Maximilian Schich

On the Anatomy of Canon and Co-Popularity

Complex Network Structures in Art Research

in collaboration with Sune Lehmann and Juyong Park (www.barabasilab.com)
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Martin Raspe, Georg Schelbert and Prof. Sybille Ebert-Schifferer (www.biblhertz.it)

This lecture was first presented in German language at Bibliotheca Hertziana (Max-Planck-Institute for Art History) in Rome on October 27, 2008.
The English Version was presented at Università degli Studi „La Sapienza“ in Rome on October 29, 2008
(organized by Guido Caldarelli and Vittorio Loreto).

Art research data is usually not *normal* !

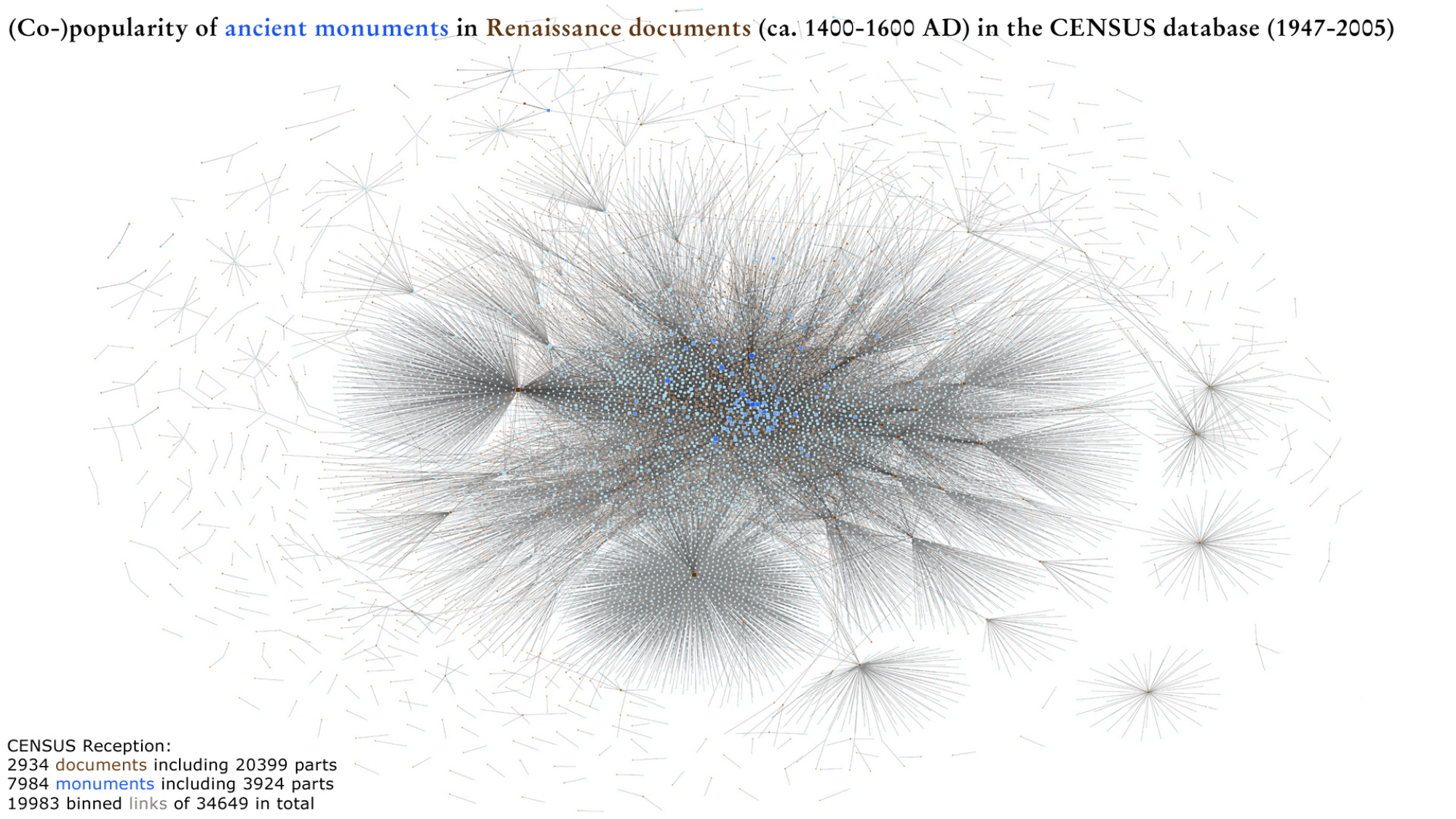
The normal distribution by Carl Friedrich Gauß

No large deviation from the average.

The Long Tail (after Anderson 2006)

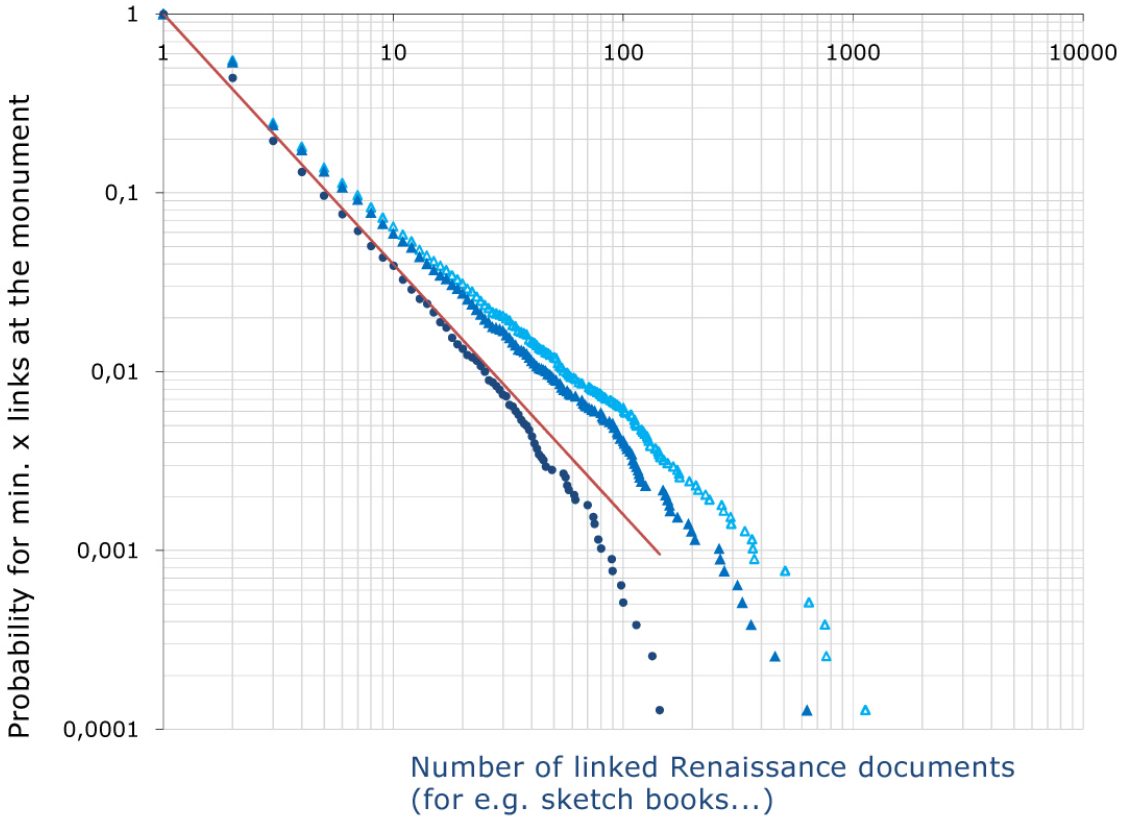
A few giants and many dwarfs.

(Co-)popularity of ancient monuments in Renaissance documents (ca. 1400-1600 AD) in the CENSUS database (1947-2005)

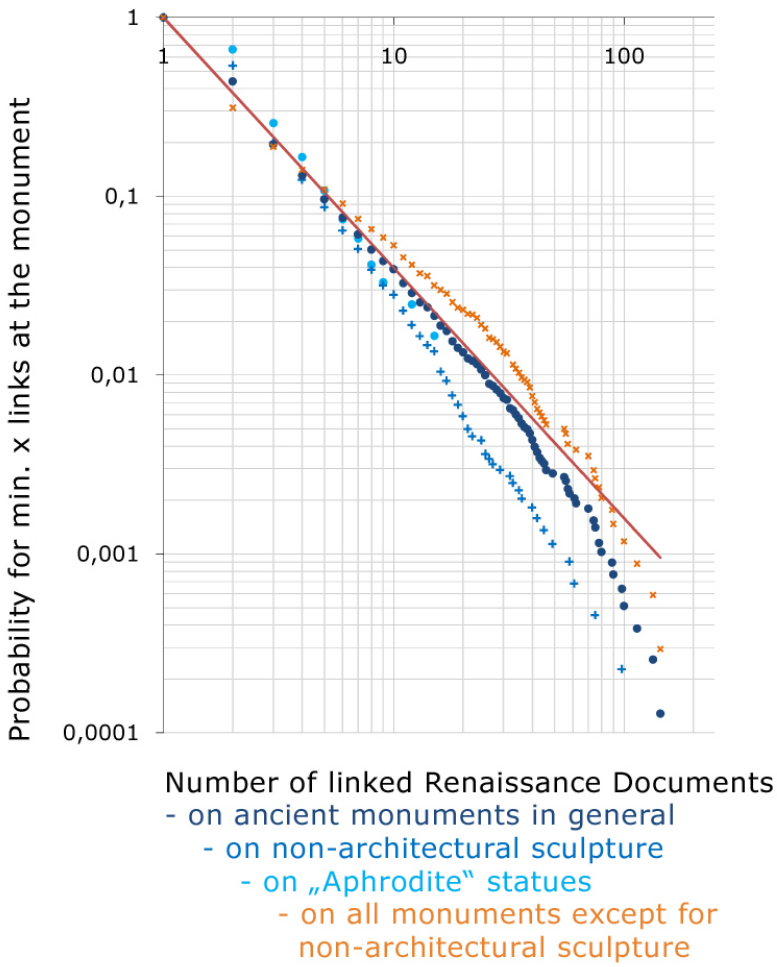


CENSUS Reception:
2934 documents including 20399 parts
7984 monuments including 3924 parts
19983 binned links of 34649 in total

Popularity of ancient monuments in Renaissance documents (ca. 1400-1600 AD) in the CENSUS database (1947-2005)

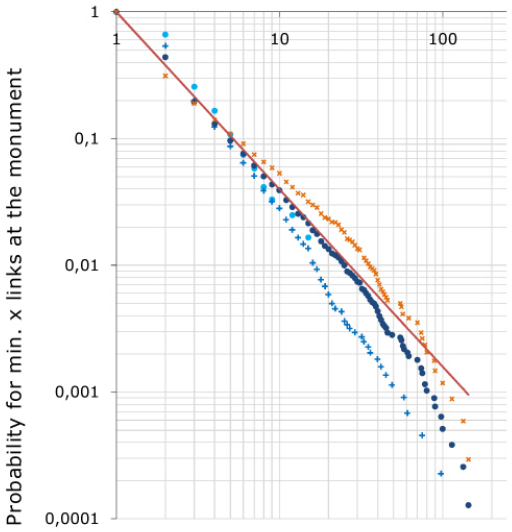


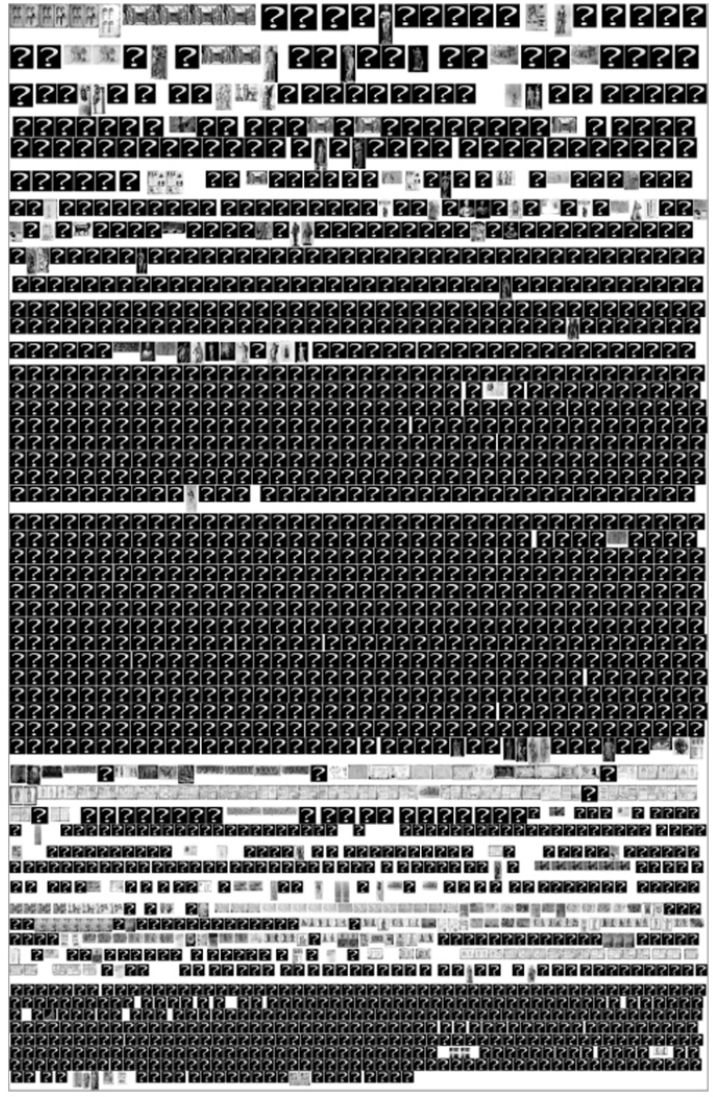
Popularity of ancient monument classes in Renaissance documents (ca. 1400-1600 AD) in the CENSUS database (1947-2005)



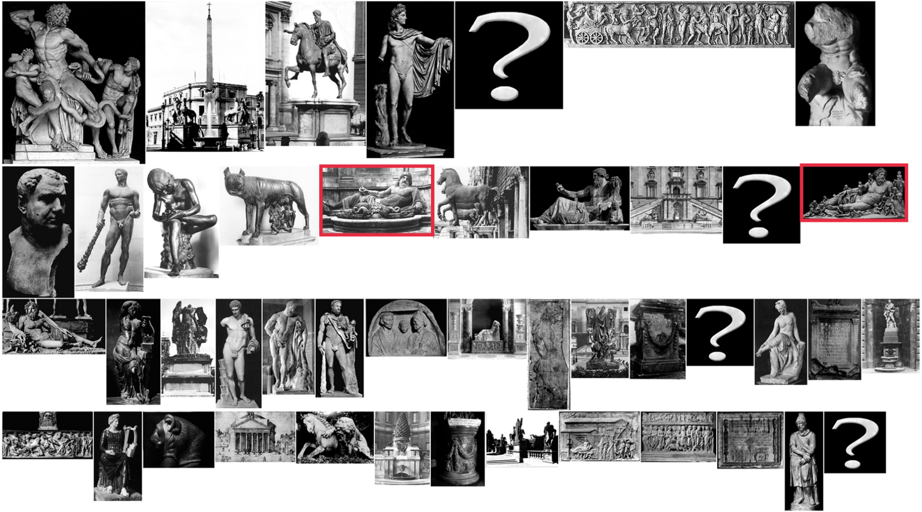
NodeID	Ancient Monument	Renaissance documents	occurence in documents	total links	link overpopulation
150908	*Arch of Constantine (triumphal arch)*	***144***	*360*	*764*	*112%*
150770	Pantheon (temple)	**134**	629	1131	80%
150940	*Arch of Septimius Severus (triumphal arch)*	***114***	*329*	*754*	*129%*
150792	Colosseum (amphitheatre)	**100**	457	642	40%
219823	**Laocoon (group of statues)**	**98**	156	156	0%
151057	*Column of Trajan (honorific column)*	***90***	*261*	*363*	*39%*
150958	*Arch of Titus (triumphal arch)*	***89***	*264*	*372*	*41%*
150812	Baths of Diocletian (thermae)	**80**	314	506	61%
150826	Basilica of Constantine (basilica)	**78**	198	268	35%
150784	Temple of Mars Ultor (temple)	**75**	159	338	113%
150776	**Horsetamers (group of statues)**	**75**	107	108	1%
151227	Forum of Nerva (forum)	**74**	172	273	59%
150844	Baths of Caracalla (thermae)	**70**	275	506	84%
150890	Theatre of Marcellus (theatre)	**70**	205	366	79%
151328	Temple of Antoninus and Faustina (temple)	**62**	160	228	43%
151697	**Equestrian Statue of Marcus Aurelius (equestrian statue)**	**61**	94	94	0%
150779	**Apollo Belvedere (statue)**	**58**	66	66	0%
151259	Mausoleum of Hadrian (sepulchral monument)	**57**	125	142	14%
151930	Temple of Minerva (temple)	**56**	149	212	42%
150806	Septizonium (facade)	**56**	118	124	5%
151038	Temple of Castor and Pollux (temple)	**55**	153	207	35%
234323	**Regisole (equestrian statue)**	**49**	80	80	0%
151320	Temple of Saturn (temple)	**46**	110	145	32%
151322	Curia Julia (curia)	**45**	95	112	18%
151625	**Bacchic Sarcophagus (sarcophagus)**	**45**	75	75	0%
151065	Temple of Serapis (temple)	**44**	120	175	46%
150785	Forum Augustum (forum)	**43**	90	129	43%
151046	Forum of Trajan (forum)	**42**	82	90	10%
151526	**Torso Belvedere (statue)**	**42**	53	53	0%
151143	Basilica Aemilia (basilica)	**41**	117	176	50%

The visual tail of non-architectural sculpture

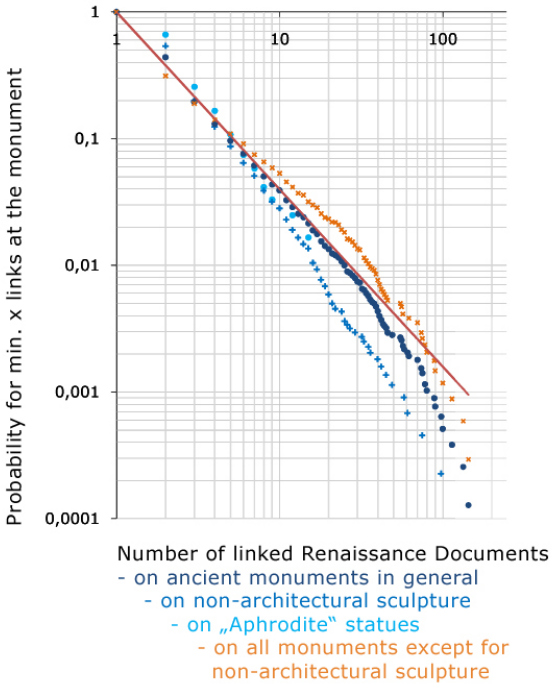


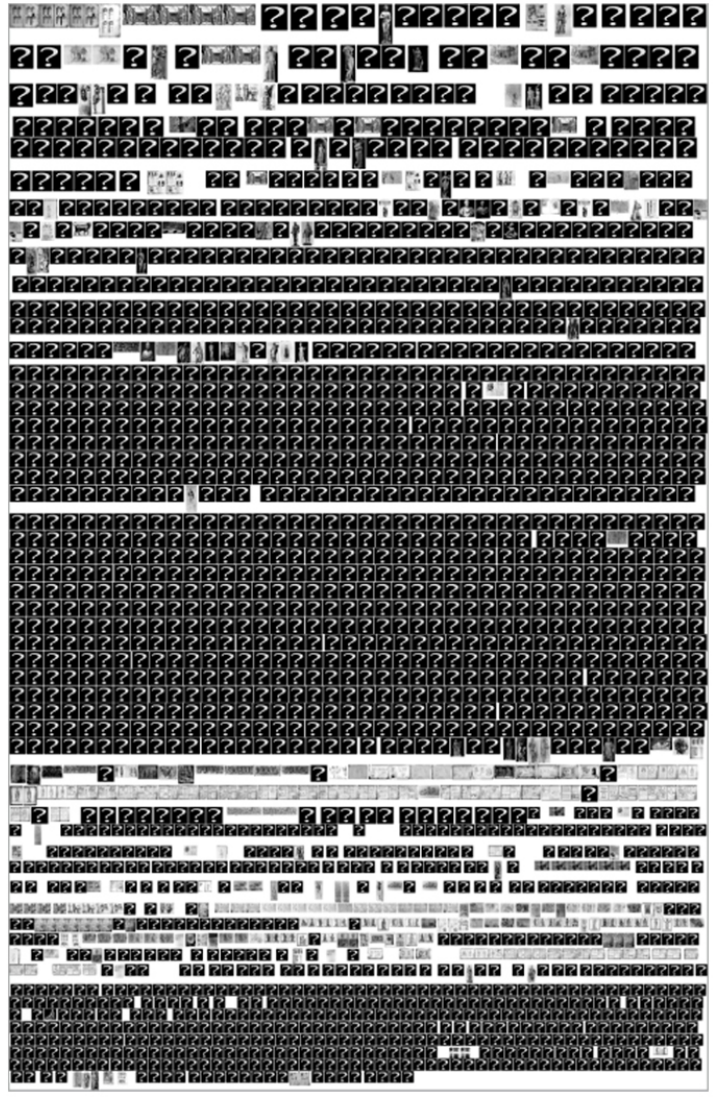


The head of the *long tail* is in close analogy to the canon expected by specialists



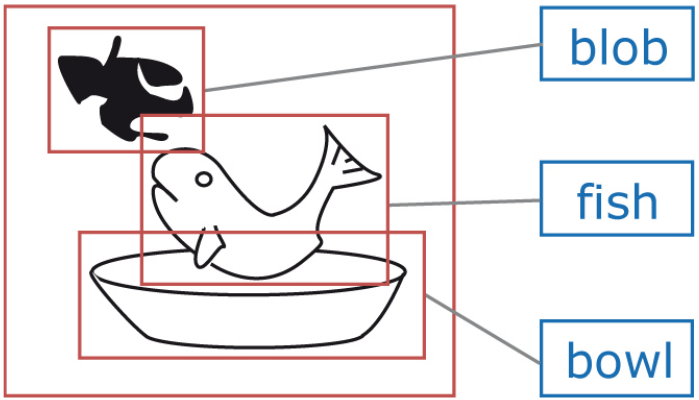
The visual tail can be dissected into arbitrary sub-tails...

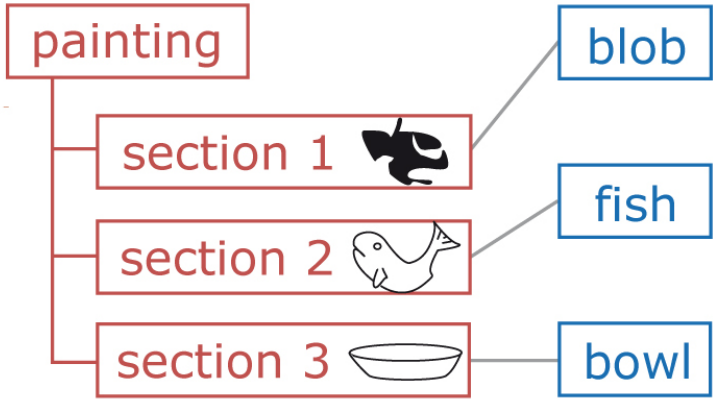




The canon of statues identified (at least once in history according to the CENSUS) as Venus or Aphrodite

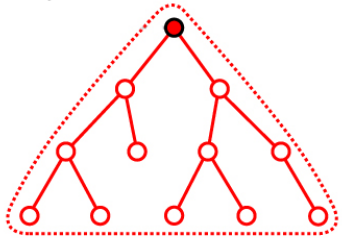
Visual Co-Popularity



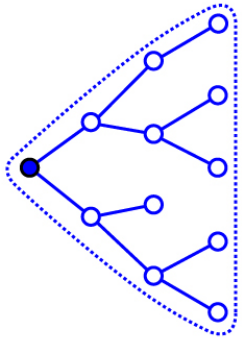


painting 1			
painting 2			
painting 3			

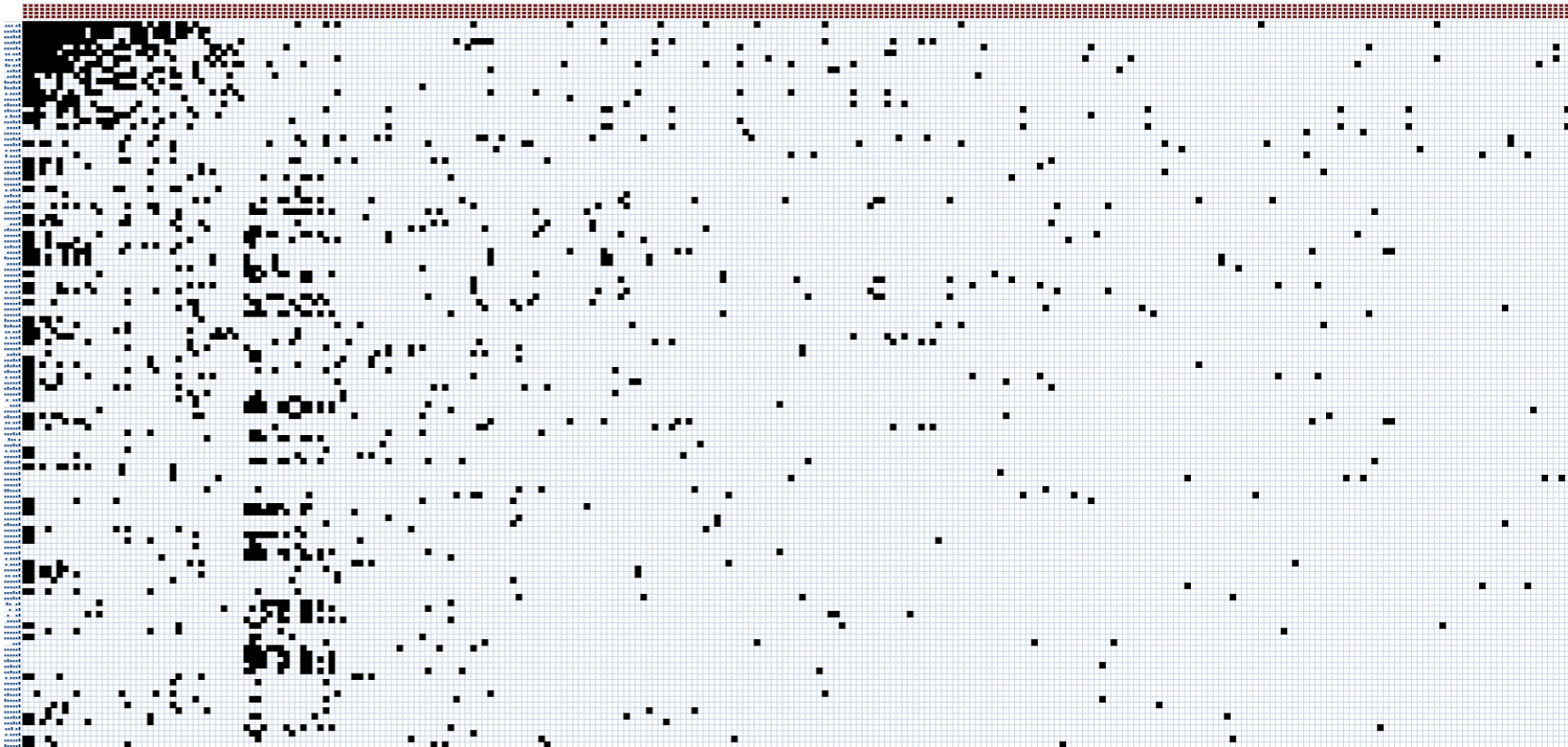
Visual Co-Popularity 1: We start with a sparse bi-partite classification network (as seen in the matrix)



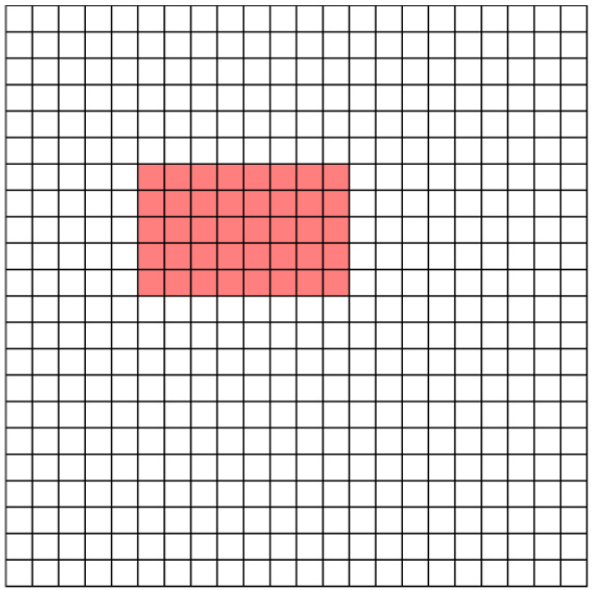
Renaissance documents in the *CENSUS database* (ca. 1450-1600 AD)



Ancient monuments

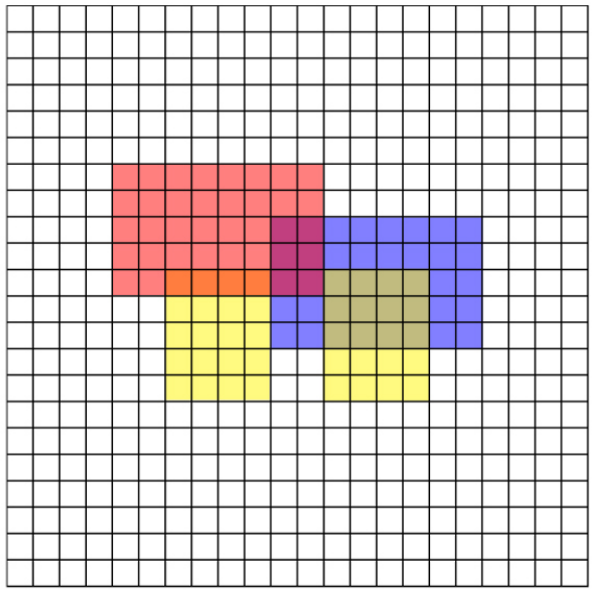


Visual Co-Popularity 1: We find dense areas in the network by using a community finding algorithm (in our example: BCFinder)



A clique is a completely filled in rectangle in the matrix.

(all documents show the same selection of monuments)

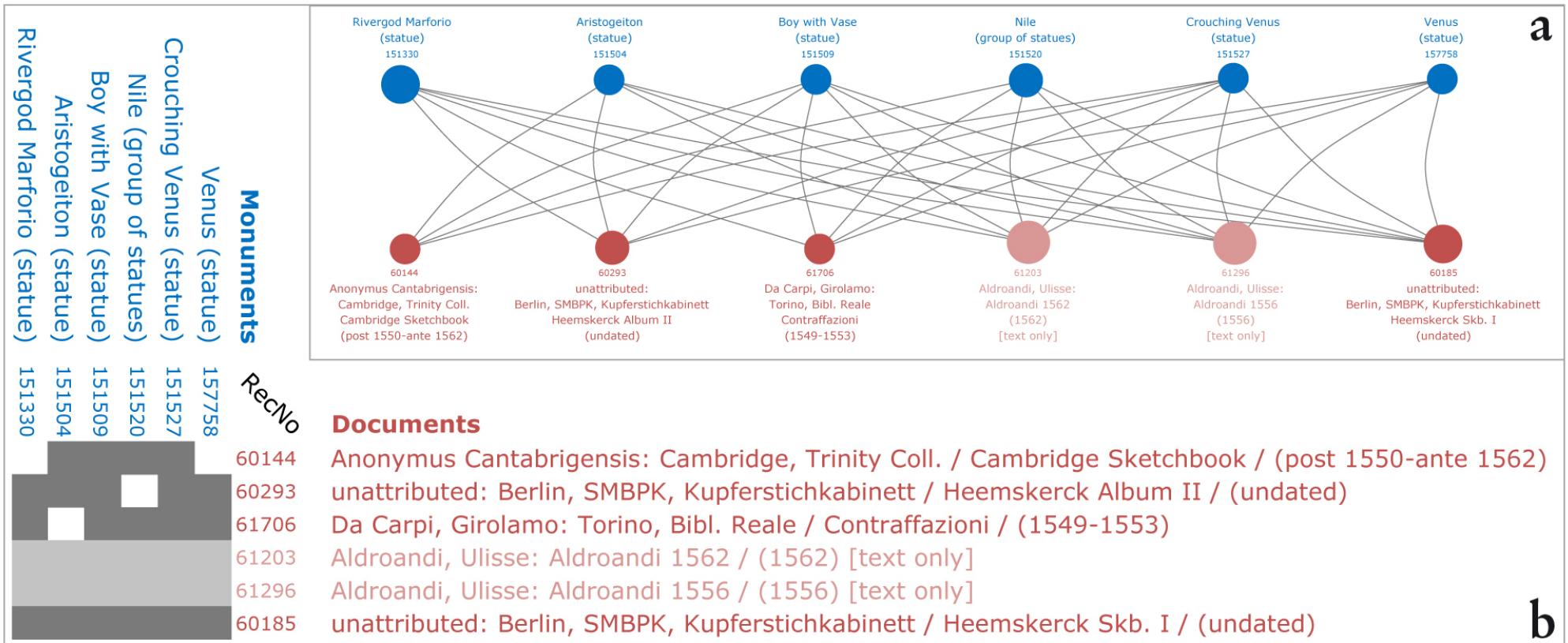


A community of cliques is a group of overlapping, completely filled in rectangles in the matrix.
Note the reordering problem!

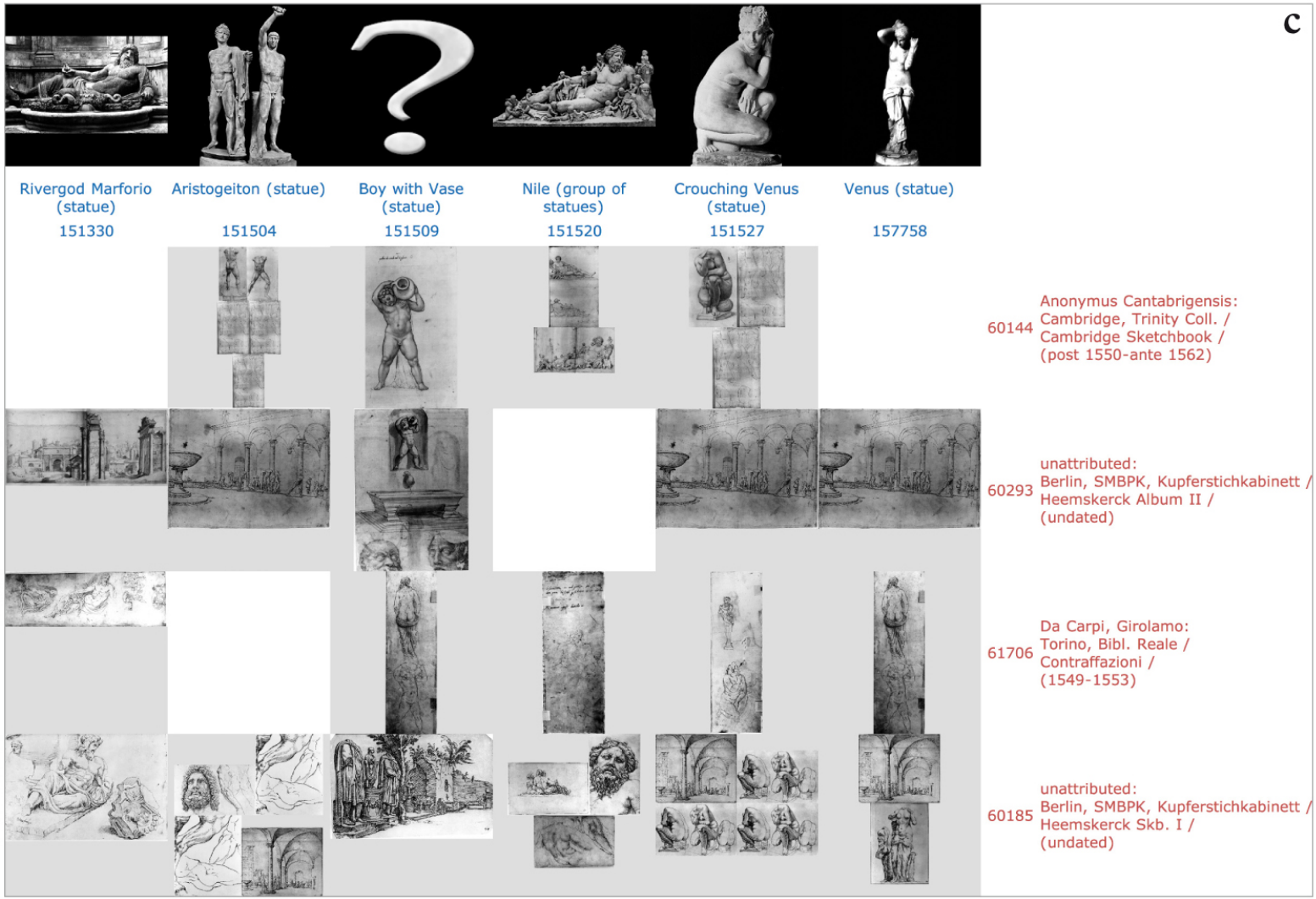
(the documents show a varying, but overlapping selection of monuments)

S. Lehmann, M. Schwartz and L.K. Hansen (2008): Biclique comunities. Phys. Rev. E 78, 016108

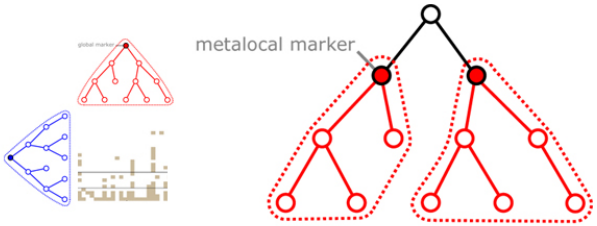
Visual Co-Popularity 1: A bi-clique community from a BCFinder result as a matrix



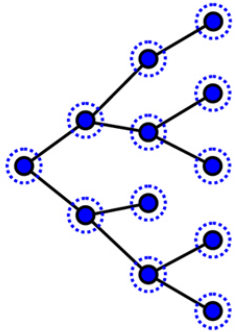
Visual Co-Popularity 1: From matrix to image matrix



Visual Co-Popularity 2: We start again with a sparse classification network

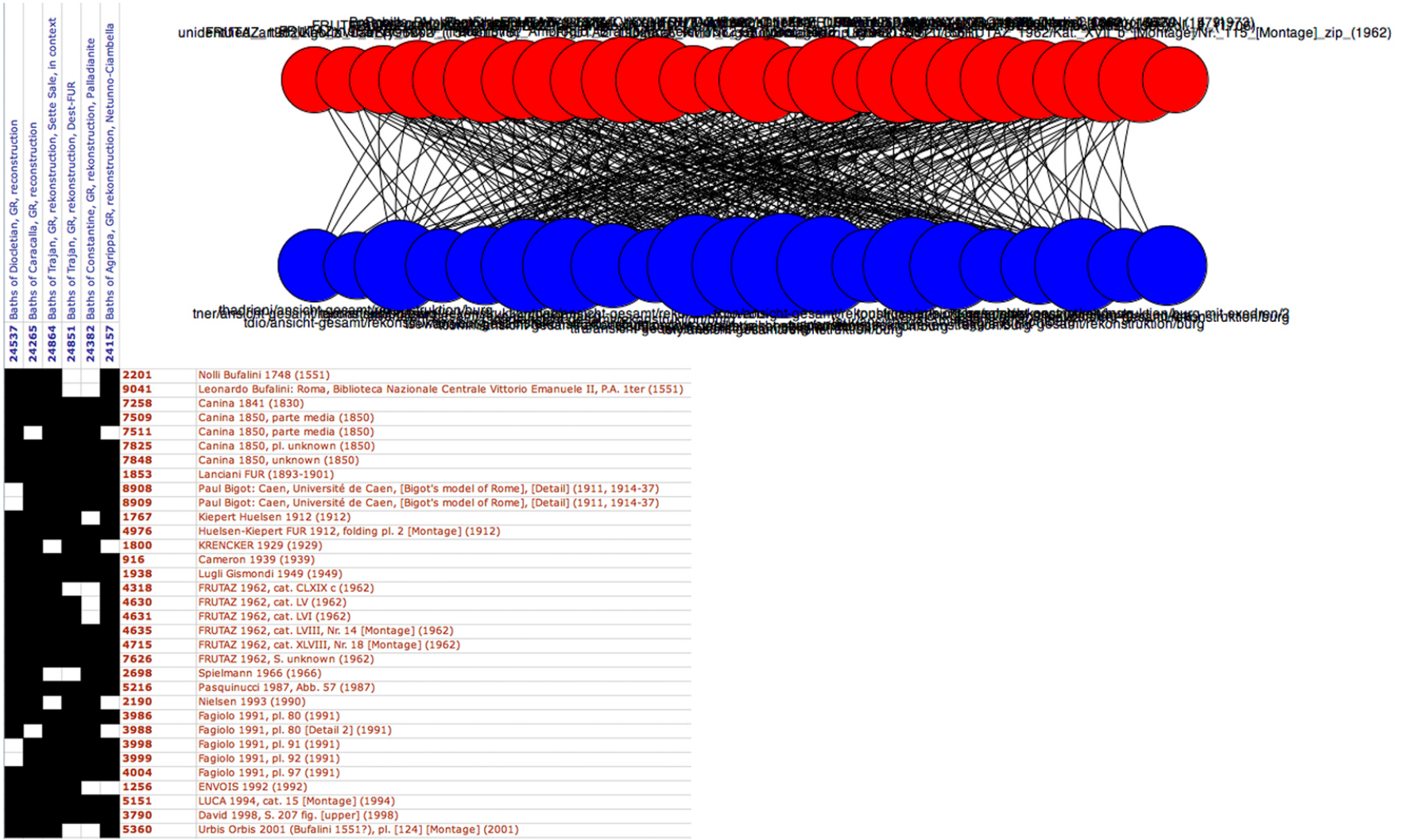


Visual documents in the *THERMAE dataset* (ca. 1450-2002 AD)

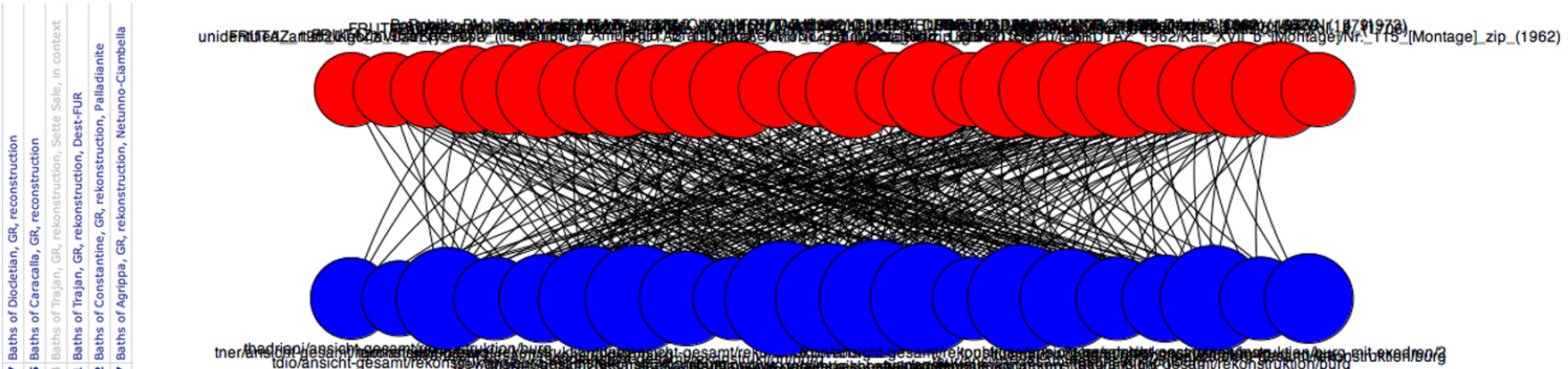


Monument depiction types

Visual Co-Popularity 2: In the matrix even large communities stay appealing to the human eye!

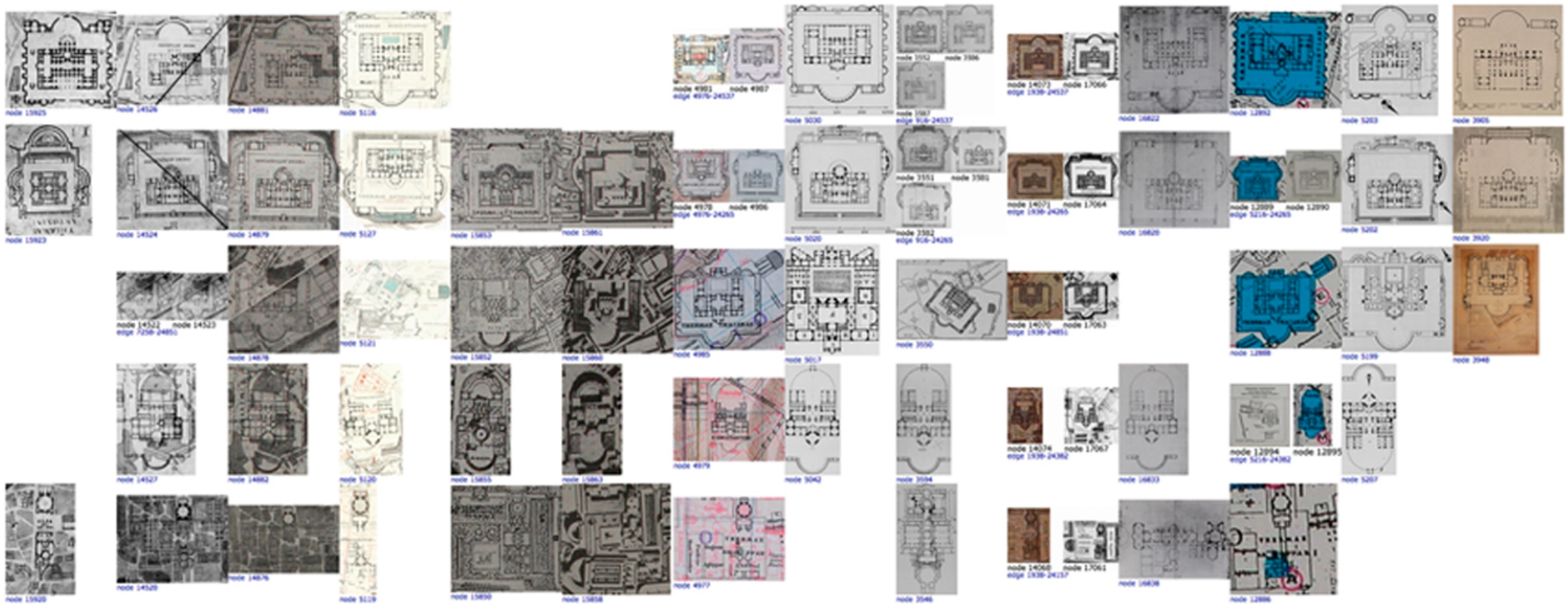


Visual Co-Popularity 2: Large communities can be filtered



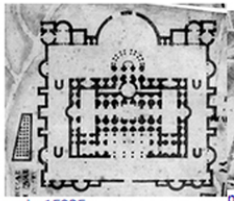
	2201	Nolli Bufalini 1748 (1551)
■	9041	Leonardo Bufalini: Roma, Biblioteca Nazionale Centrale Vittorio Emanuele II, P.A. 1ter (1551)
■	7258	Canina 1841 (1830)
■	7509	Canina 1850, parte media (1850)
	7511	Canina 1850, parte media (1850)
	7825	Canina 1850, pl. unknown (1850)
	7848	Canina 1850, unknown (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)
	1767	Kiepert Huelsen 1912 (1912)
■	4976	Huelsen-Kiepert FUR 1912, folding pl. 2 [Montage] (1912)
■	1800	KRENCKER 1929 (1929)
■	916	Cameron 1939 (1939)
■	1938	Lugli Gismondi 1949 (1949)
	4318	FRUTAZ 1962, cat. CLXIX c (1962)
	4630	FRUTAZ 1962, cat. LV (1962)
	4631	FRUTAZ 1962, cat. LVI (1962)
	4635	FRUTAZ 1962, cat. LVIII, Nr. 14 [Montage] (1962)
	4715	FRUTAZ 1962, cat. XLVIII, Nr. 18 [Montage] (1962)
	7626	FRUTAZ 1962, S. unknown (1962)
■	2698	Spielmann 1966 (1966)
■	5216	Pasquinucci 1987, Abb. 57 (1987)
■	2190	Nielsen 1993 (1990)
	3986	Fagiolo 1991, pl. 80 (1991)
	3988	Fagiolo 1991, pl. 80 [Detail 2] (1991)
	3998	Fagiolo 1991, pl. 91 (1991)
	3999	Fagiolo 1991, pl. 92 (1991)
	4004	Fagiolo 1991, pl. 97 (1991)
■	1256	ENVOIS 1992 (1992)
	5151	LUCA 1994, cat. 15 [Montage] (1994)
	3790	David 1998, S. 207 fig. [upper] (1998)
	5360	Urbis Orbis 2001 (Bufalini 1551?), pl. [124] [Montage] (2001)

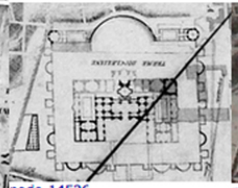
Visual Co-Popularity 2: The result.



Baths of Diocletian, GR, reconstruction	Baths of Caracalla, GR, reconstruction	Baths of Trajan, GR, rekonstruction, Dest-FUR	Baths of Constantine, GR, rekonstruction, Palladianite	Baths of Agrippa, GR, rekonstruction, Netunno-Ciambella	
24537	24265	24851	24382	24157	
[redacted]					9041 Leonardo Bufalini: Roma, Biblioteca Nazionale Centrale Vittorio Emanuele II, P.A. 1ter (1551)
[redacted]					7258 Canina 1841 (1830)
[redacted]					7509 Canina 1850, parte media (1850)
[redacted]					1853 Lanciani FUR (1893-1901)
[redacted]					8908 Paul Bigot: Caen, Université de Caen, [Bigot's plan of Rome], [Detail] (1911, 1914-37)
[redacted]					8909 Paul Bigot: Caen, Université de Caen, [Bigot's model of Rome], [Detail] (1911, 1914-37)
[redacted]					4976 Huelsen-Kiepert FUR 1912, folding pl. 2 [Montage] (1912)
[redacted]					1800 KRENCKER 1929 (1929)
[redacted]					916 Cameron 1939 (1939)
[redacted]					1938 Lugli Gismondi 1949 (1949)
[redacted]					2698 Spielmann 1966 (1966)
[redacted]					5216 Pasquinucci 1987, Abb. 57 (1987)
[redacted]					2190 Nielsen 1993 (1990)
[redacted]					1256 ENVOIS 1992 (1992)

Visual Co-Popularity 2: The result.


node 15925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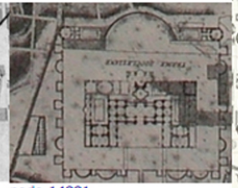
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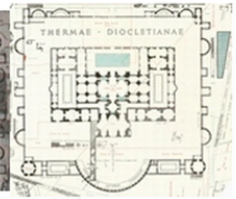

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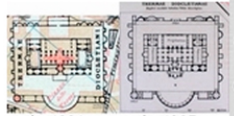
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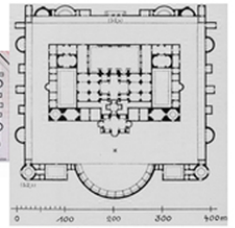

node 5030

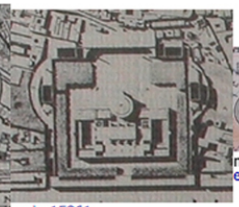

node 15923


node 14524


node 14879

node 5127


node 15853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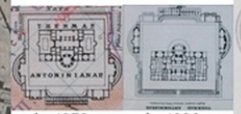
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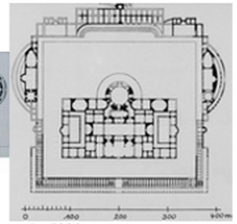
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node 14522 node 14523
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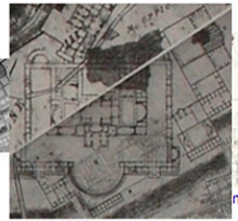
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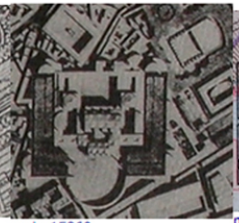
node 5121


node 15852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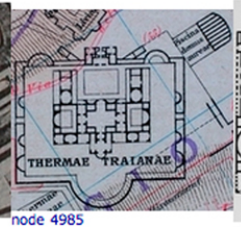

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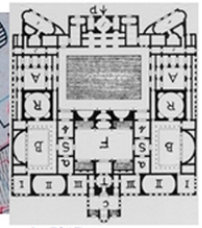
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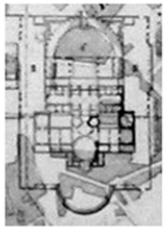
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node 14882


node 5120

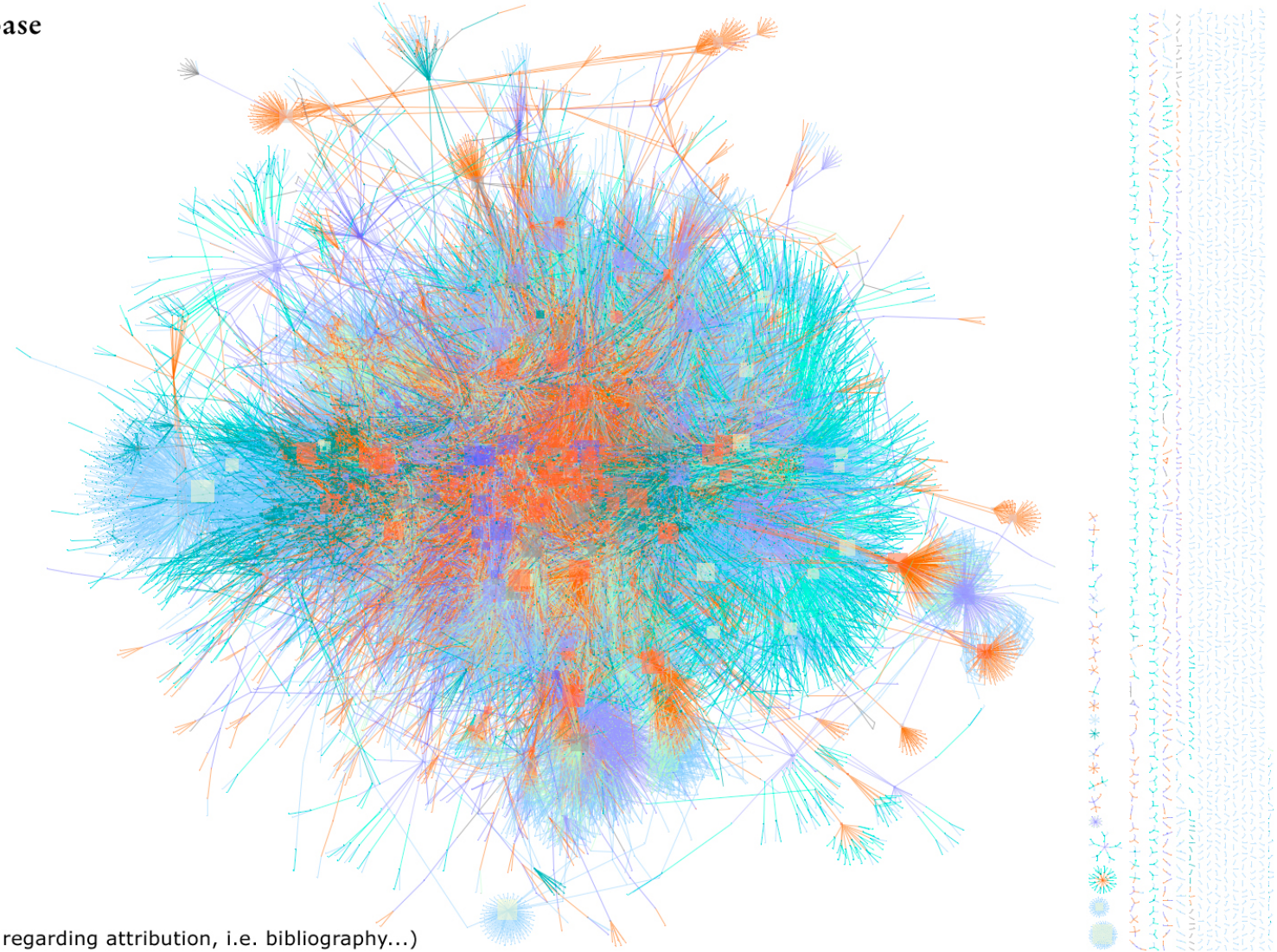

node 15855


node 15863

node 4979


node 5042

The ZUCCARO database



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	Person
	PrintCopy
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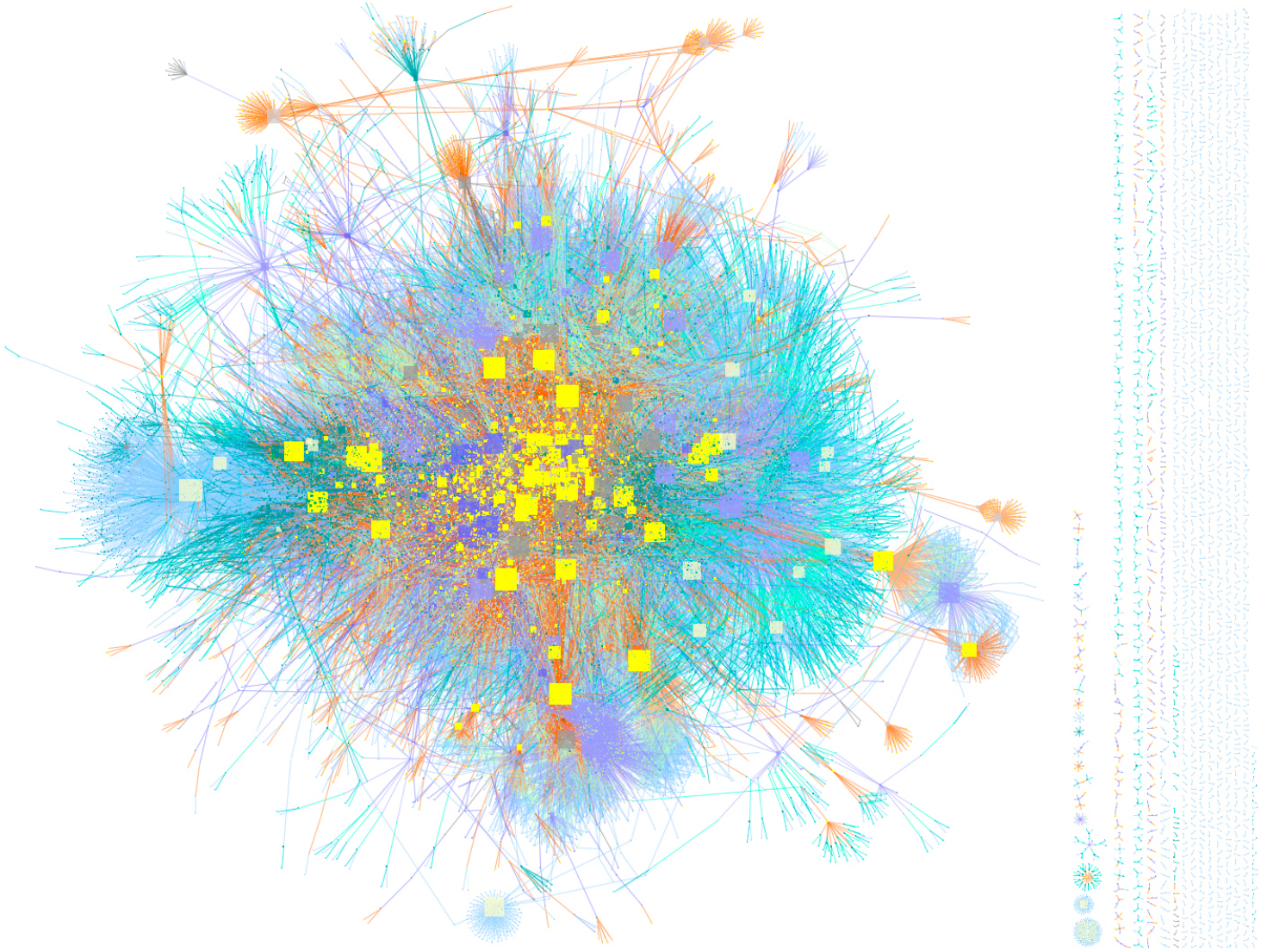
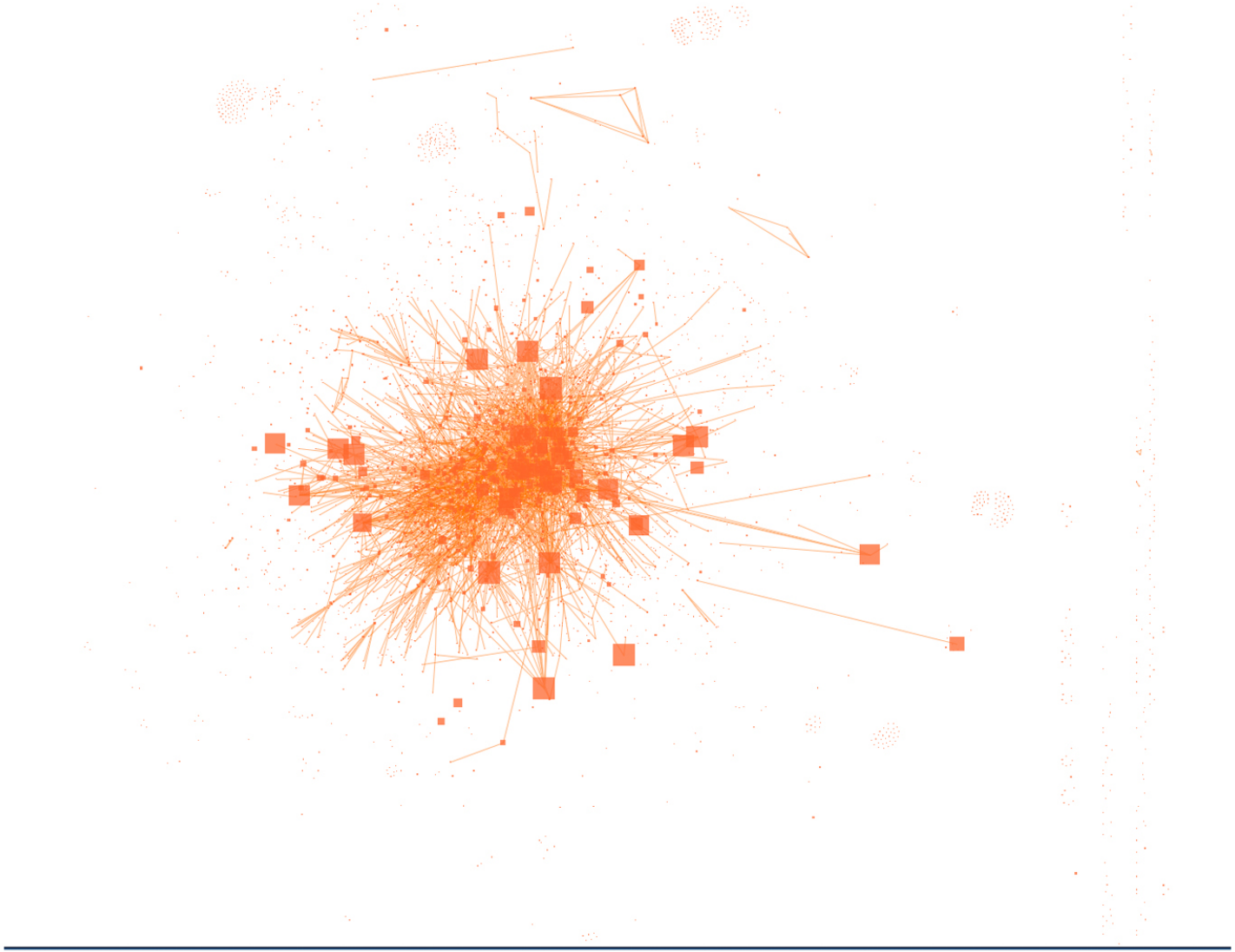
ca. 50.000 nodes
ca. 89.000 links
(+ ca. 50.000 additional links regarding attribution, i.e. bibliography...)

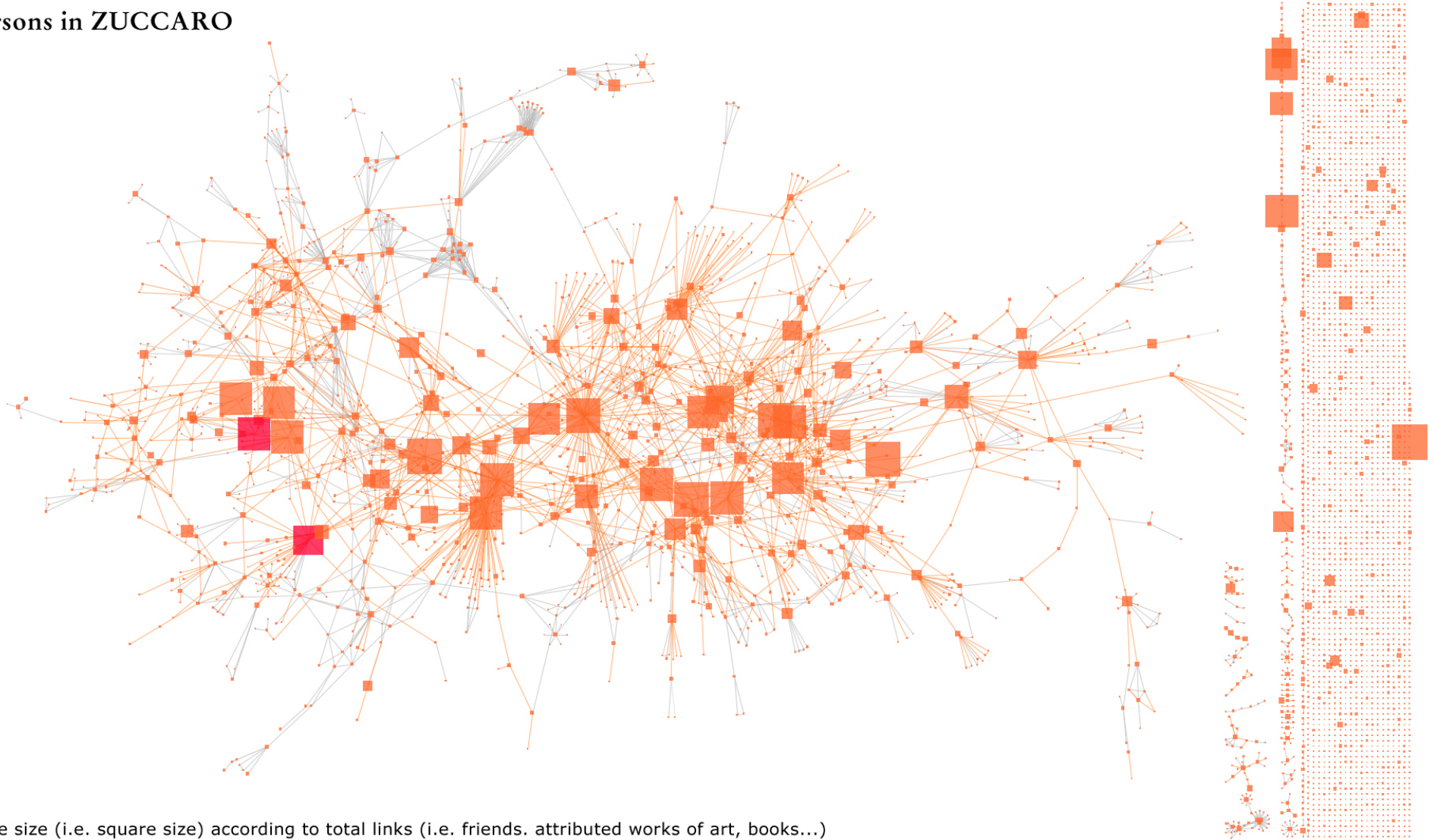
Persons in ZUCCARO



Persons in ZUCCARO

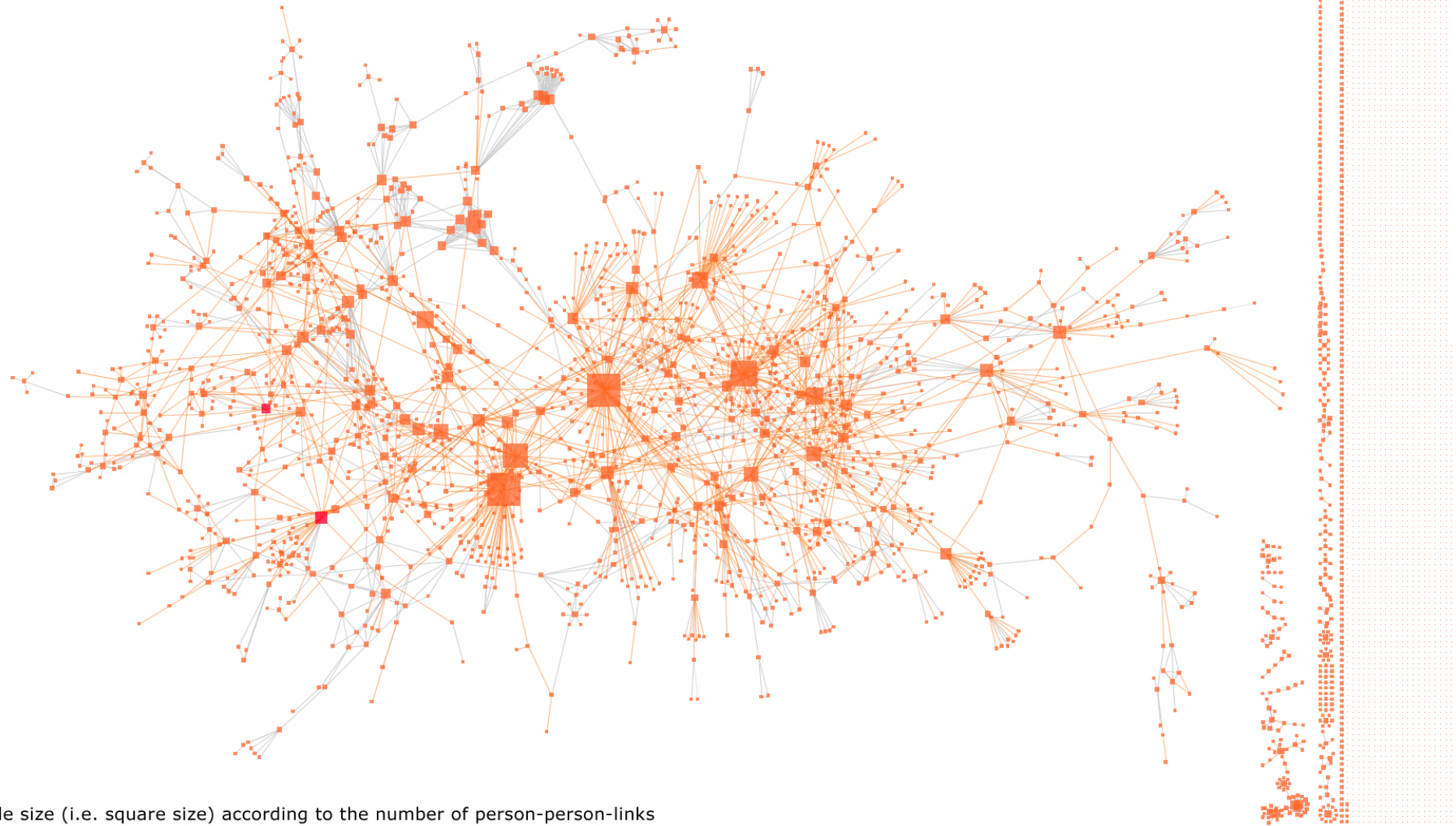


Persons in ZUCCARO



Node size (i.e. square size) according to total links (i.e. friends. attributed works of art, books...)

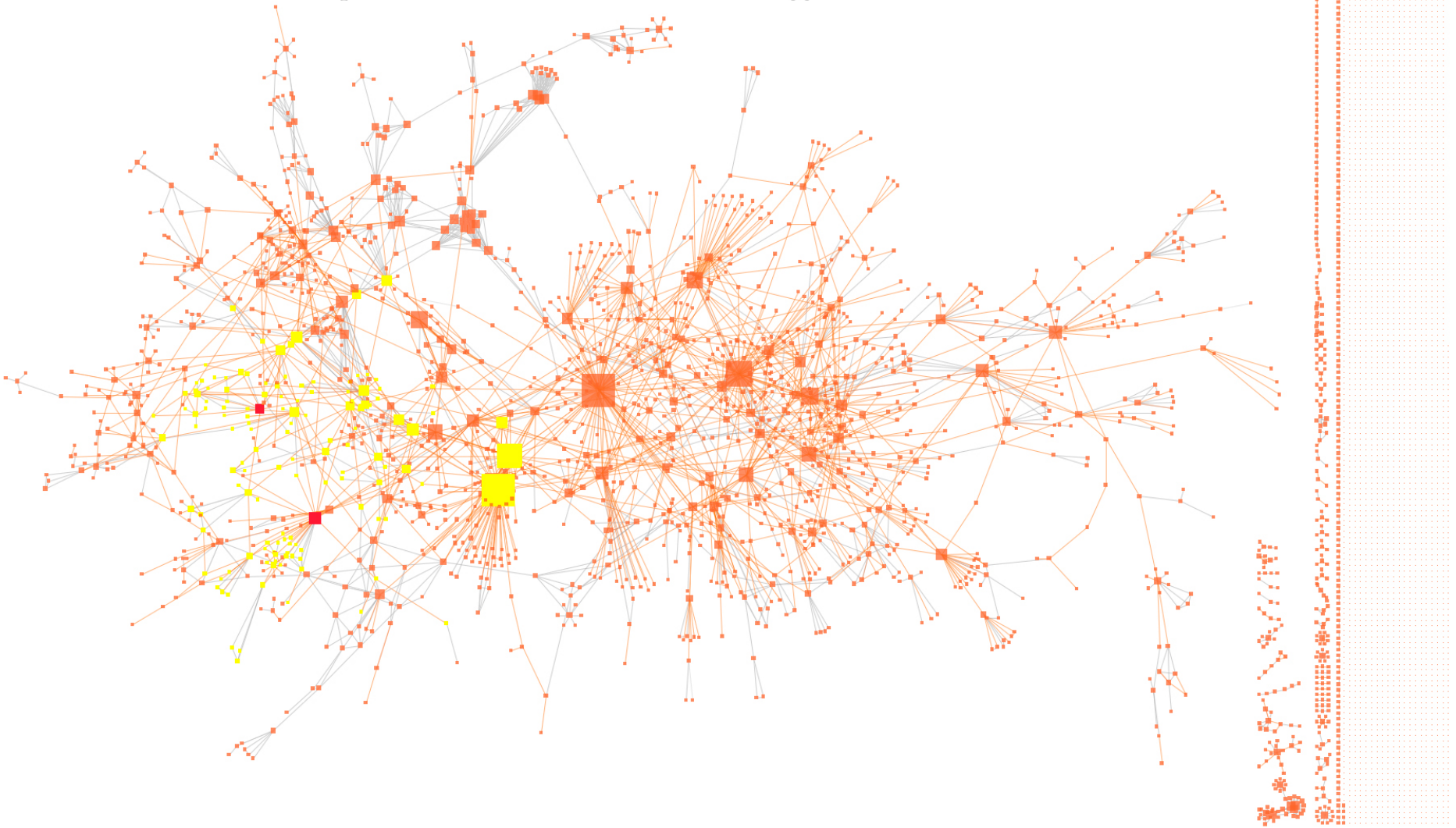
Persons in ZUCCARO



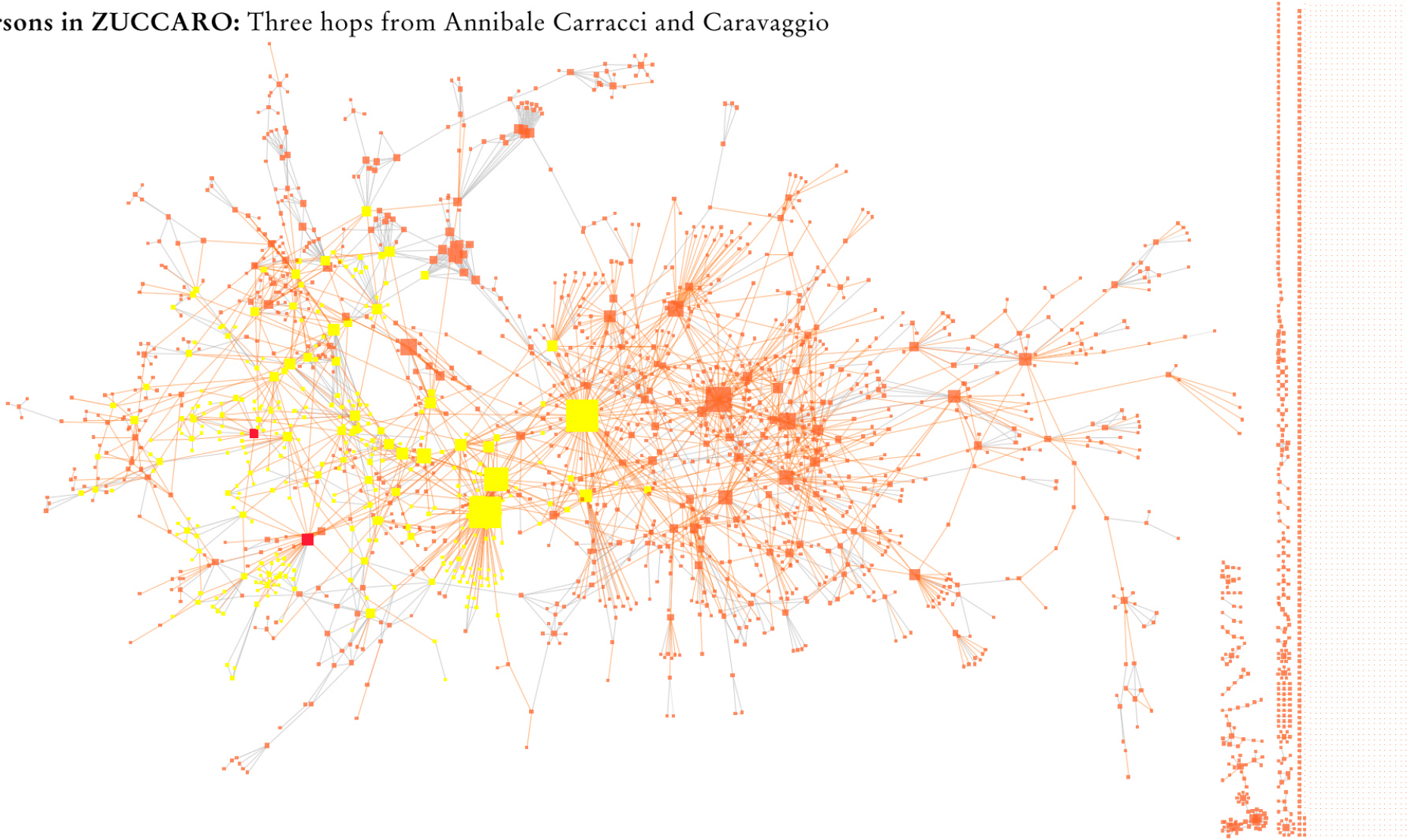
Node size (i.e. square size) according to the number of person-person-links

Persons in ZUCCARO: The immediate circle of Annibale Carracci and Caravaggio

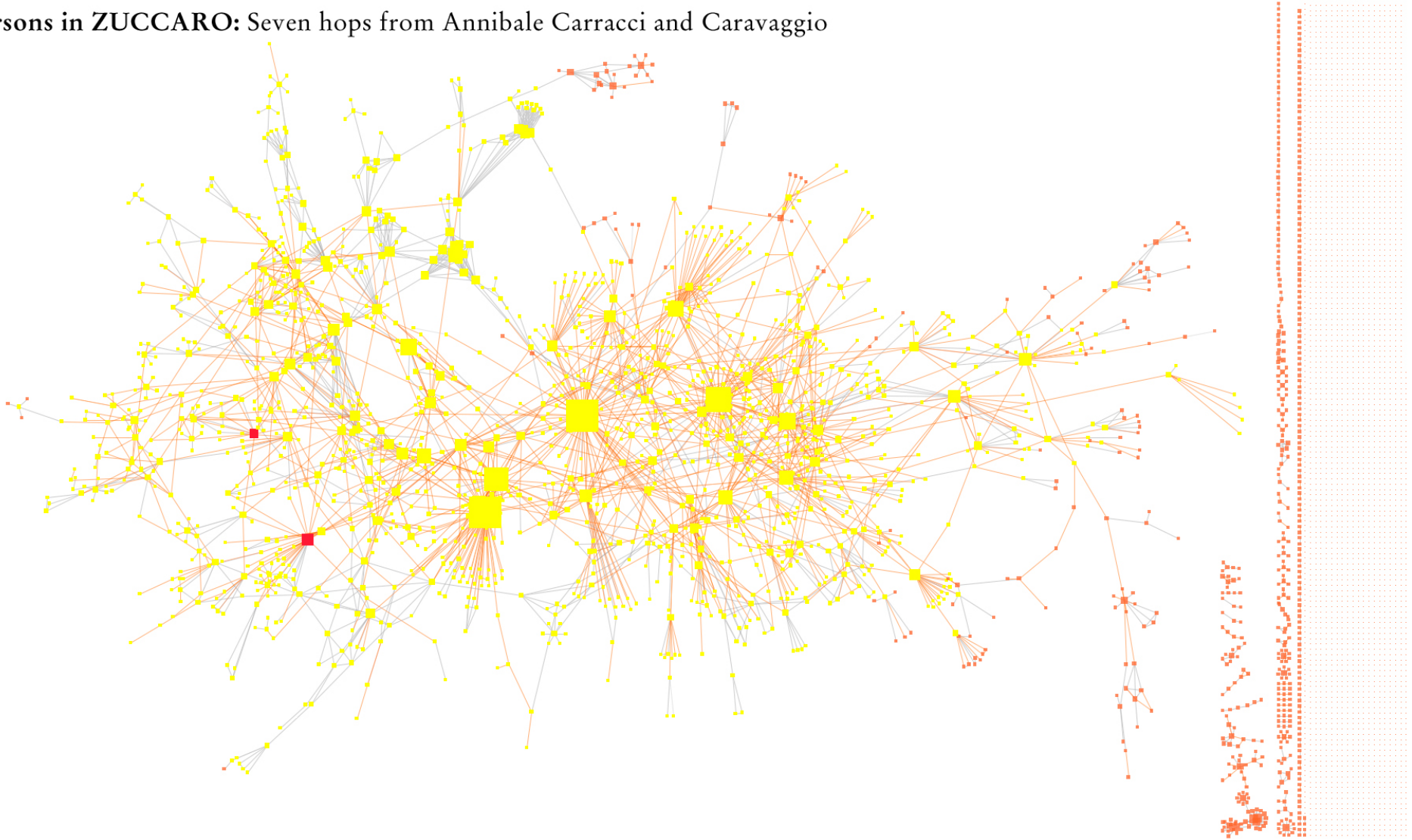
Persons in ZUCCARO: Two hops from Annibale Carracci and Caravaggio



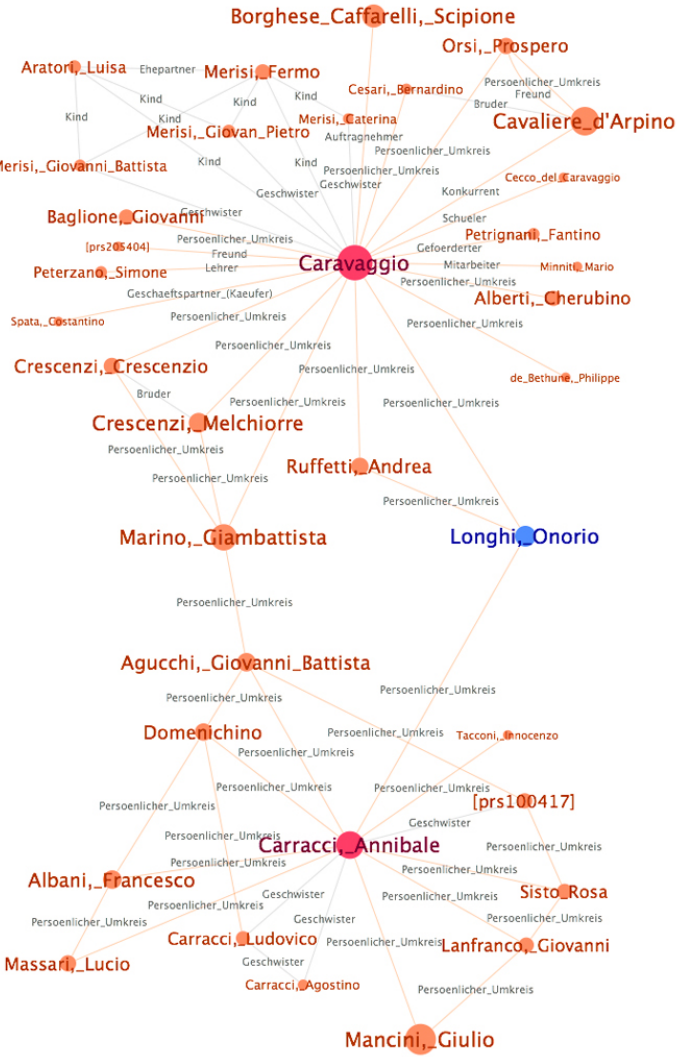
Persons in ZUCCARO: Three hops from Annibale Carracci and Caravaggio

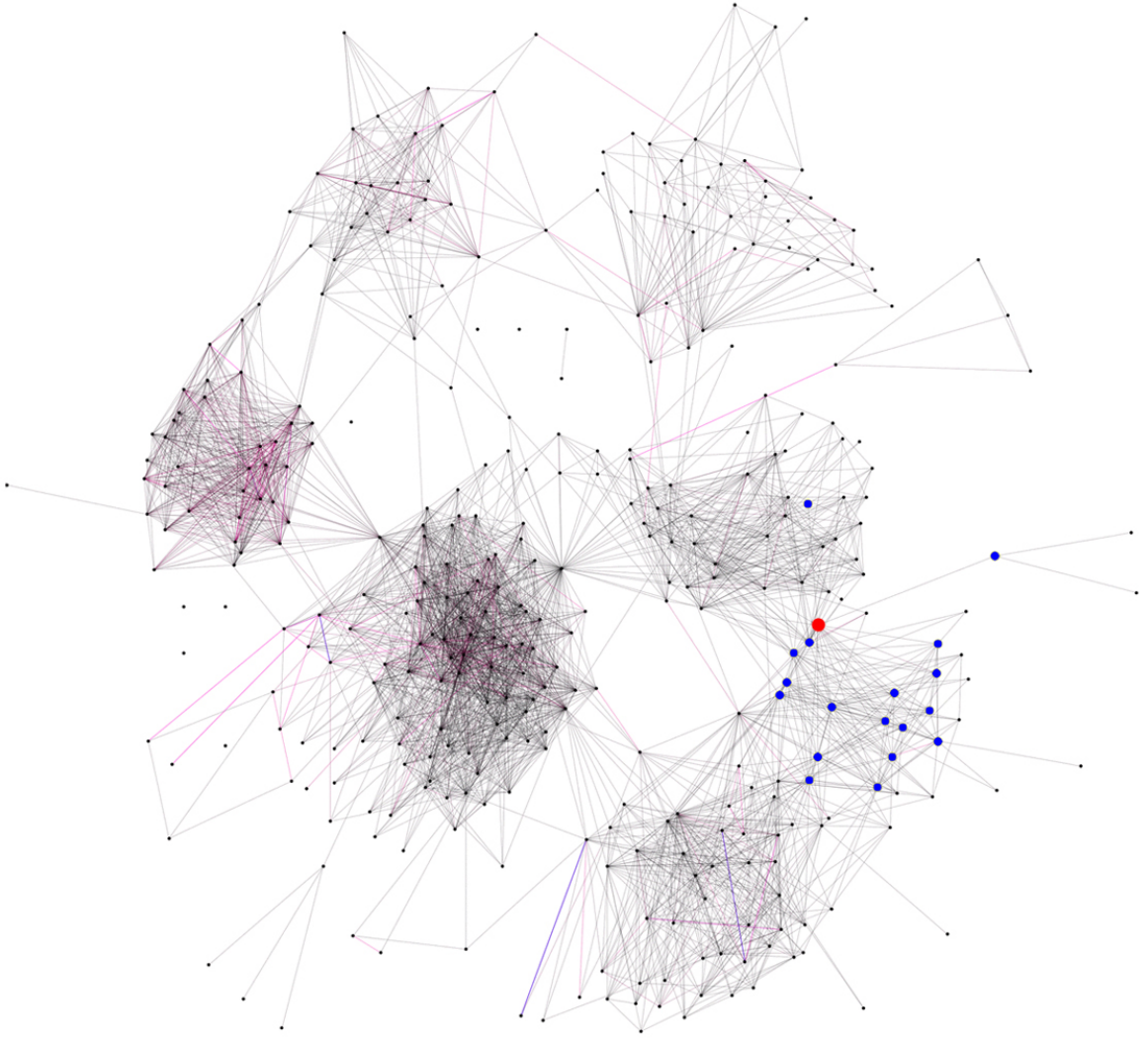


Persons in ZUCCARO: Seven hops from Annibale Carracci and Caravaggio



The immediate circle of Annibale Carracci and Caravaggio in ZUCCARO vs. a single friend in Facebook



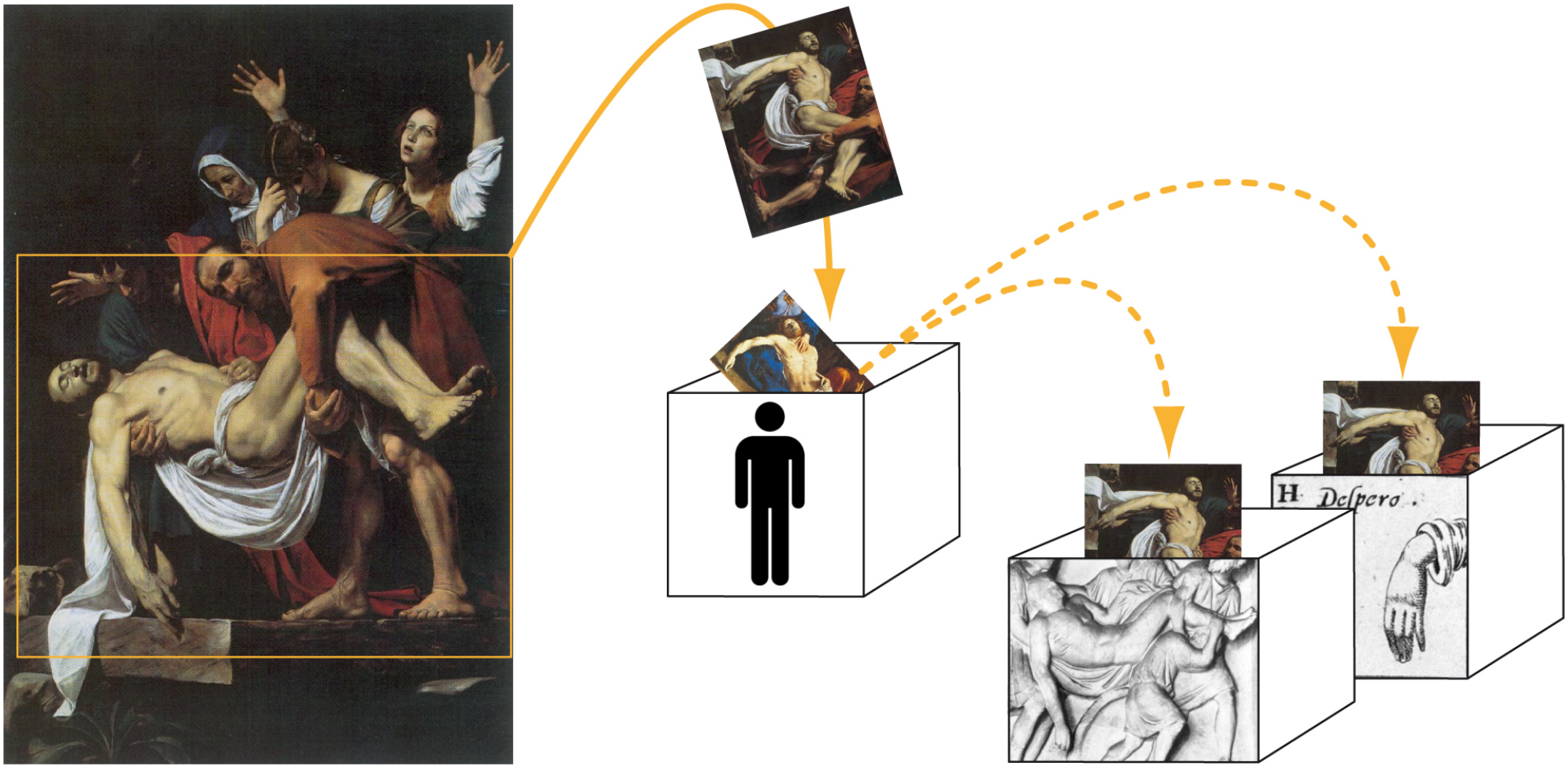


166 paintings by Annibale Carracci

89 paintings by Caravaggio

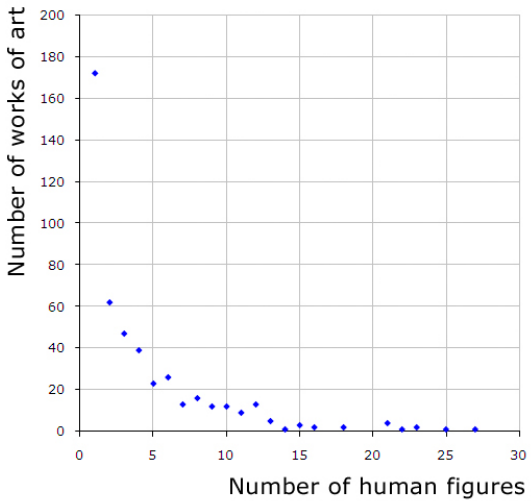
+ 455 related works of art in ARS ROMA (not shown)

Image classification in two steps

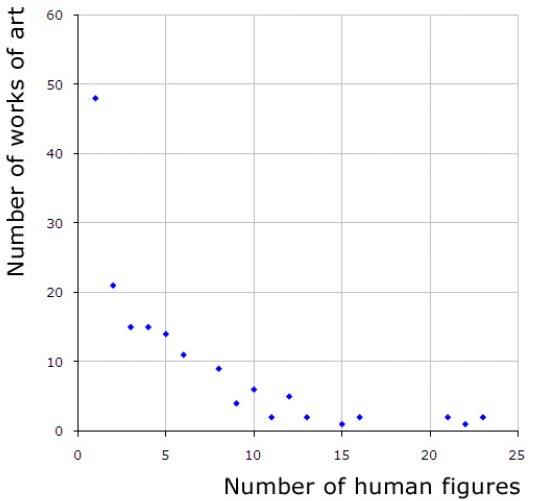


Number of human figures in the investigated works of art

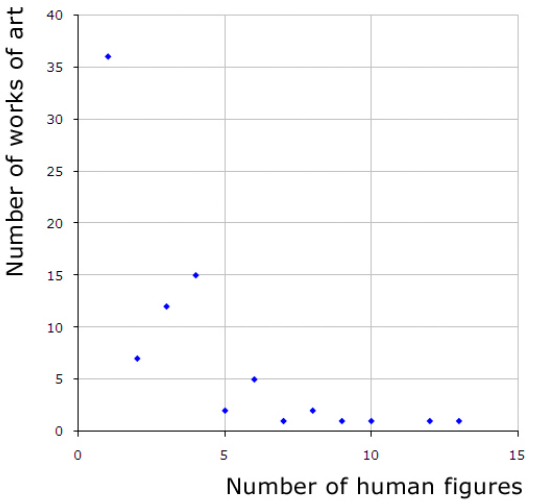
All works of art



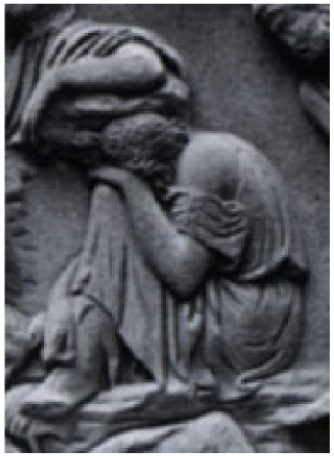
Annibale Carracci

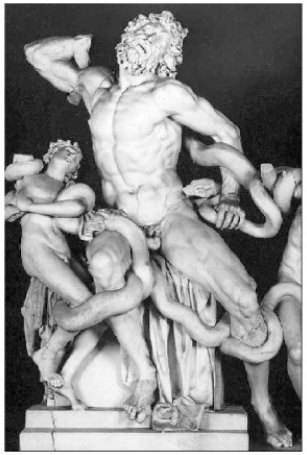


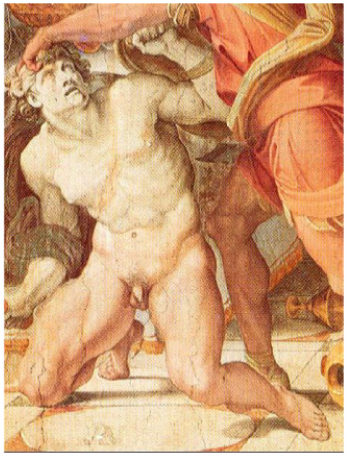
Caravaggio



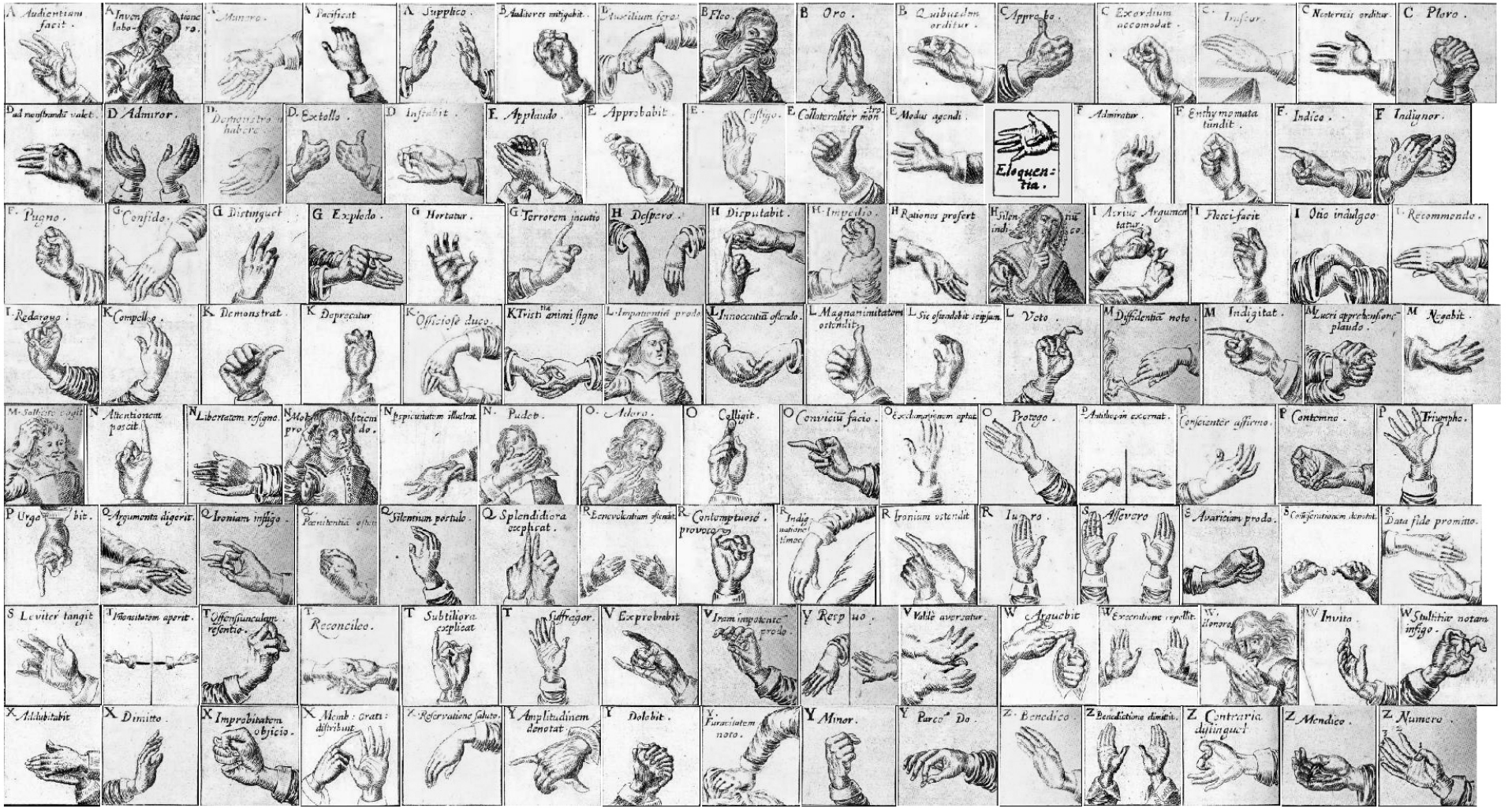
Classification of full figures (like Repoussoir-figures) vs. classification of features (like gestures)



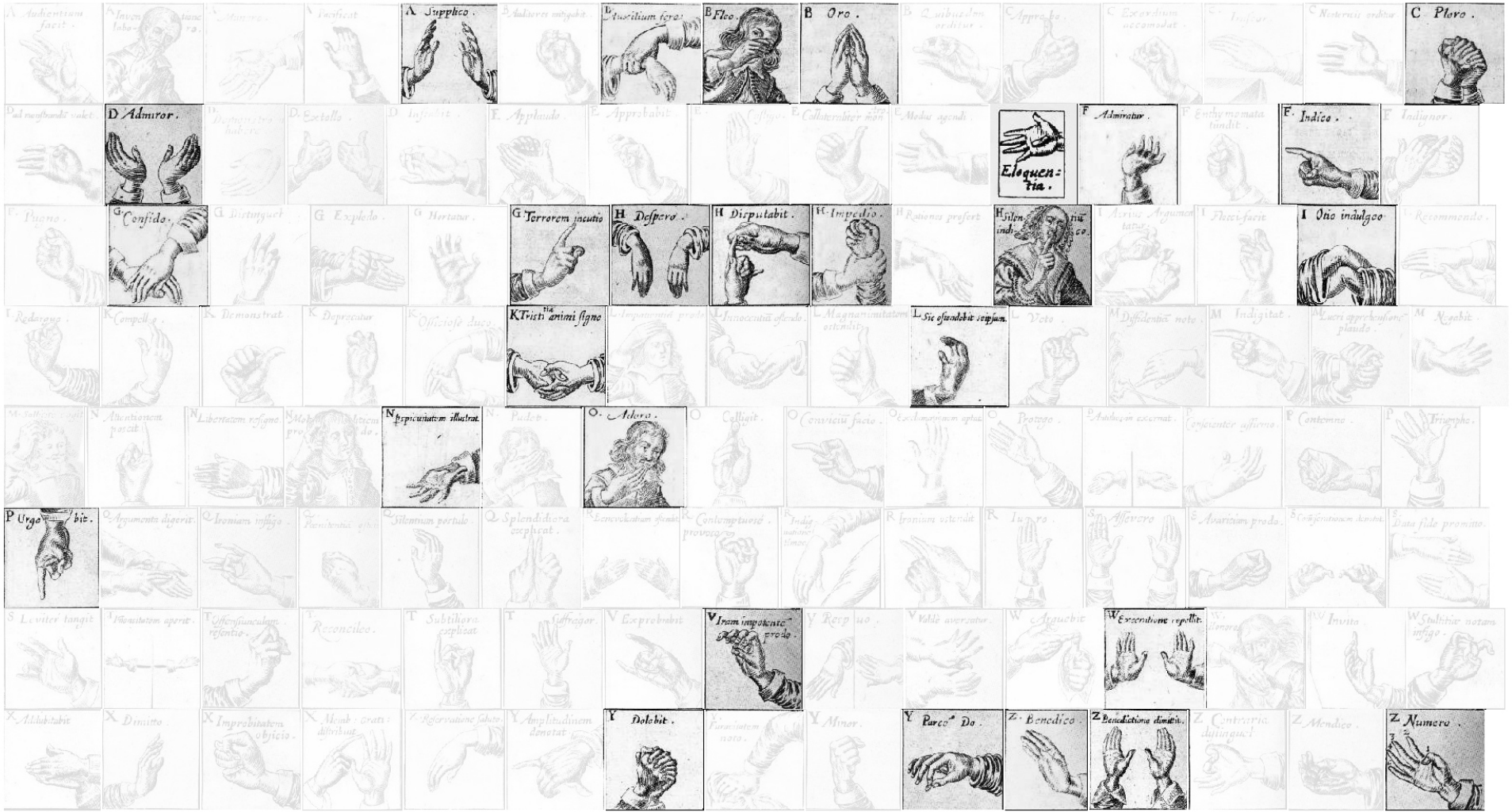




120 gestures after Bulwer



28 of 120 gestures after Bulwer appear in the investigated works of art.

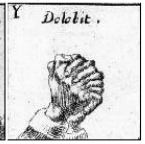


The frequency of the 28 gestures in the selected works of art decays exponentially (as seen in the visual tail) !

14 gestures in paintings by Annibale Carracci

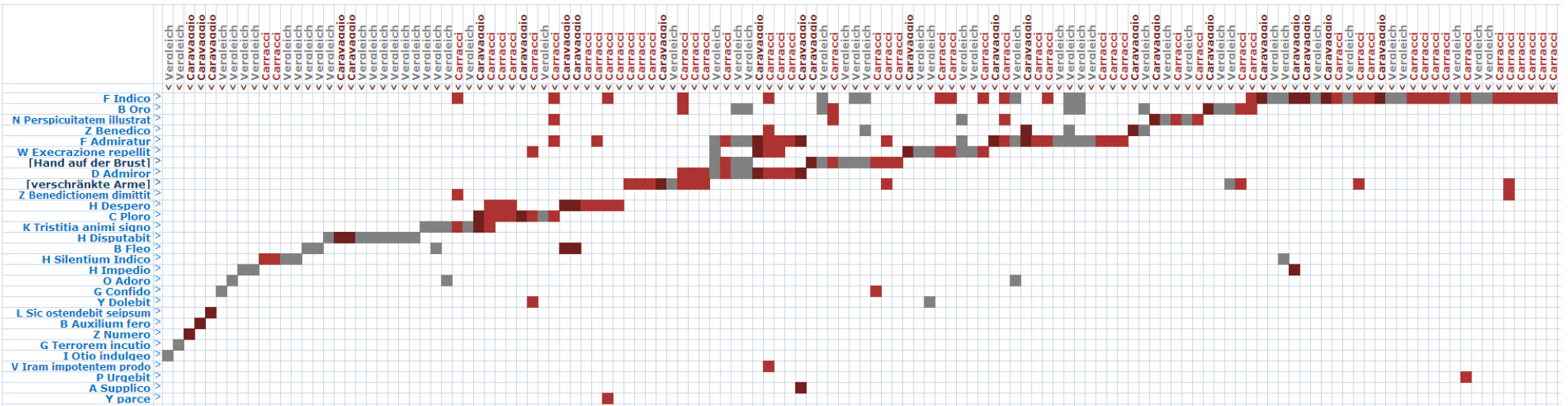
16 gestures in paintings by Caravaggio

Canon of gestures in paintings by Annibale Carracci (faded out)



... and by Caravaggio (faded out)

Visual Co-Popularity 3: Gestures in the investigated works of art

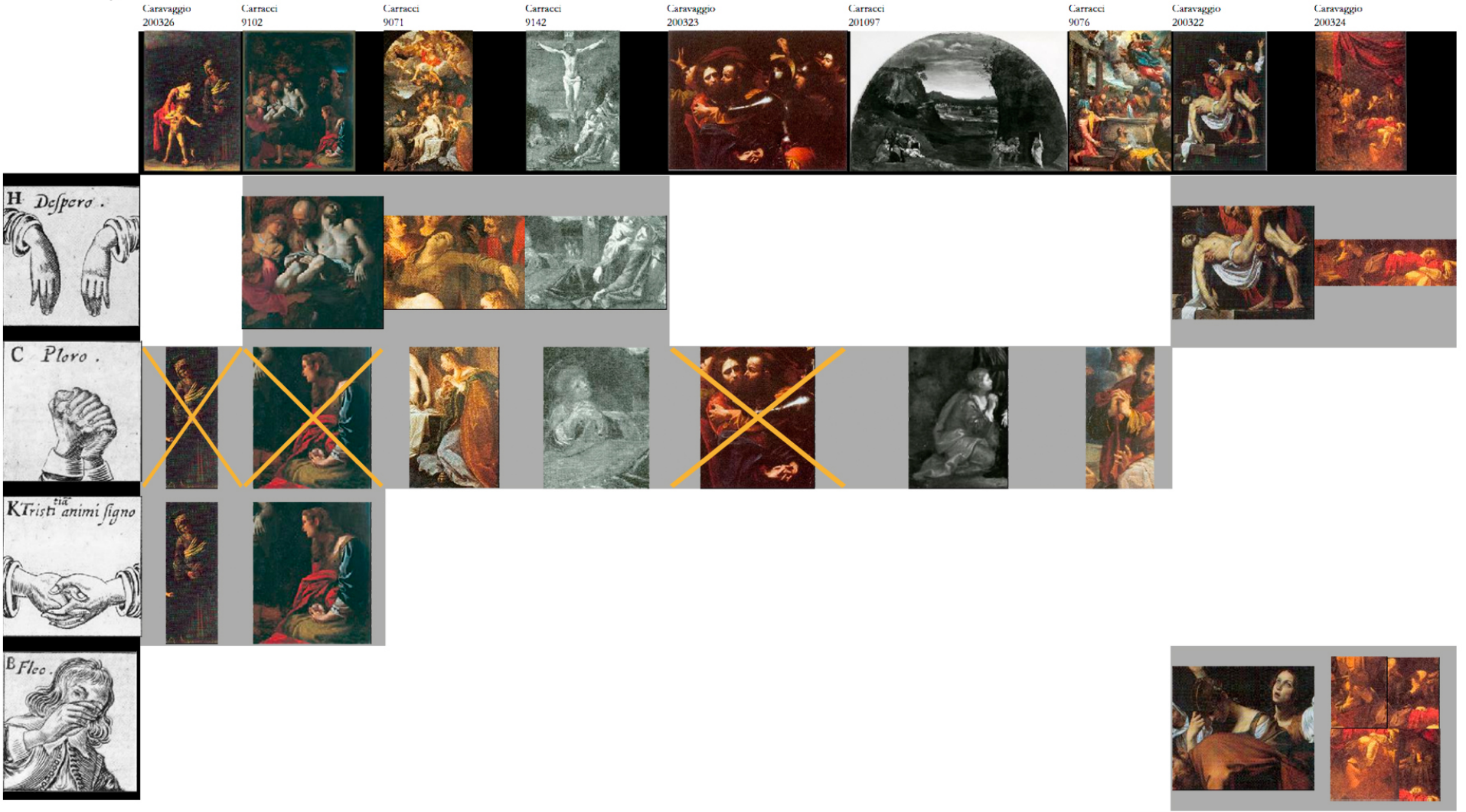


Community 1

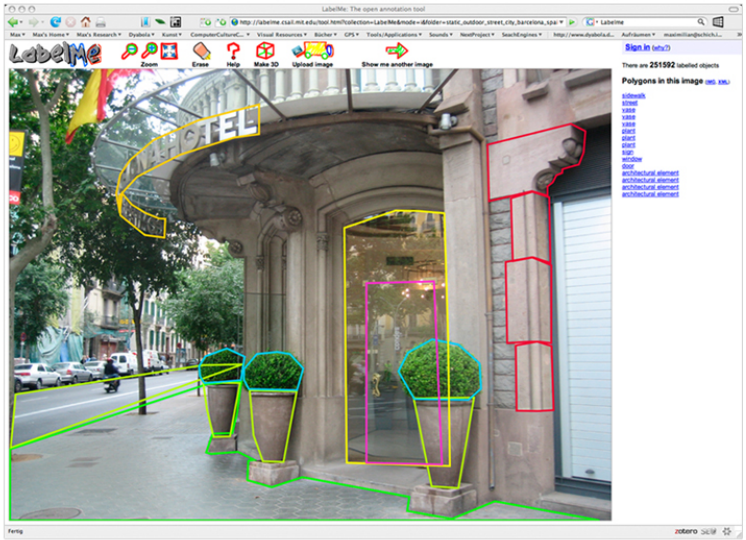

Vergleich
200073
Carracci
200103
Vergleich
201098
Vergleich
201099
Caravaggio
7073
Carracci
8043
Carracci
9028
Carracci
9139
Caravaggio
200707

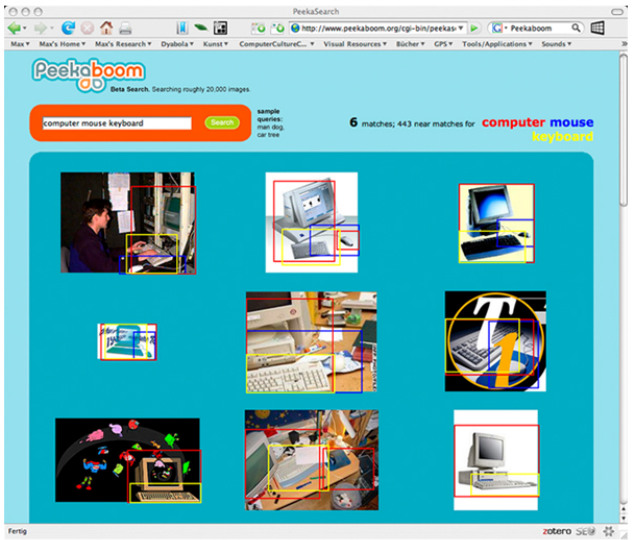

Z Benedico.
F Admiratur.
W Execrationē repellit.
D Admiror.

Community 2


Caravaggio
200326
Carracci
9102
Carracci
9071
Carracci
9142
Caravaggio
200323
Carracci
201097
Carracci
9076
Caravaggio
200322
Caravaggio
200324
H Despero .
C Ploro .
K Tristi tia animi signo
B Fleo .

Further possible applications





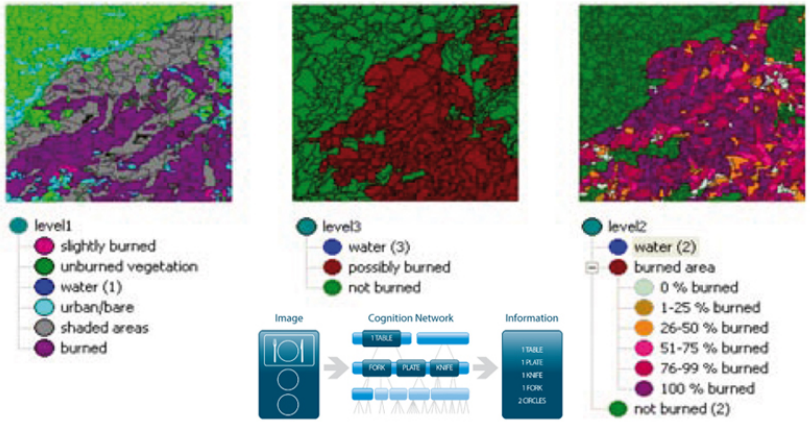


Figure: Subsets for three different levels of classification

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

Special thanks go to:

MAX-PLANCK-GESELLSCHAFT

ROMA

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