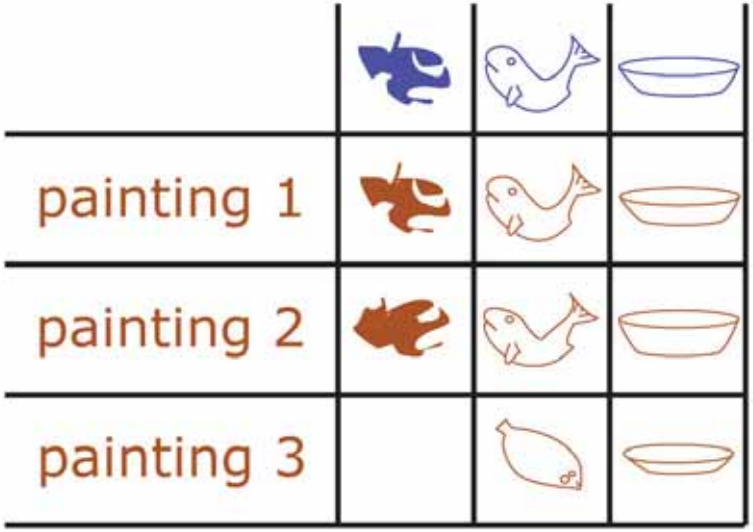
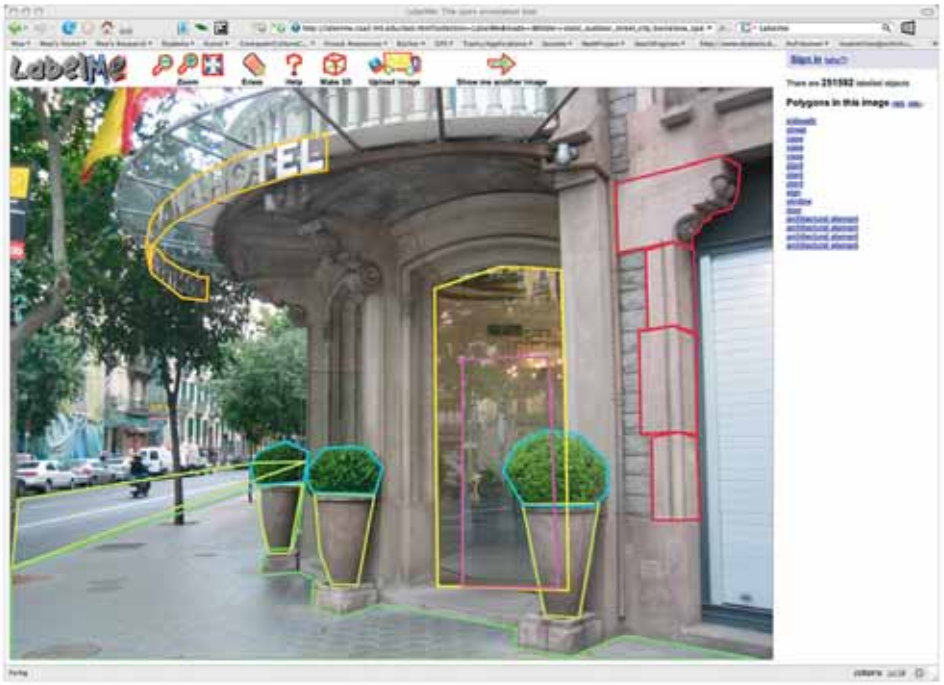
Generating 2-Dimensional Overviews from a Bi-Partite Classification of Images

by Maximilian Schich and Sune Lehmann

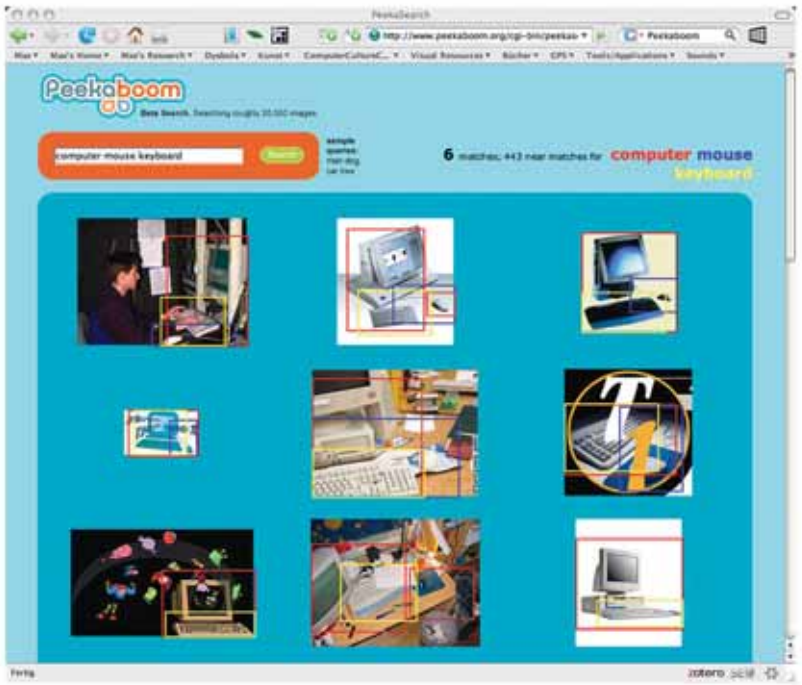


Today massive amounts of images and image-segments are subject to classification...

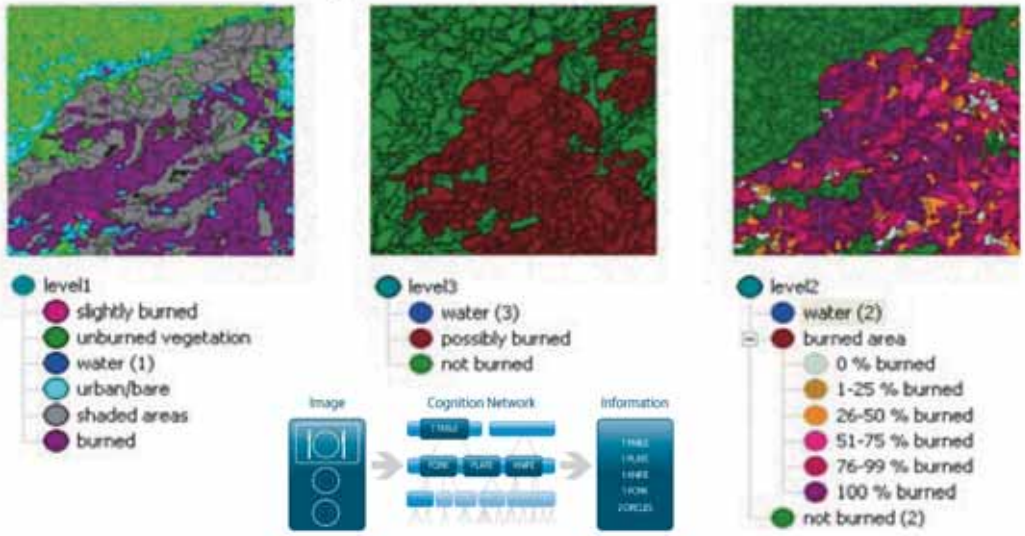
... by human editors as in LabelMe,



... by humans playing games as in Peekaboom,

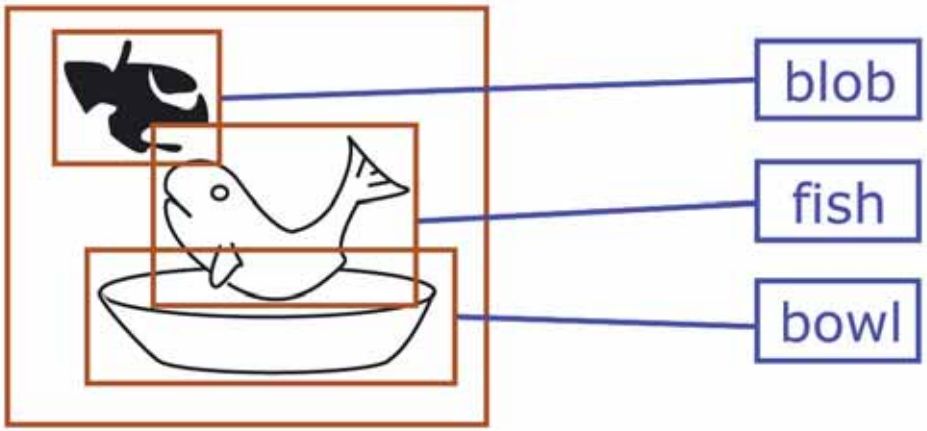


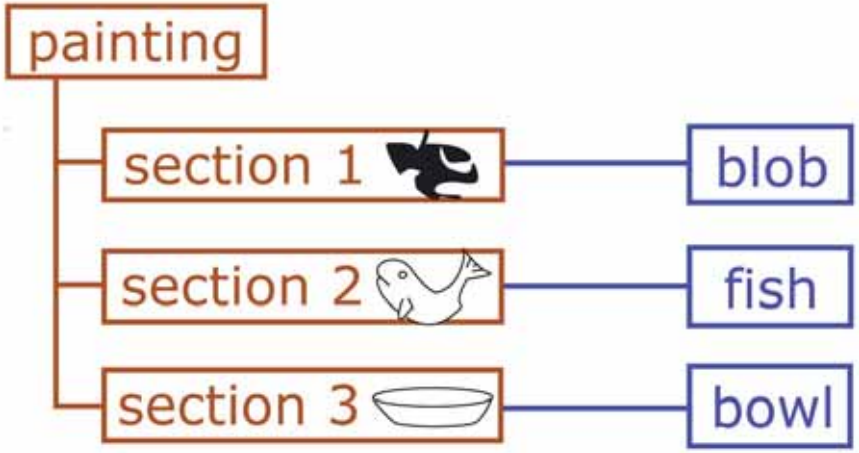
... or by machine as by Definiens.



Sources:
www.labelme.csail.mit.edu
www.peekaboom.org
www.definiens.com

This classifications of images can be understood as bi-partite networks!

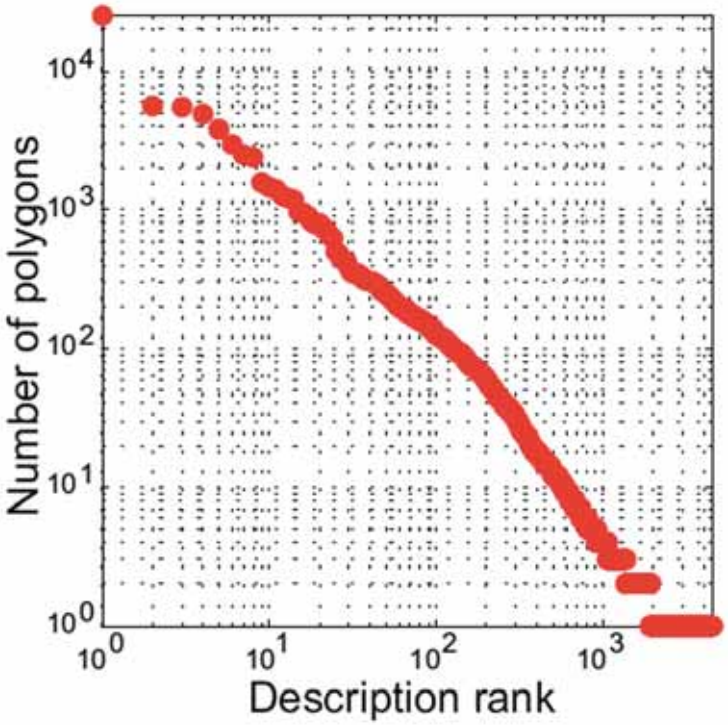




painting 1			
painting 2			
painting 3			

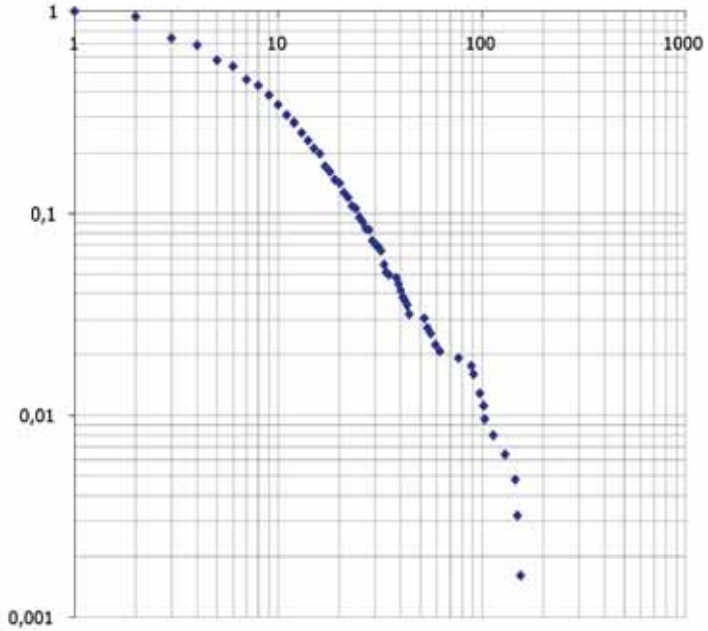
Usually these classification networks contain long tail degree distributions and other complex network properties!

LabelMe dataset:
IN-degree of classification criteria (descriptions),
i.e. number of image segments (polygons).
[Zipf rank?]



Source:
Russell Torralba Murphy Freeman 2008

THERMAE dataset:
IN-degree of classification criteria (depicted monuments),
i.e. number of image segments (document parts).
[cumulative projection]



Source:
Schich 2007 (Diss. HU-Berlin)

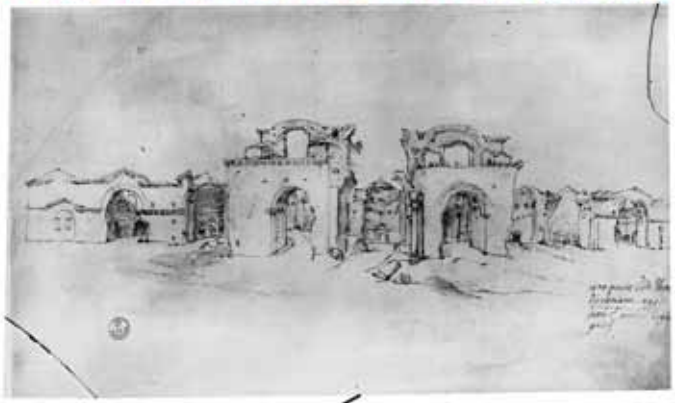
Our example for generating 2-dimensional overviews: the THERMAE dataset

Source: Pirro Ligorio: The City of Rome. Large Version (1561)

The THERMAE dataset will be published: see thermae.schich.info

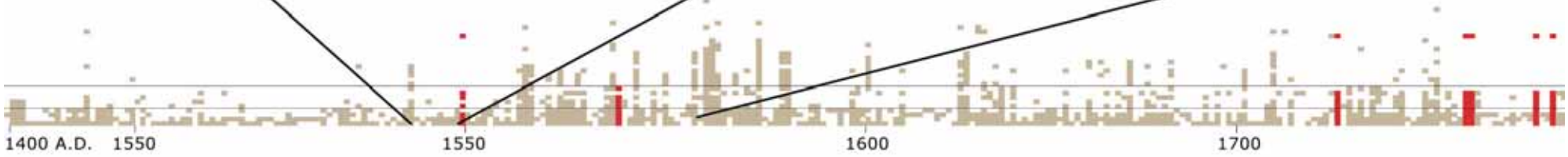
In one partition we find visual documents on Roman baths:

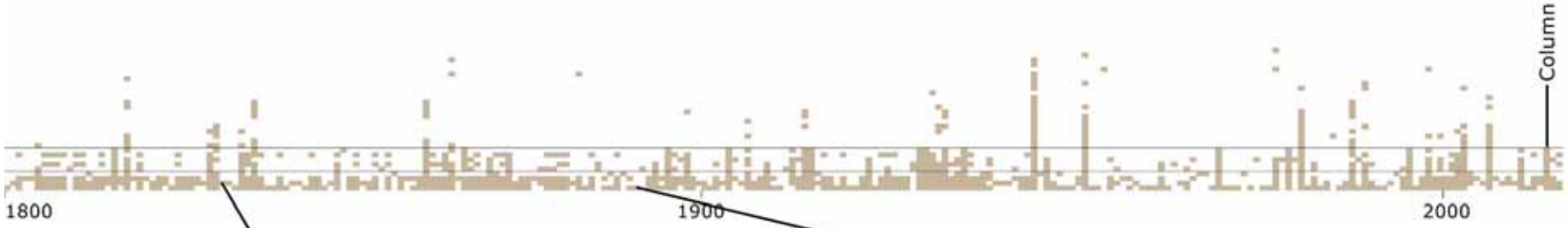
Symbols

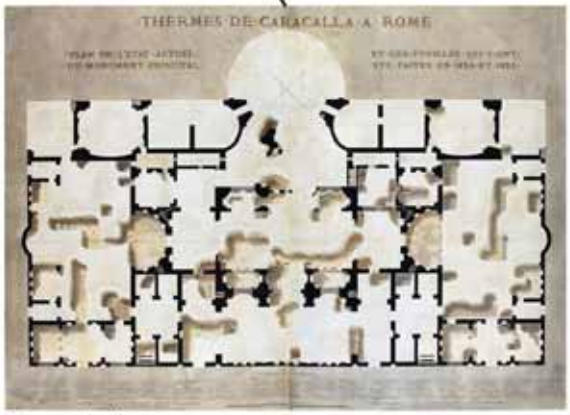


Vedutae (views)

Overviews

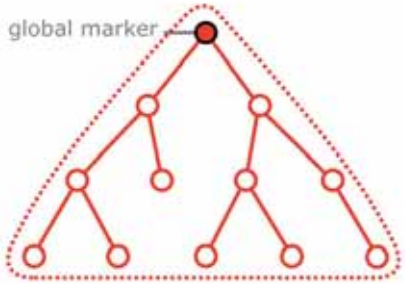






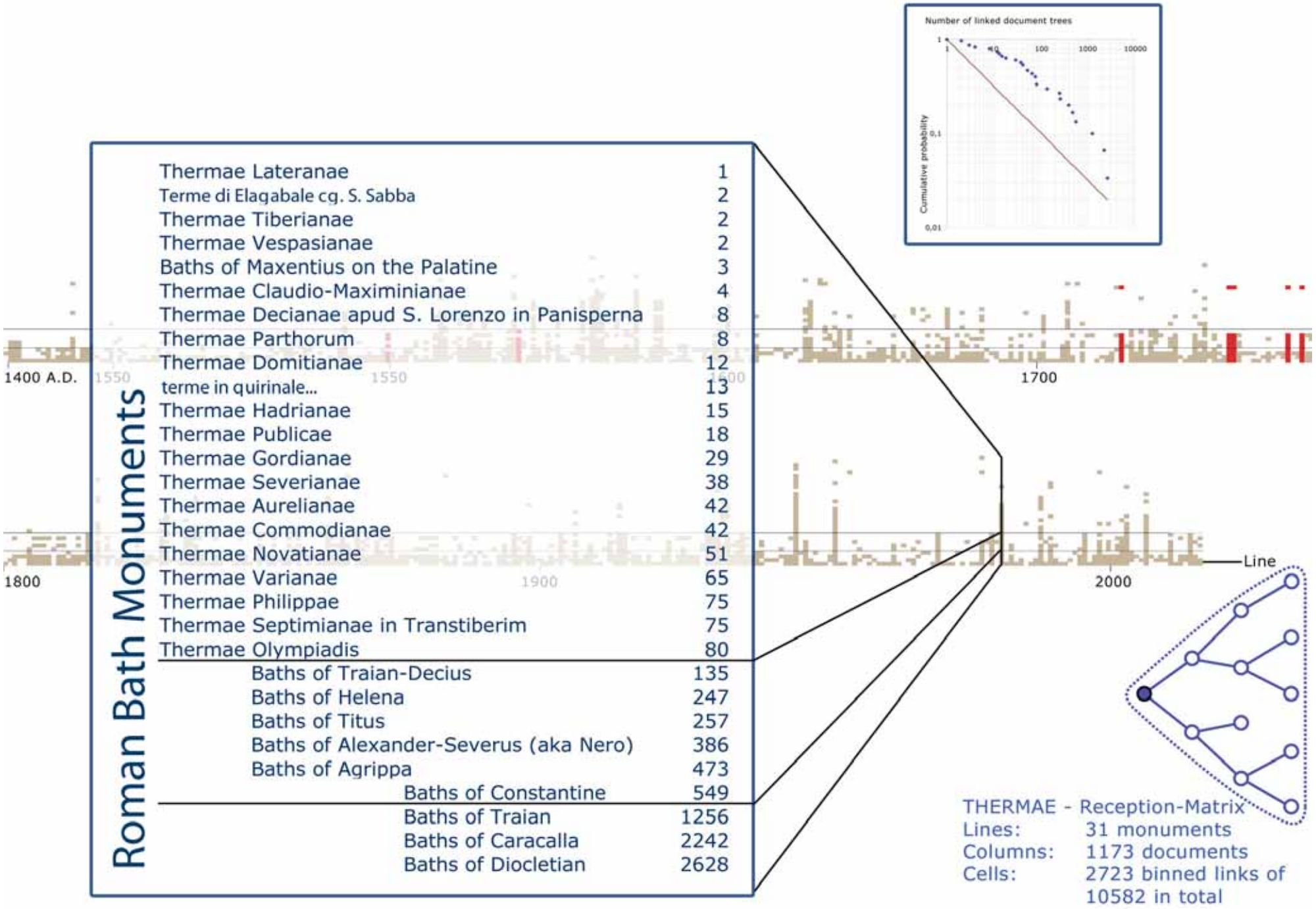
Ground plans

Sections & elevations

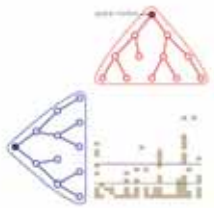


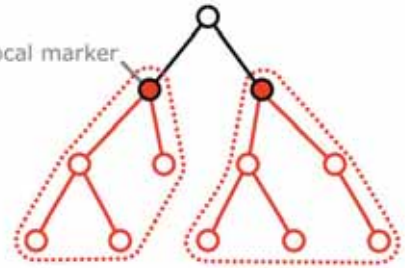
THERMAE - Reception-Matrix
Lines: 31 monuments
Columns: 1173 documents
Cells: 2723 binned links of 10582 in total

The other partition comprises monuments subdivided by depiction types:



Folded out we can spot community structure with our bare eyes:

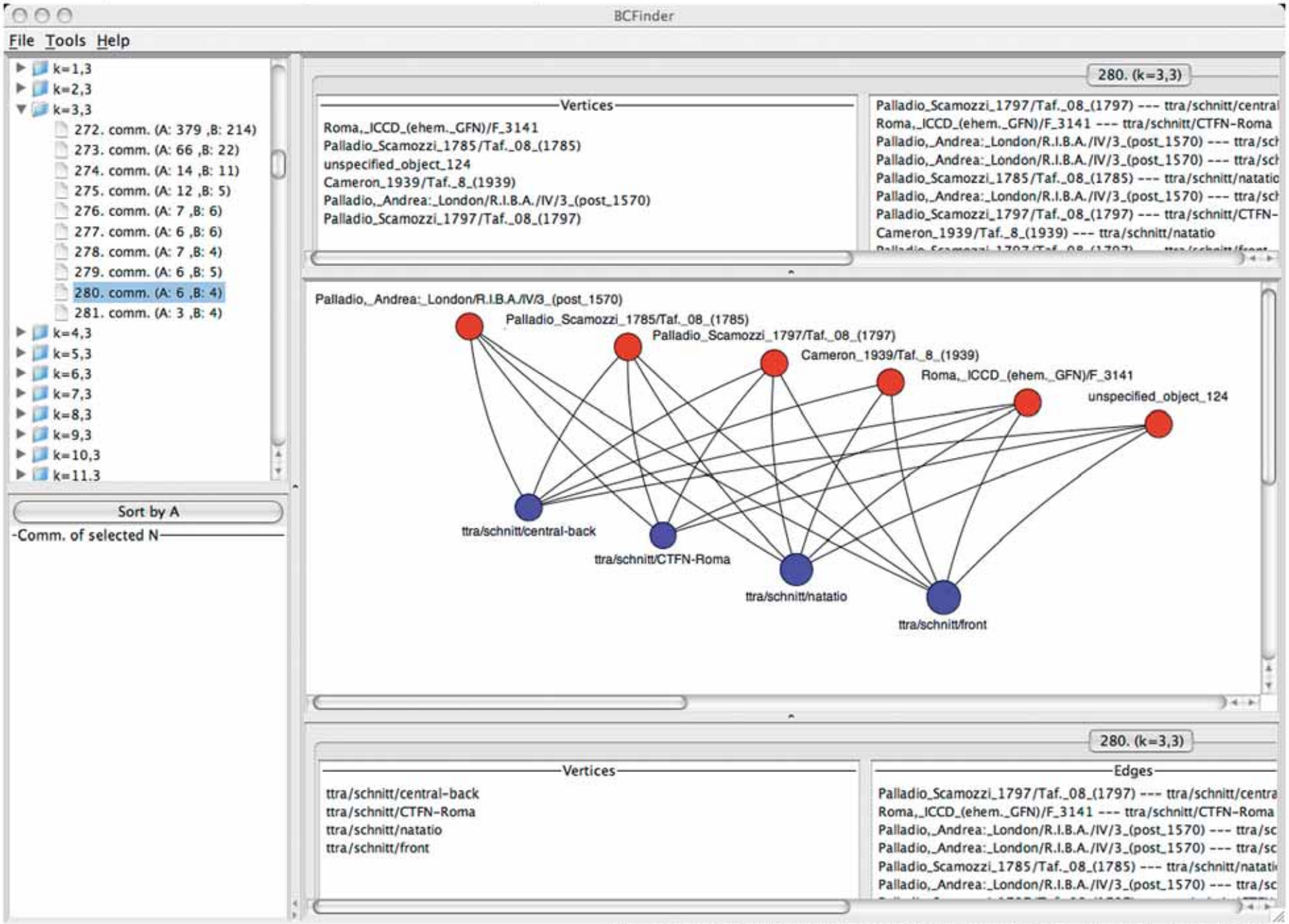




Lines now represent single monument depiction types;
Columns represent metalocal document parts including single image segments.

Starting from this state we use BCFinder to find communities of bi-cliques...

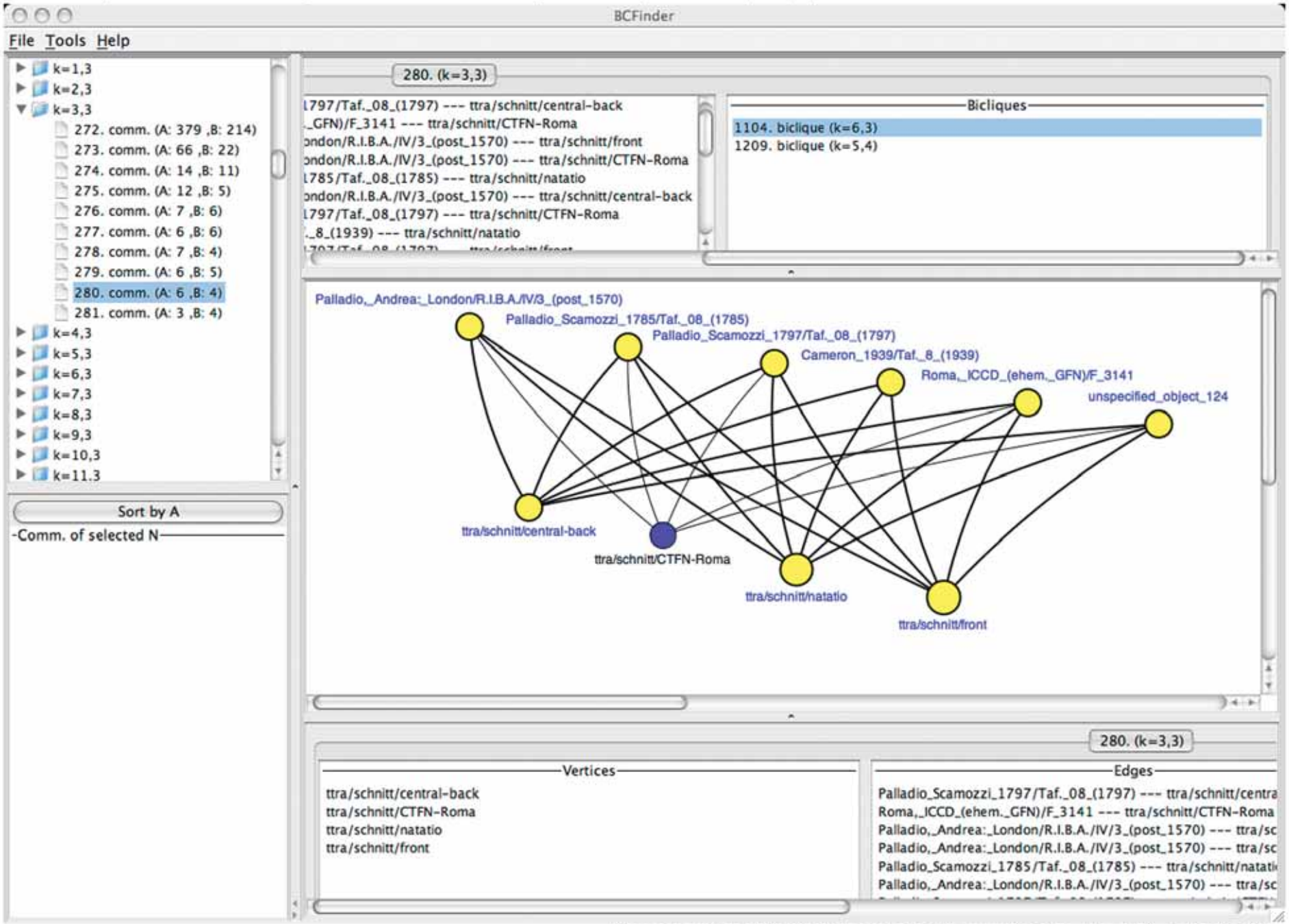
In our example below community 280 contains two cliques...



Download the BCFinder at http://www2.imm.dtu.dk/~mhs/bcfinder/

Starting from this state we use BCFinder to find communities of bi-cliques...

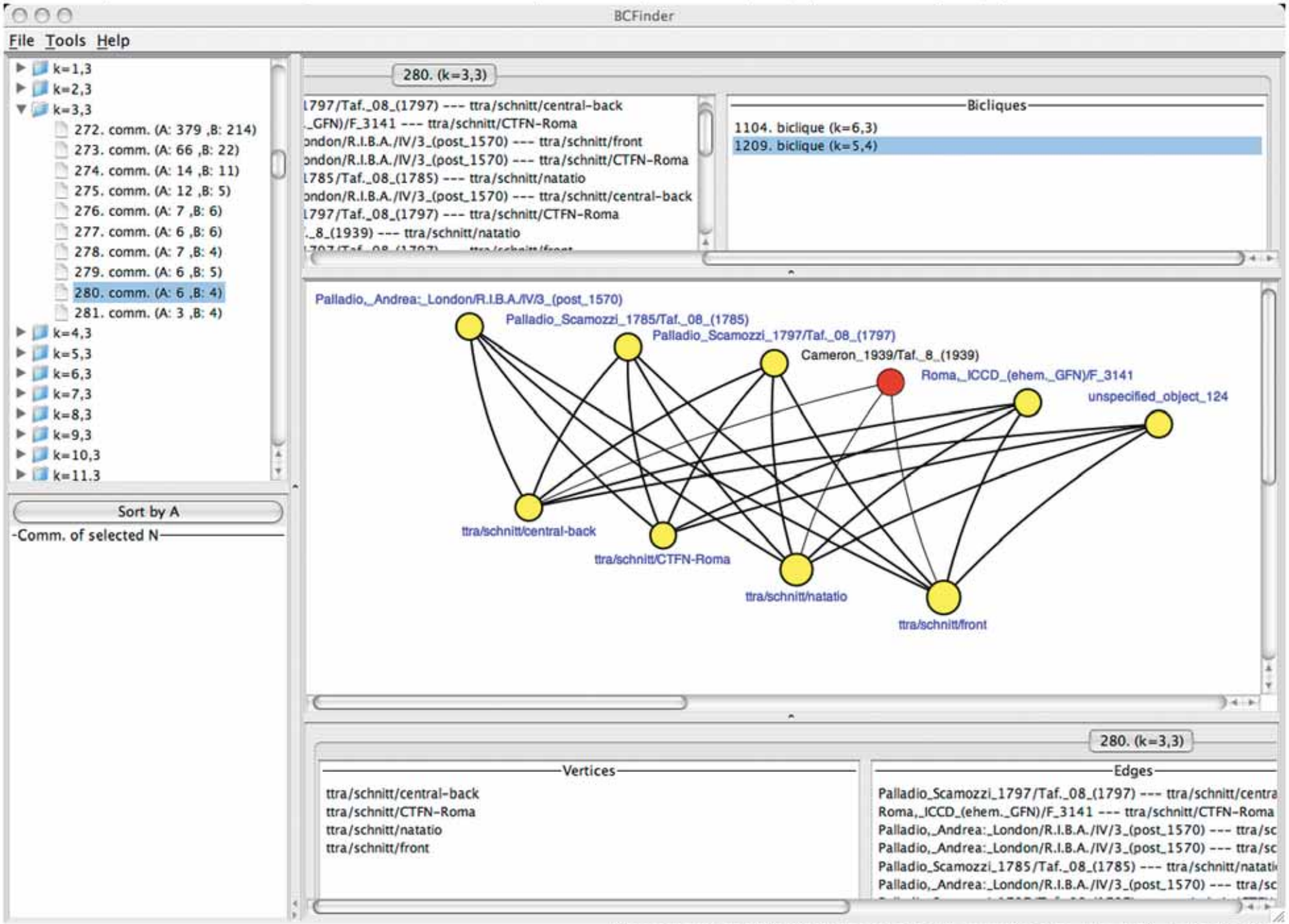
In our example below community 280 contains two cliques: Biclique 1104 (k=6,3) and...



Download the BCFinder at http://www2.imm.dtu.dk/~mhs/bcfinder/

Starting from this state we use BCFinder to find communities of bi-cliques...

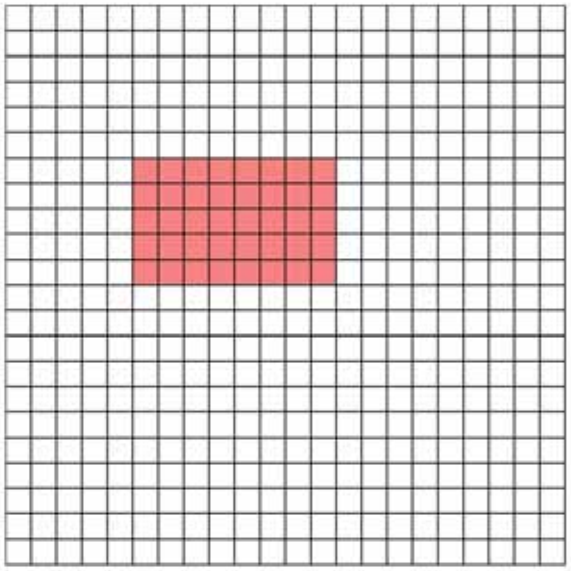
In our example below community 280 contains two cliques: Biclique 1104 (k=6,3) and 1209 (k=5,4).



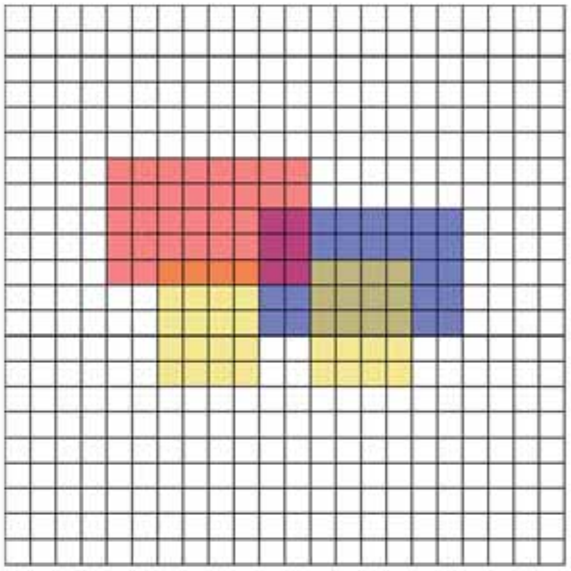
Download the BCFinder at http://www2.imm.dtu.dk/~mhs/bcfinder/

We now permutate and filter the matrix according to a choosen BCFinder result...

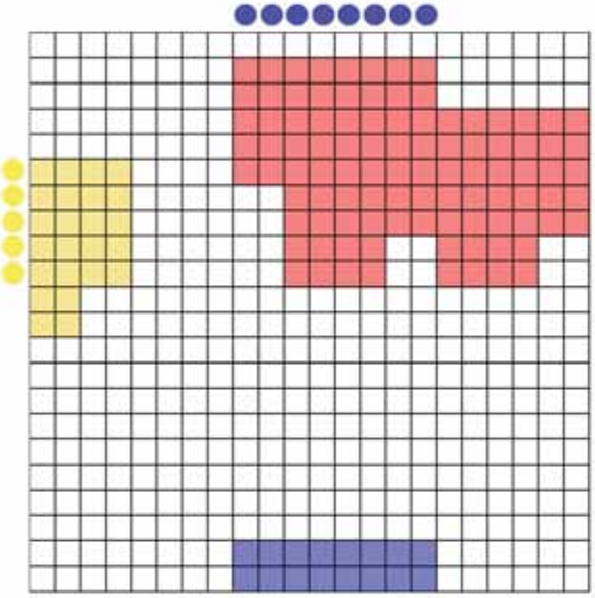
A single clique can be shown as a rectangle of filled cells.



A community of bi-cliques is shown as a group of overlapping rectangles. (note the reordering problem!)

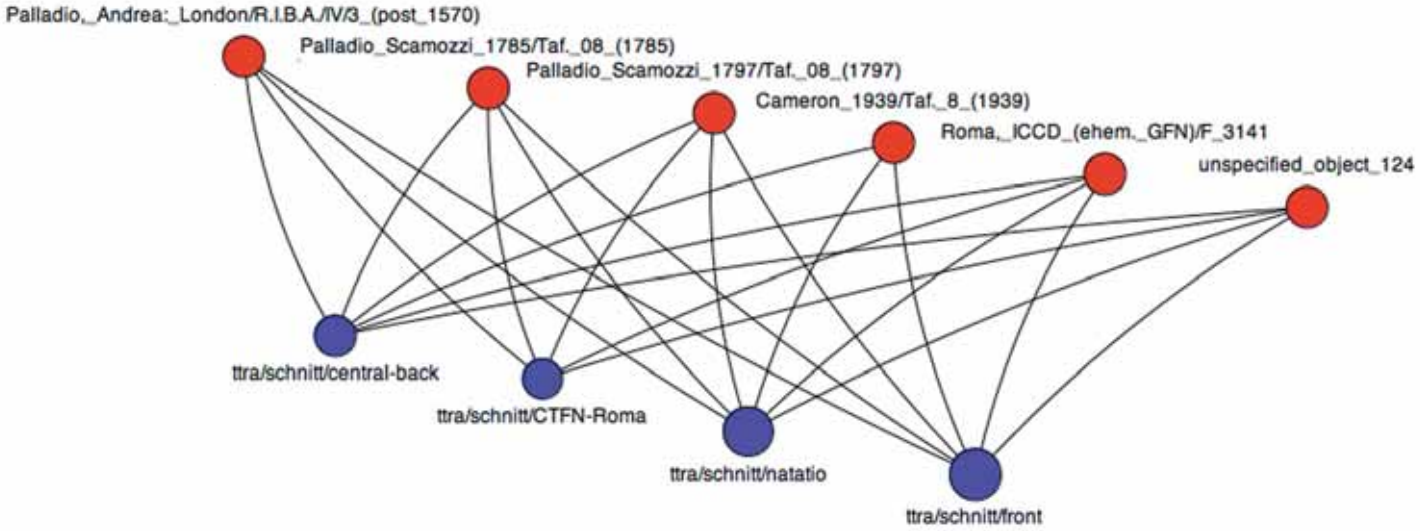


A community network comprises communities sharing nodes, i.e. lines and/or columns.



Remember that the bi-community finder adds context to the k-clique method ...

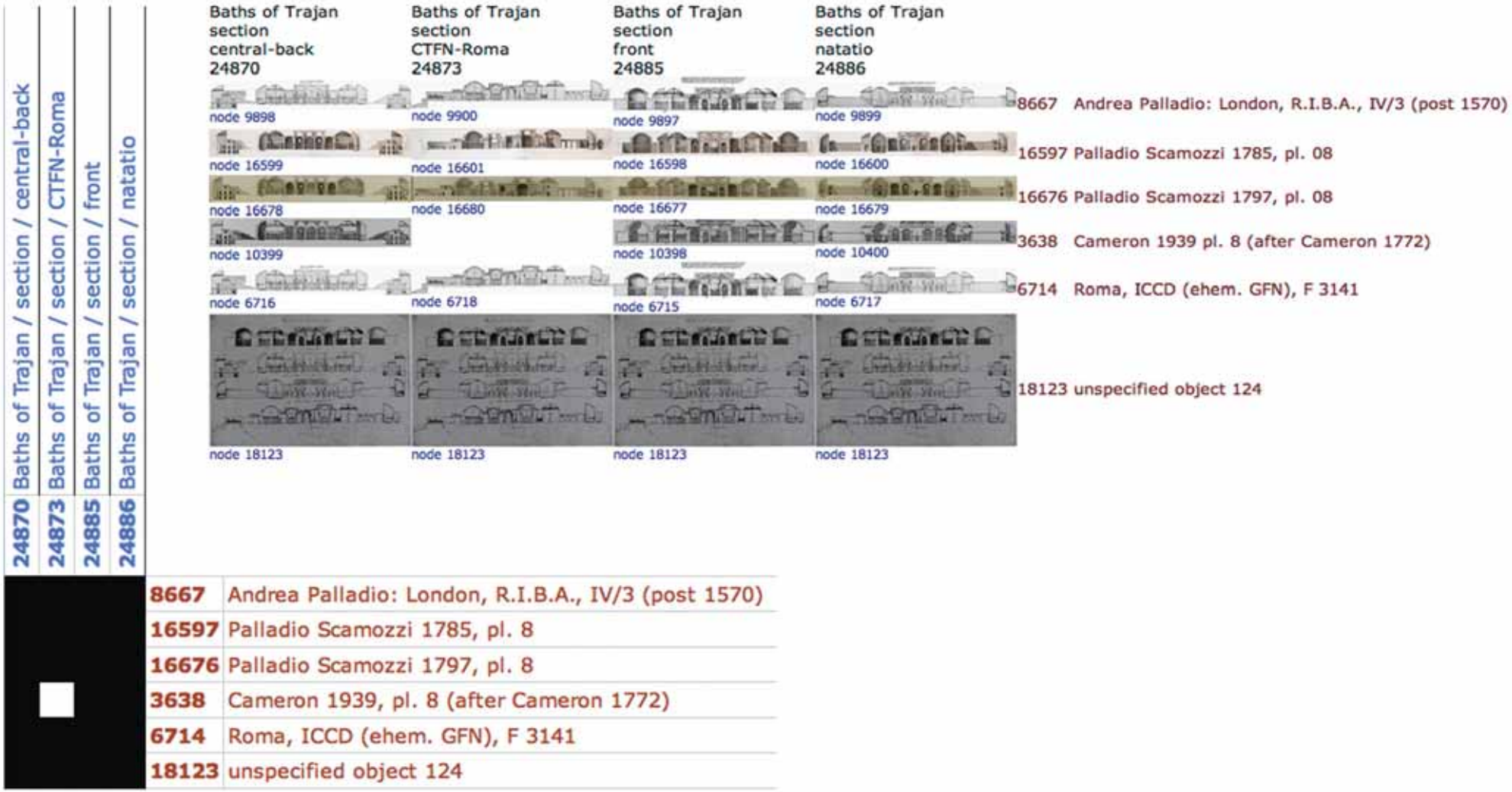
24870	Baths of Trajan / section / central-back
24873	Baths of Trajan / section / CTFN-Roma
24885	Baths of Trajan / section / front
24886	Baths of Trajan / section / natatio



8667	Andrea Palladio: London, R.I.B.A., IV/3 (post 1570)
16597	Palladio Scamozzi 1785, pl. 8
16676	Palladio Scamozzi 1797, pl. 8
3638	Cameron 1939, pl. 8 (after Cameron 1772)
6714	Roma, ICCD (ehem. GFN), F 3141
18123	unspecified object 124

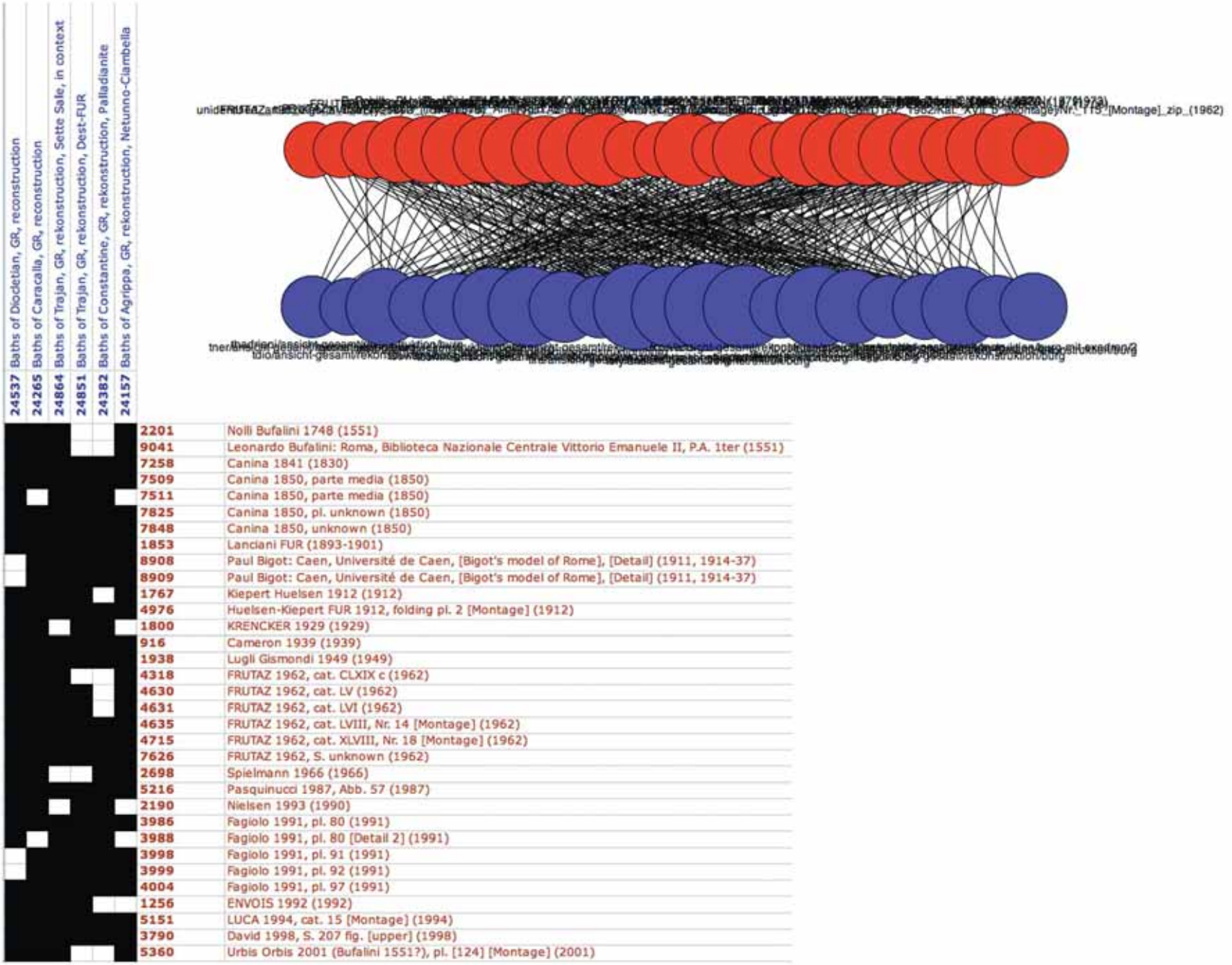
... Now we add even more context as we convert the matrix into an image matrix!

In this step (subordinate) nodes from the image partition are placed in the location of the links in the matrix.



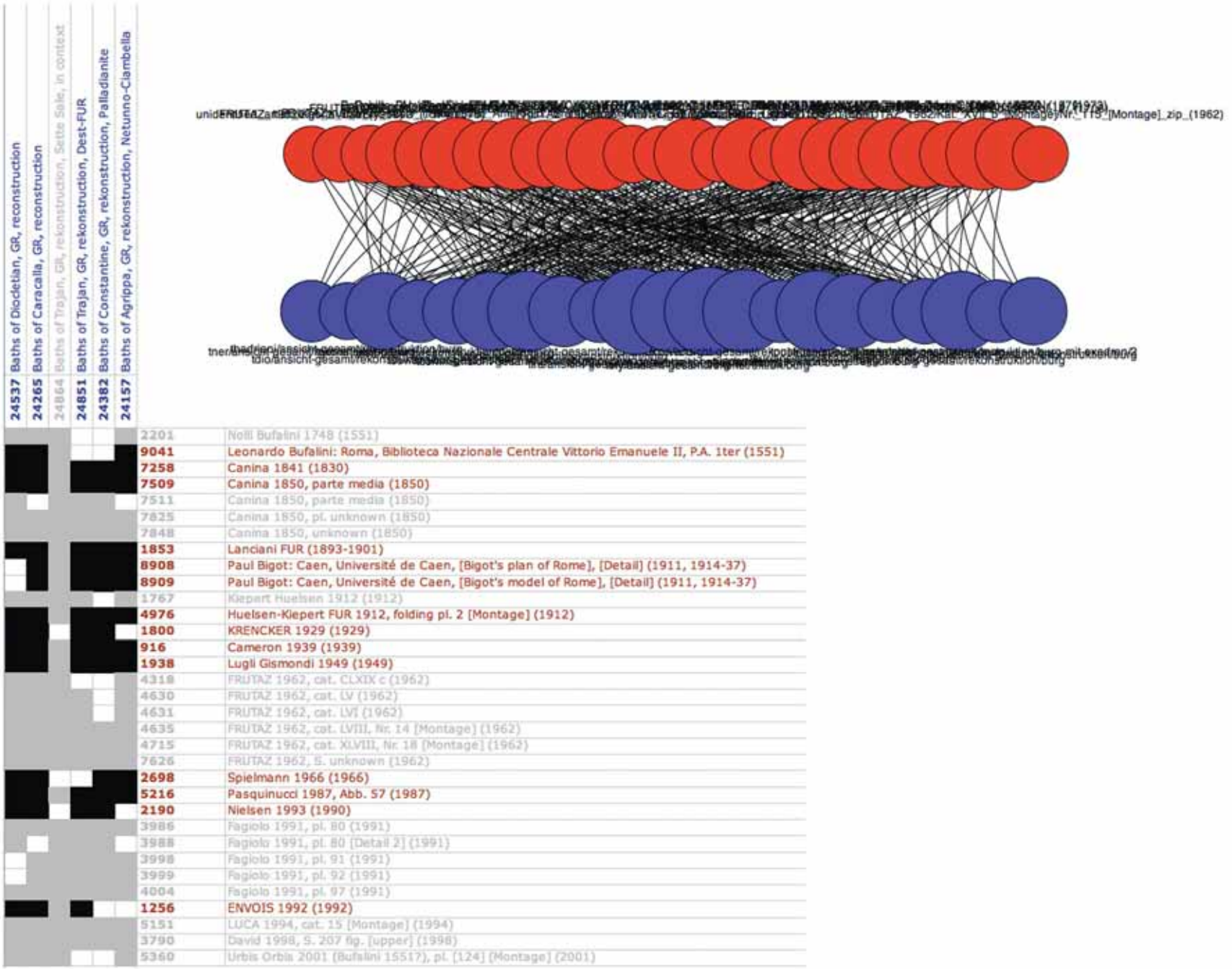
More on the *method producing scalable image matrices* see http://tinyurl.com/29rb9l

This process stays appealing to the human eye for much larger communities...



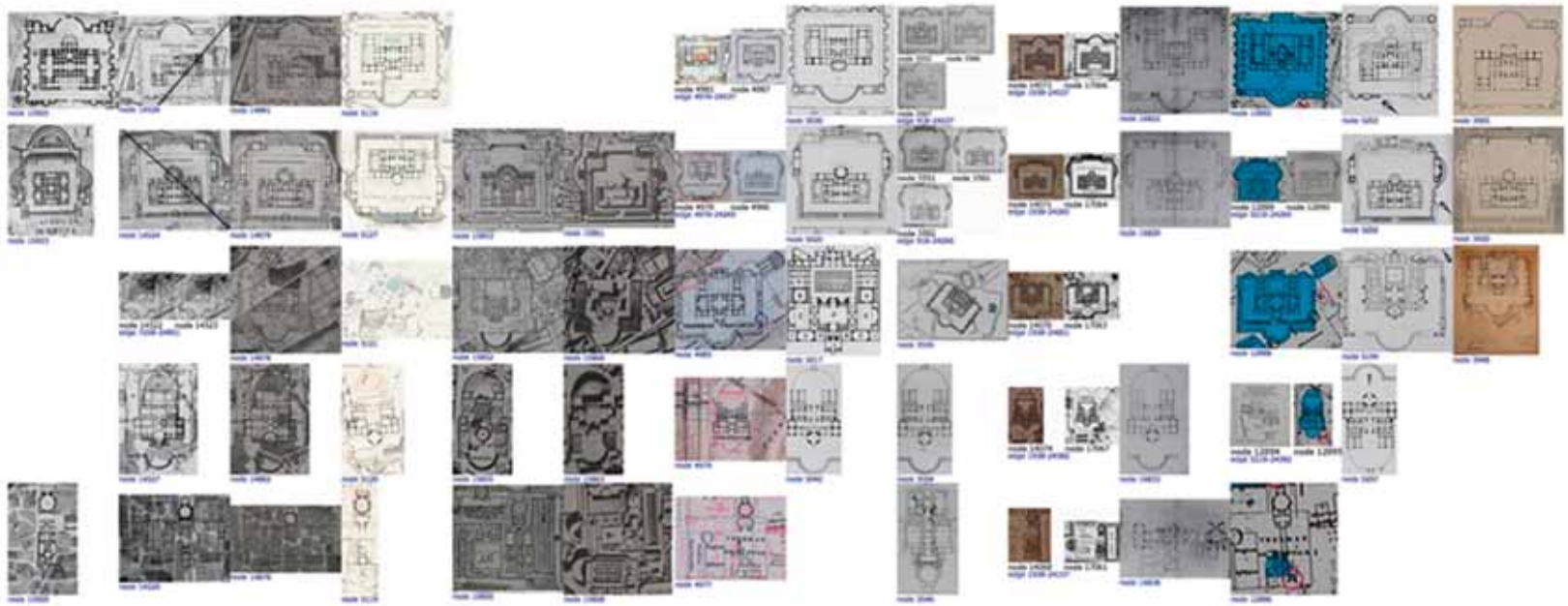
More on the *method producing scalable image matrices* see http://tinyurl.com/29rb9l

After a first examination as an image matrix such a large community is filtered...



More on the *method producing scalable image matrices* see http://tinyurl.com/29rb9l

... collapsed, transposed and visualized in order to produce a smaller image matrix...



24537	Baths of Diocletian, GR, reconstruction
24265	Baths of Caracalla, GR, reconstruction
24851	Baths of Trajan, GR, rekonstruction, Dest-FUR
24382	Baths of Constantine, GR, rekonstruction, Palladianite
24157	Baths of Agrippa, GR, rekonstruction, Netunno-Ciambella

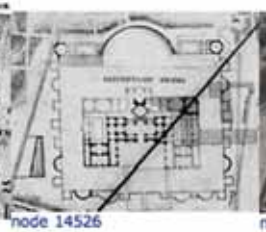
9041	Leonardo Bufalini: Roma, Biblioteca Nazionale Centrale Vittorio Emanuele II, P.A. 1ter (1551)
7258	Canina 1841 (1830)
7509	Canina 1850, parte media (1850)
1853	Lanciani FUR (1893-1901)
8908	Paul Bigot: Caen, Université de Caen, [Bigot's plan of Rome], [Detail] (1911, 1914-37)
8909	Paul Bigot: Caen, Université de Caen, [Bigot's model of Rome], [Detail] (1911, 1914-37)
4976	Huelsen-Kiepert FUR 1912, folding pl. 2 [Montage] (1912)
1800	KRENCKER 1929 (1929)
916	Cameron 1939 (1939)
1938	Lugli Gismondi 1949 (1949)
2698	Spielmann 1966 (1966)
5216	Pasquinucci 1987, Abb. 57 (1987)
2190	Nielsen 1993 (1990)
1256	ENVOIS 1992 (1992)

More on the *method producing scalable image matrices* see http://tinyurl.com/29rb9l

... resulting in a clear visualization of what the community means!

In the present case we see a correlating group of groundplans including their similarities and variations since 1850.

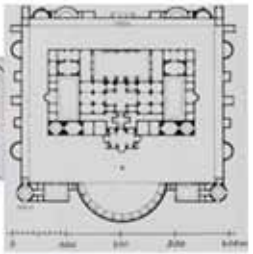

node 15925


node 14526

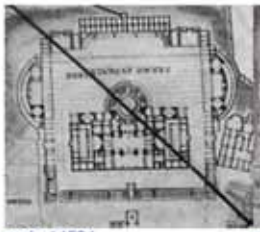

node 14881

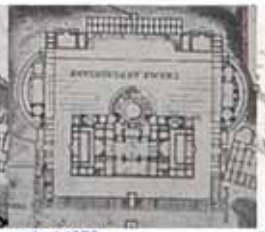

node 5116


node 4981 node 4987
edge 4976-24537

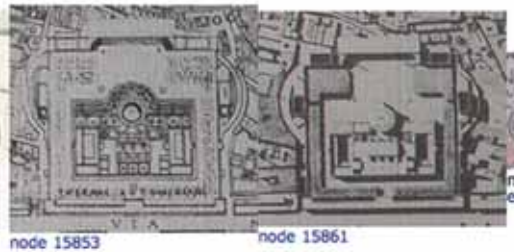

node 5030


node 15923

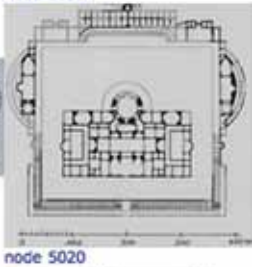

node 14524


node 14879


node 5127


node 15853 node 15861

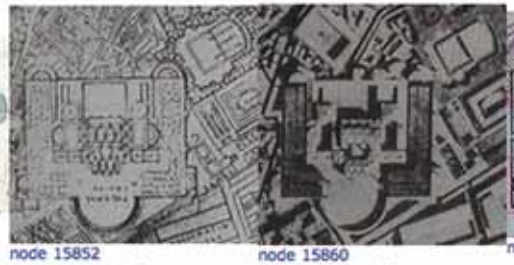

node 4978 node 4986
edge 4976-24265


node 5020

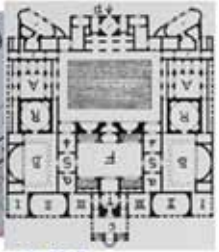

node 14522 node 14523
edge 7258-24851

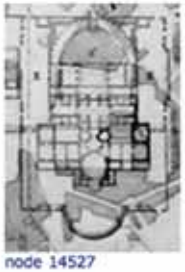

node 14878


node 5121


node 15852 node 15860


node 4985


node 5017


node 14527

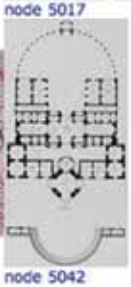

node 14882


node 5120


node 15855


node 15863


node 4979


node 5042


node 15920


node 14520


node 14876

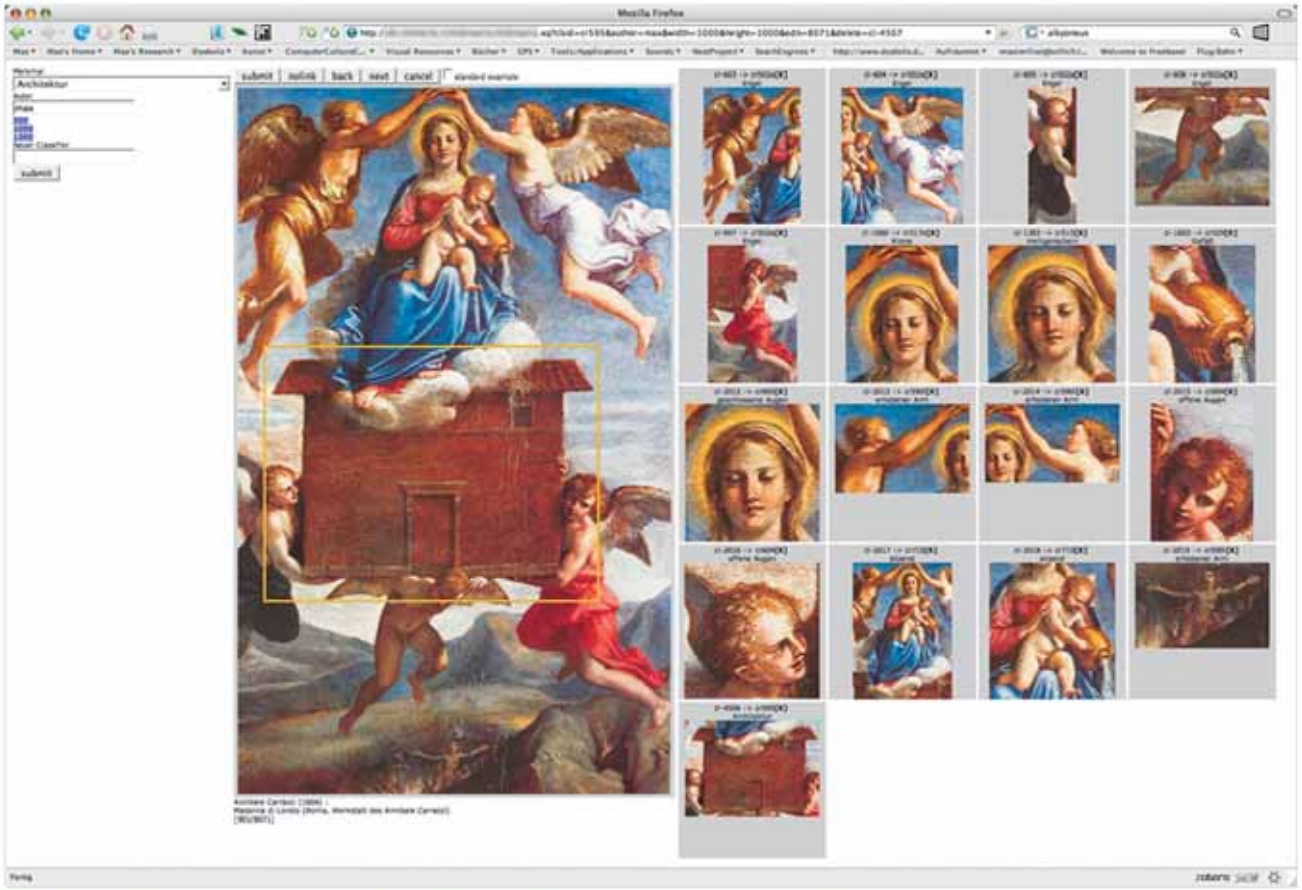

node 5119


node 15850


node 15858

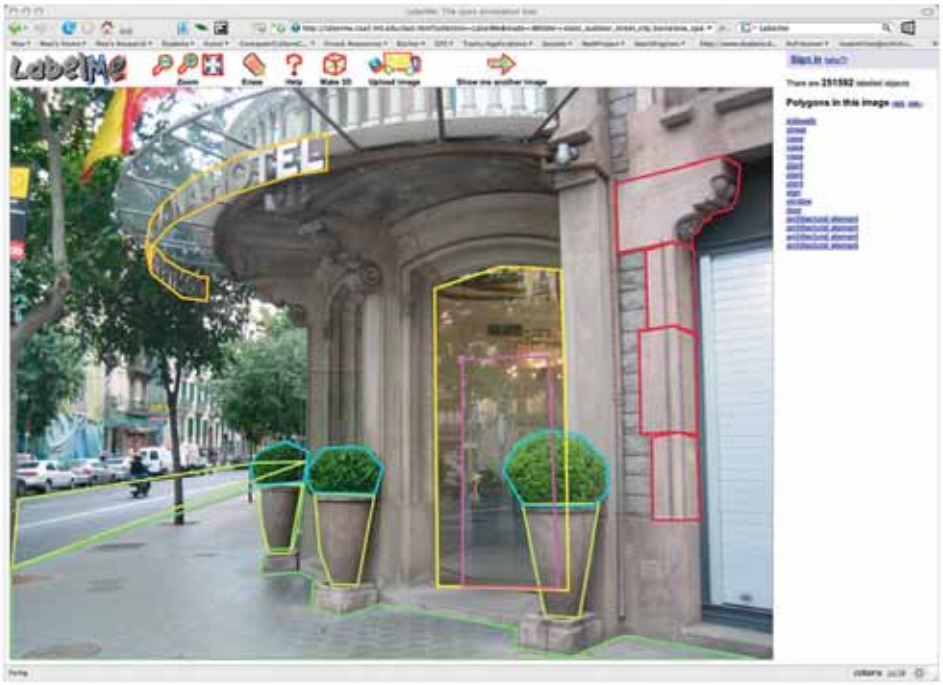

node 4977

Current work: The phase transition in Roman Baroque painting.

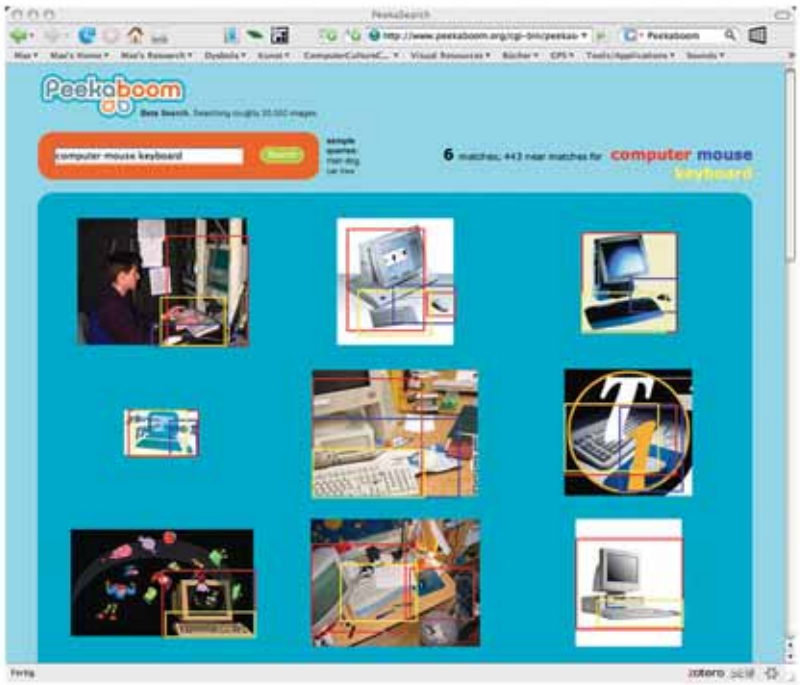


Future work ?

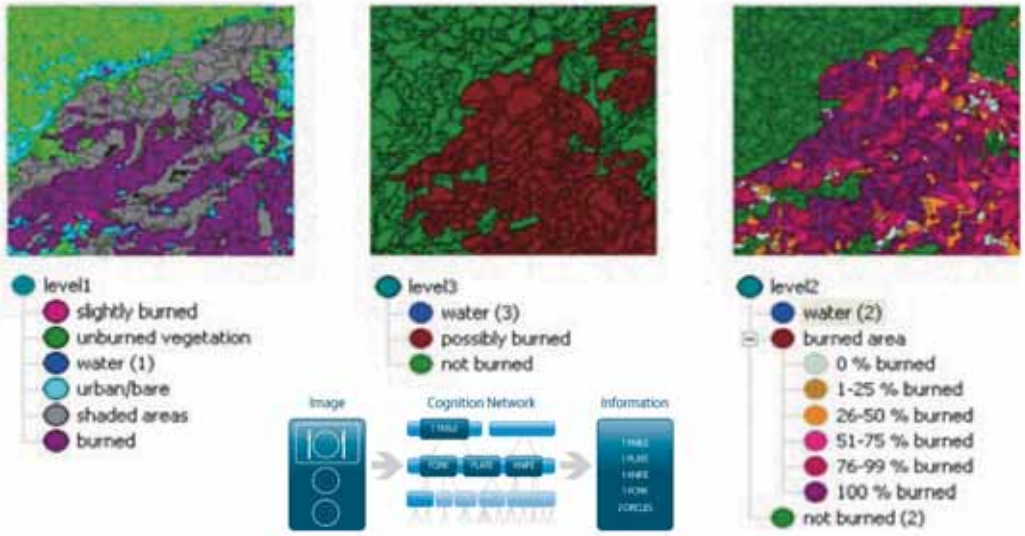
LabelMe ?



Peekaboom ?



Definiens ?



Sources:
www.labelme.csail.mit.edu
www.peekaboom.org
www.definiens.com

Special thanks go to...

MAX-PLANCK-GESELLSCHAFT

ROMA

Northeastern UNIVERSITY

BarabásiLab

ccnr/center for complex network research

DYA Projekt Dyabola @ STIFTUNG ARCHÄOLOGIE

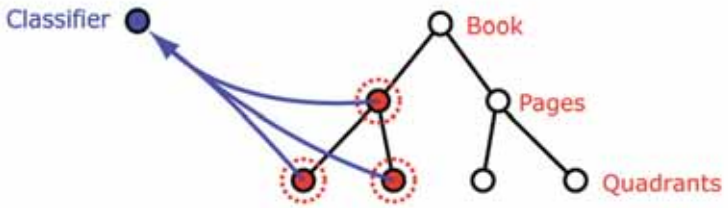
www.biblhertz.it
www.barabasilab.com
www.dyabola.de
www.stiftung-archaeologie.de

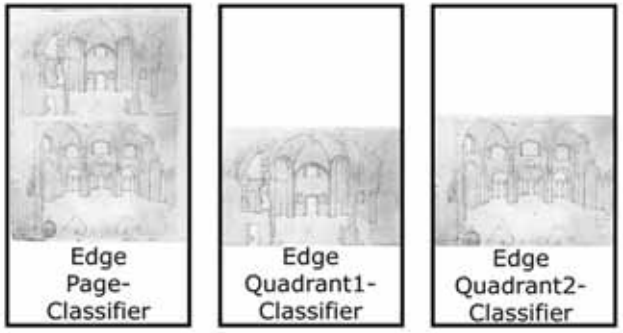
...to be continued: see www.schich.info

An edge in the image matrix can contain multiple links:

Local Matrix:

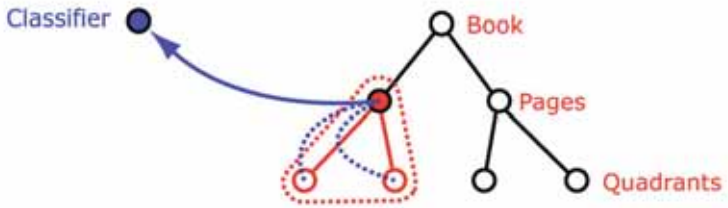
Every node contains only one image.
The edge *Page-Classifier* represents only the link from the Page to the classifier.

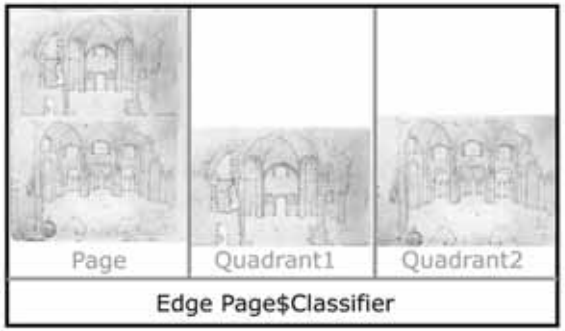


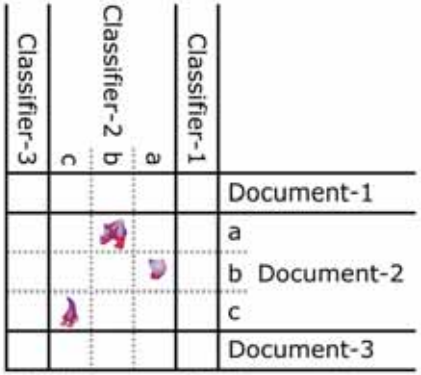


Global or Metalocal Matrix:

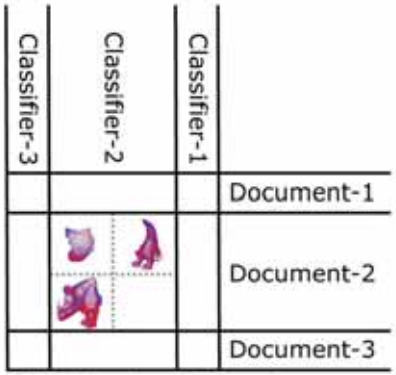
The choosen superordinate nodes summarize all subordinate nodes.
If necessary the edge *Page-Classifier* represents a number of links from the page and it's quadrants to the classfier.



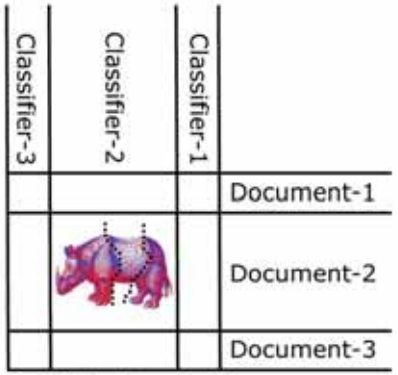




a) multiple edge as detail-imagematrix



b) multiple edge as 1D overview



c) multiple edge as montage