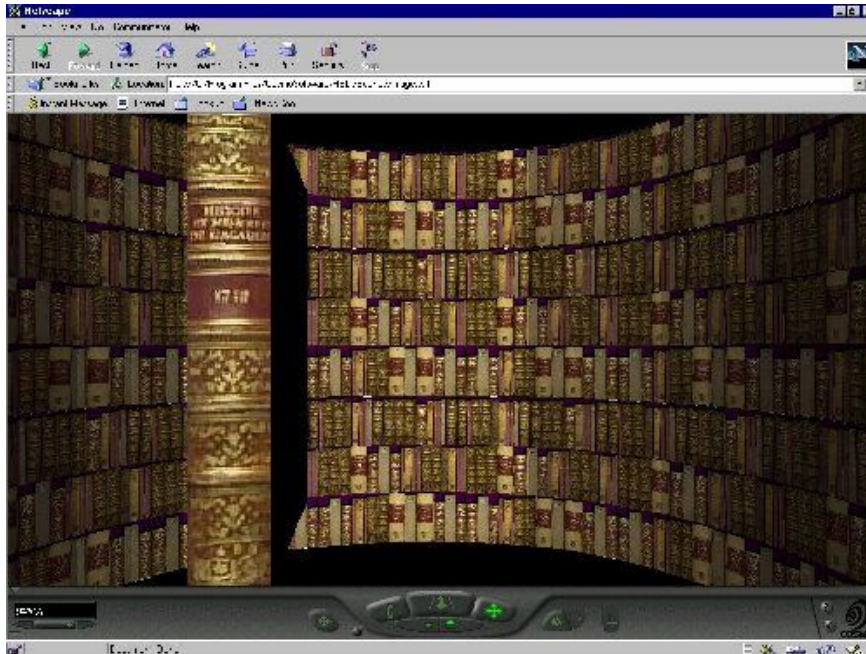


Data mountain
Robertson et al UIST'1998

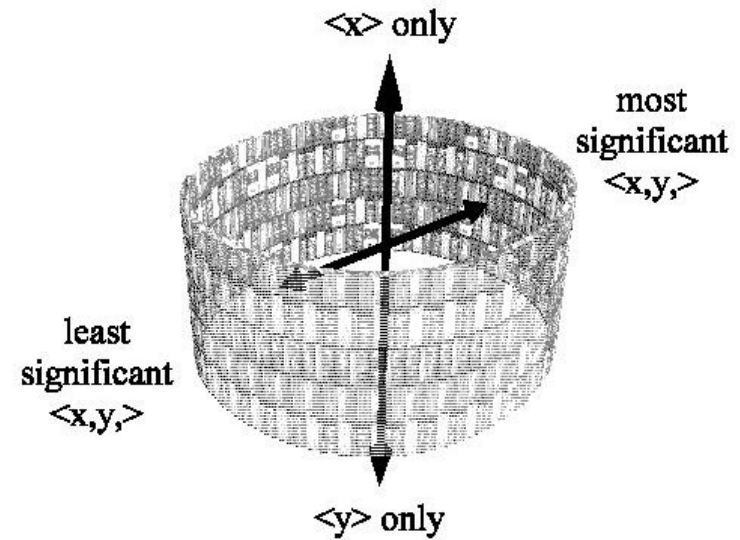
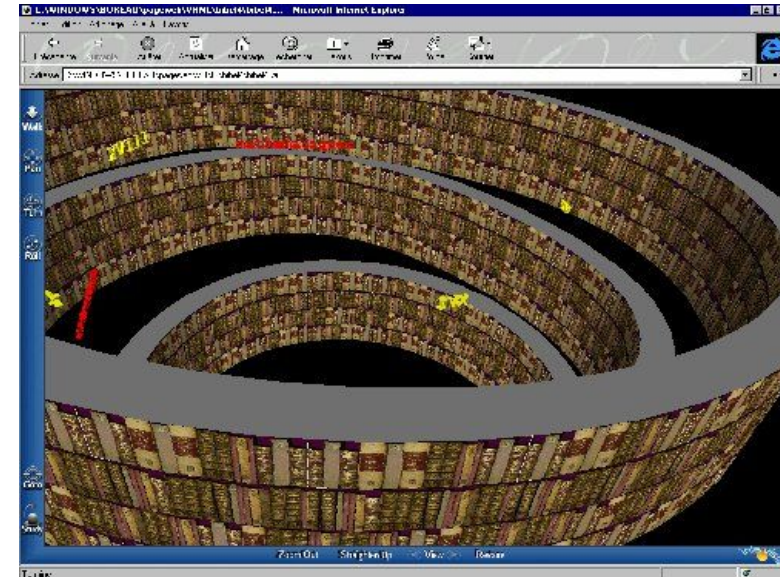


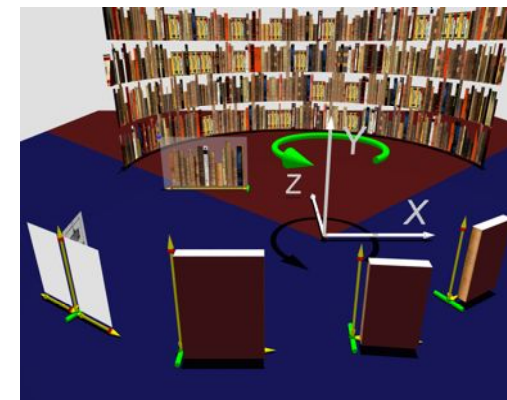
Task Gallery
Robertson et al. CHI'2000

Au CNAM



Cubaud, Thiria, Topol - ACM DL'1998





Cubaud et al. ACM-IEEE joint conf. digital libraries, 2002

Skimming ?

Google Recherche de livres

À propos de ce livre

Mémoire



De Antoine La
Lavoisier

Publié 1920
[Gauthiers-Villars](#)

67 pages

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Numérisé le 8/11/2009

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Rechercher dans ce livre

Rechercher

affordance

YouTube - Introducing the book (repost)

http://www.youtube.com/watch?v=xFAWR6hzZek&feature=related

ECDL10 Processing [Cédric]CB Intr@cnam intraCEP mailCNAM AnnuaireCNAM Deptinfo CNUMDEV Sta

You Tube Search Browse Upload

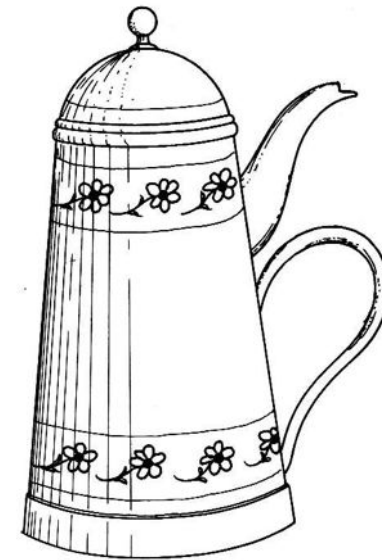
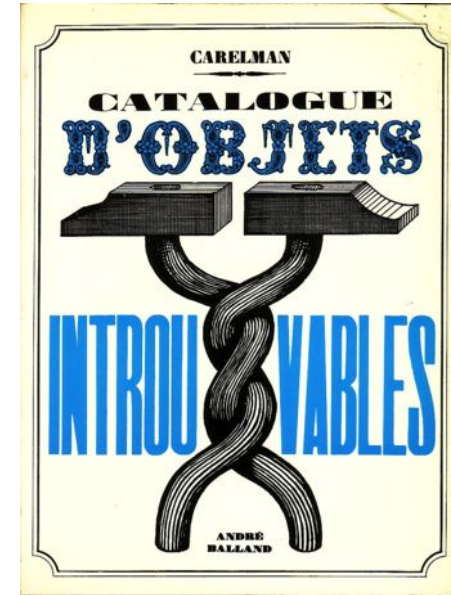
Introducing the book (repost)

ZrednaZ 11 videos Subscribe

- I "turn the page"?
- Yes, turn the page.

1:07 / 2:39 360p

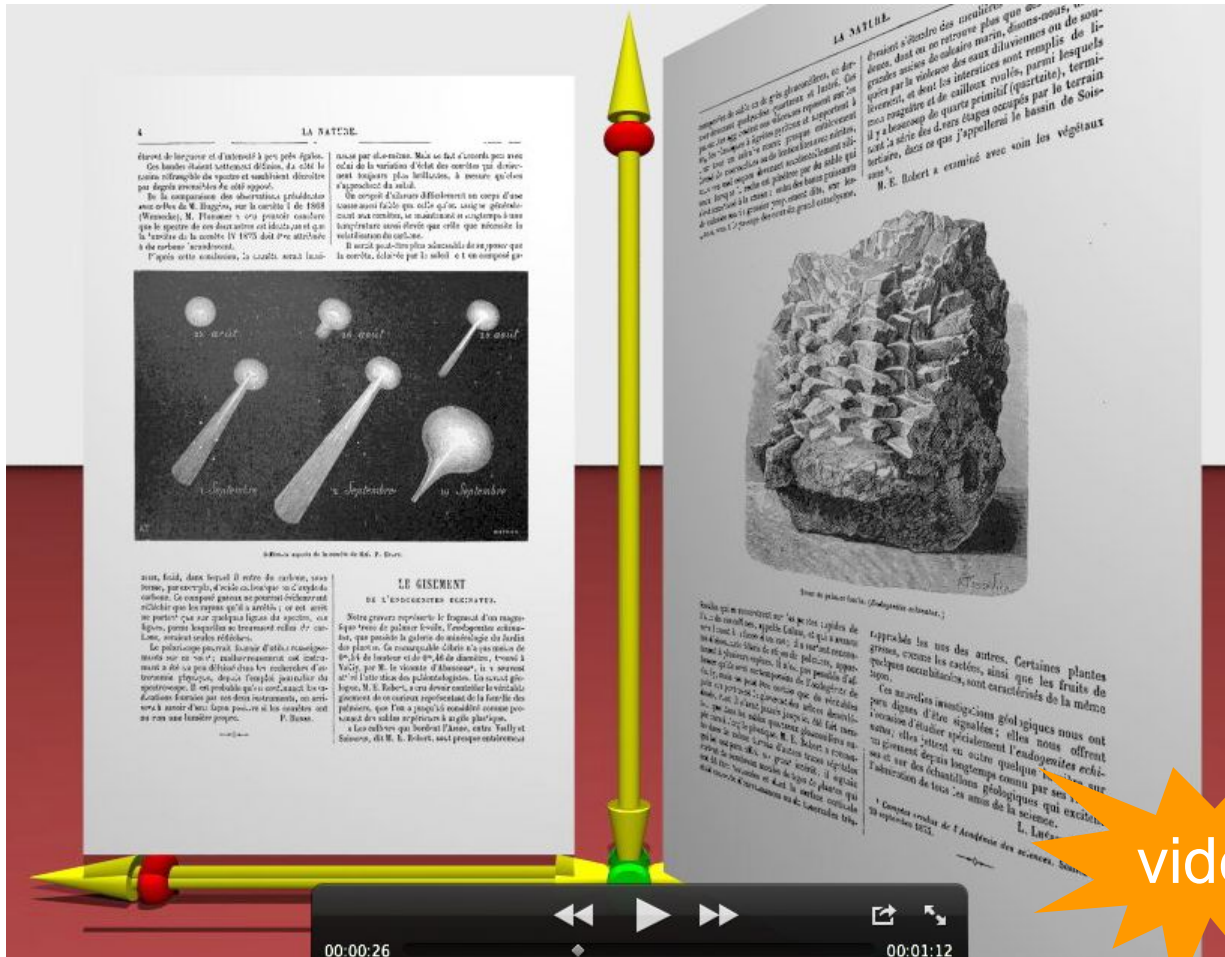
ZrednaZ | February 21, 2007 | 2:38
Comments require approval due to spam. Sorry. A.k.a. Medieval Helpdesk. This... 1,135,236 views



E18 — Cafetière pour masochiste.
Nous pensons que le dessin est suffisamment explicite pour ne pas s'appesantir sur des détails qui pourraient s'avérer pénibles.



« Turning the page » CARPENTER L., SHAW S., PRESCOTT A. (eds)
Towards the digital library : The british library initiatives for access programme.
London, British lib., 1998 (p. 61 et suiv.)

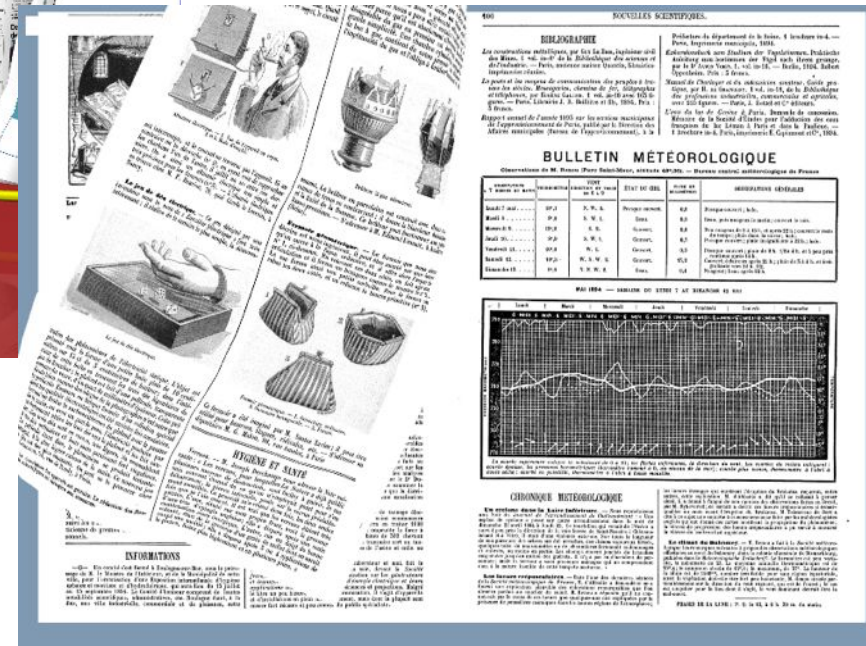


Cubaud, Topol ACM Web3D'2001

moteur physique



Topol et al. ACM-IEEE JCDL'2007



Topol et al. CIDE'2012

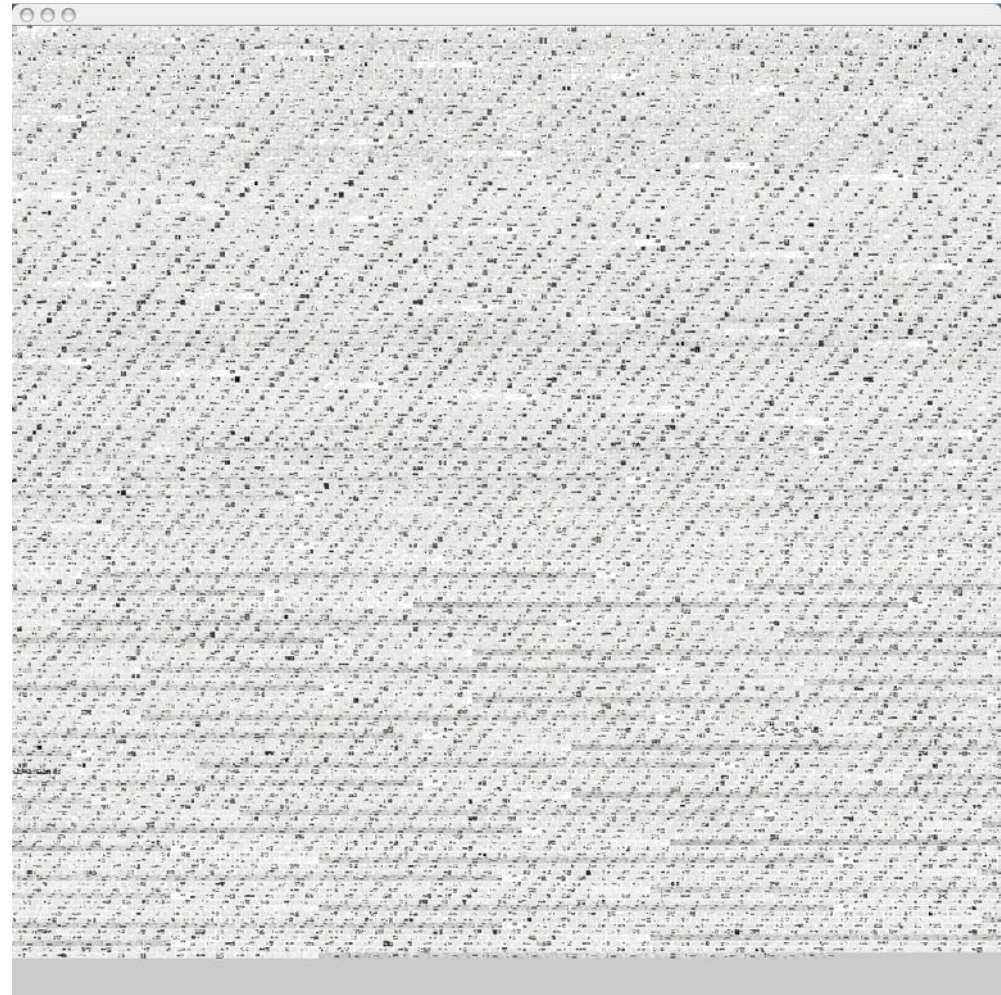
feuilleter en survol = 500 images/seconde !!!



T. Nakashima, Y. Watanabe, T. Komuro, M. Ishikawa
U. Tokyo, mars 2010

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Thirty first years of "la Nature" = 32500 pages