Knowledge Horizon Dynamics in Applied Computer Science

Veslava Osinska

Nicolaus Copernicus University, Toruń (Poland)

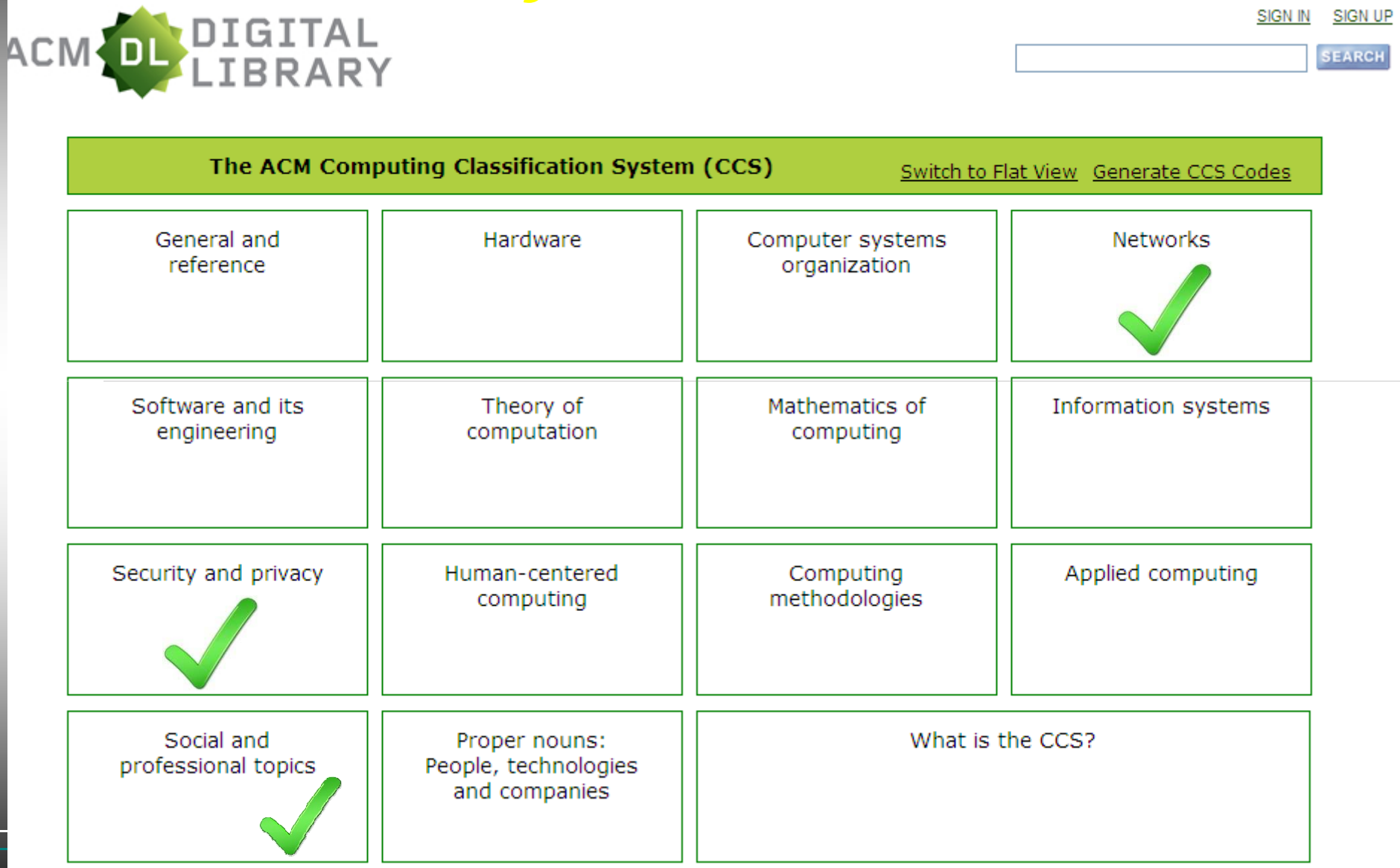
About us

- Computer Scientists
- Information scientists
- Physisists
- Cognitive Scientists

About

- Methodology
- Topology assumptions
- Interface for exploration
- Results. Interpretations
- Image analysis methods
- Animation (if time allows)

CCS today


ACM DL DIGITAL LIBRARY
SIGN IN
SIGN UP
SEARCH
The ACM Computing Classification System (CCS)
Switch to Flat View
Generate CCS Codes
General and reference
Hardware
Computer systems organization
Networks
Software and its engineering
Theory of computation
Mathematics of computing
Information systems
Security and privacy
Human-centered computing
Computing methodologies
Applied computing
Social and professional topics
Proper nouns: People, technologies and companies
What is the CCS?

Nonlinear Metrics

- Metadata of ACM DL documents:
  - title
  - author
  - year
  - **primary class symbol**
  - **aditional classes symbols**
  - keywords
  - general terms
  - subject descriptors

} analysis units

As closer thematically two subclasses the more common articles they include. Topic similarity between classes is proportional to the number of common documents

Similarity Matrix

- Documents metadata 2007 (N = 37 543)
- Dimension: 353 classes and subclassess number
- Normalization
- Symetrization
- $N = \sum_{i=1}^{353} \sum_{j=1}^{353} s_{ij}$
- $S_{ij} = 1$ $(i = j)$ and $S_{ij} < 1$ $(i \neq j)$

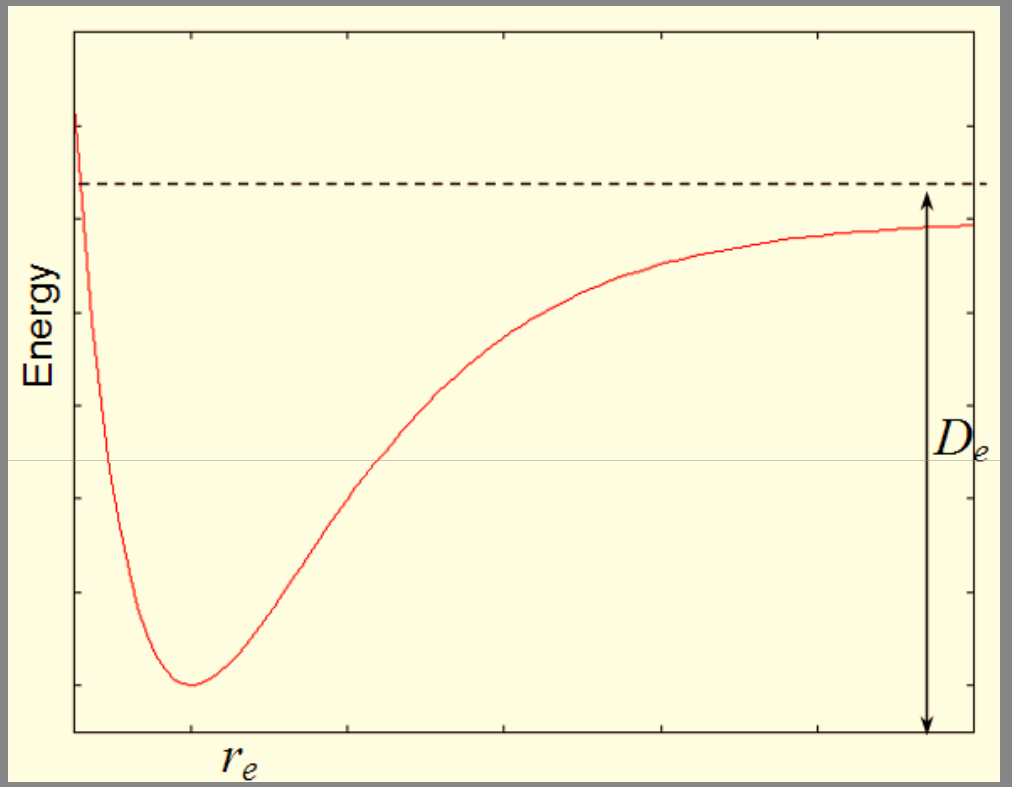
Similarity Matrix cont.

	1 A.0	2 A.1	3 A.2	**4 A.m**	5 B.0	6 B.1	7 B.1.0	8 B.1.1	9 B.1.2	10 B.1.3	11 B.1.4	12 B.1.5	13 B.2	14 B.2.0
A.0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
A.1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
A.2	0,000302	0	1	0	0	0	0	0	0	0	0	0	0	0
A.m	0,00075	0,01882	0,055555	1	0	0	0	0	0	0	0	0	0	0
B.0	0,026585	0,00909	0,013515	0	1	0	0	0	0	0	0	0	0	0
B.1	0,000302	0	0	0	0	1	0	0	0	0	0	0	0	0
B.1.0	0,000302	0	0	0	0	0	1	0	0	0	0	0	0	0
B.1.1	0	0	0	0	0	0,11539	0	1	0	0	0	0	0	0
B.1.2	0	0	0	0	0	0,2	0	0,11539	1	0	0	0	0	0
B.1.3	0	0	0	0	0	0	0	0	0	1	0	0	0	0
B.1.4	0	0	0	0	0	0	0	0	0,2	0	1	0	0	0
B.1.5	0	0	0	0	0	0	0	0	0	0	0	1	0	0
B.2	0	0	0	0	0	0	0	0,03846	0	0	0,125	0	1	0
B.2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
B.2.1	0	0	0	0	0	0	0	0	0	0	0,125	0	0,083335	0
B.2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B.2.4	0	0	0	0	0	0	0	0	0	0	0	0	0,19231	0
B.3	0,00302	0	0	0	0,013515	0	0	0	0	0	0	0	0,25	0
B.3.0	0,000905	0	0	0	0	0	0	0	0	0	0	0	0	0
B.3.1	0,00151	0	0,02	0	0	0	0	0	0	0	0	0	0	0
B.3.2	0,000605	0	0	0	0,013515	0	0	0	0	0	0	0	0,25	0
B.3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B.3.m	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B.4	0,00272	0	0	0	0,013515	0	0	0,11539	0	0	0	0	0	0
B.4.0	0,002415	0	0	0	0	0	0	0	0	0	0	0	0	0
B.4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B.4.2	0	0	0	0	0,013515	0	0	0,076925	0	0	0	0	0,03846	0
B.4.3	0,000302	0	0,00532	0	0,00532	0	0	0,076925	0	0	0	0	0	0
B.4.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B.4.m	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B.5.1	0	0	0	0,00075	0	0	0	0	0	0	0	0	0,096155	0,125

MDS

- *Phi* = 0.25
- r^2=0.47

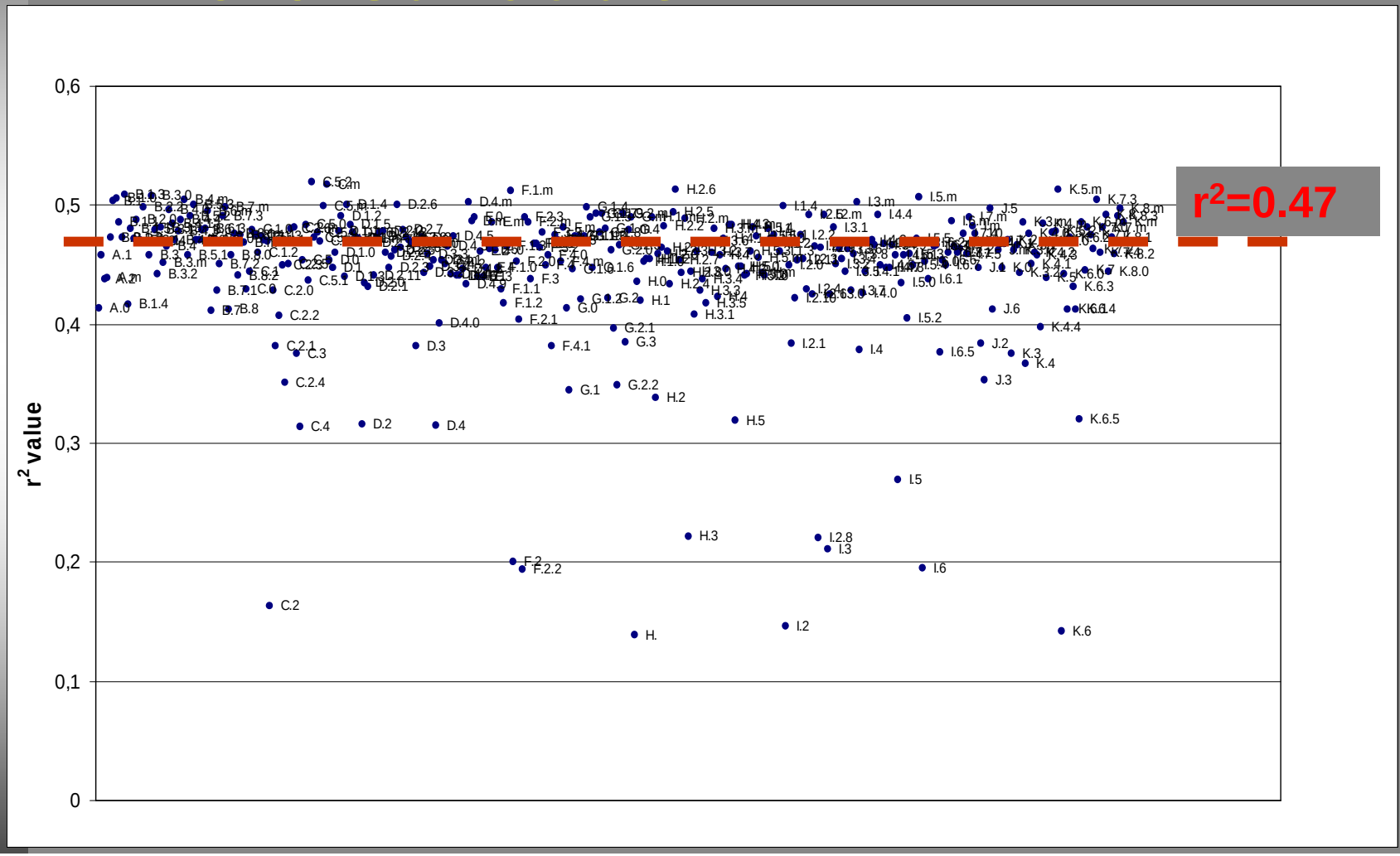
$r_{ijk}^2 = x_i^2 + y_j^2 + z_k^2$



Morse potencial

$$E_s(r) = D_e\left[\left(1 - e^{-b(r-R)}\right)^2 - 1\right]$$

The distribution r^2



Mapping Space

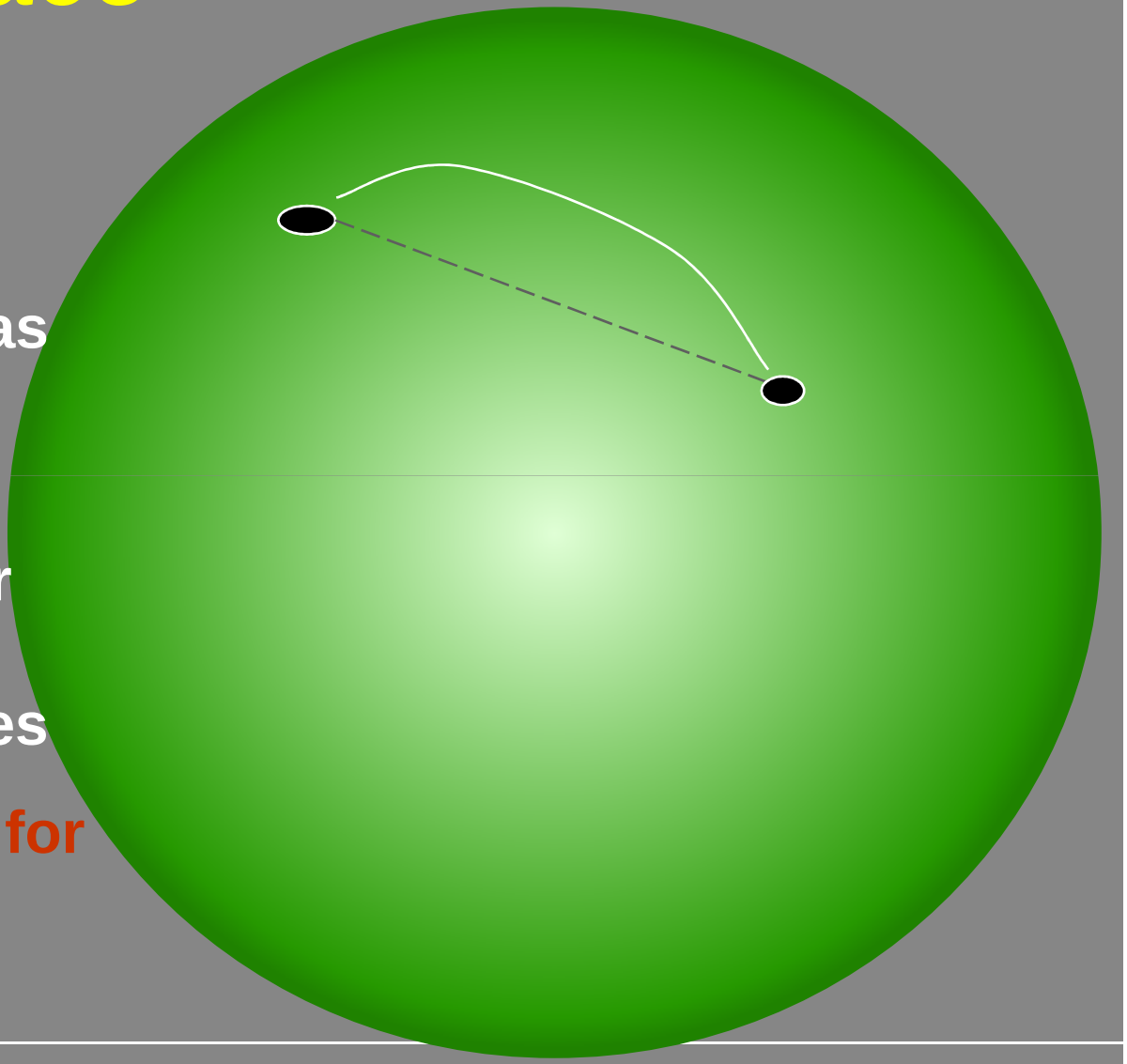
continuos

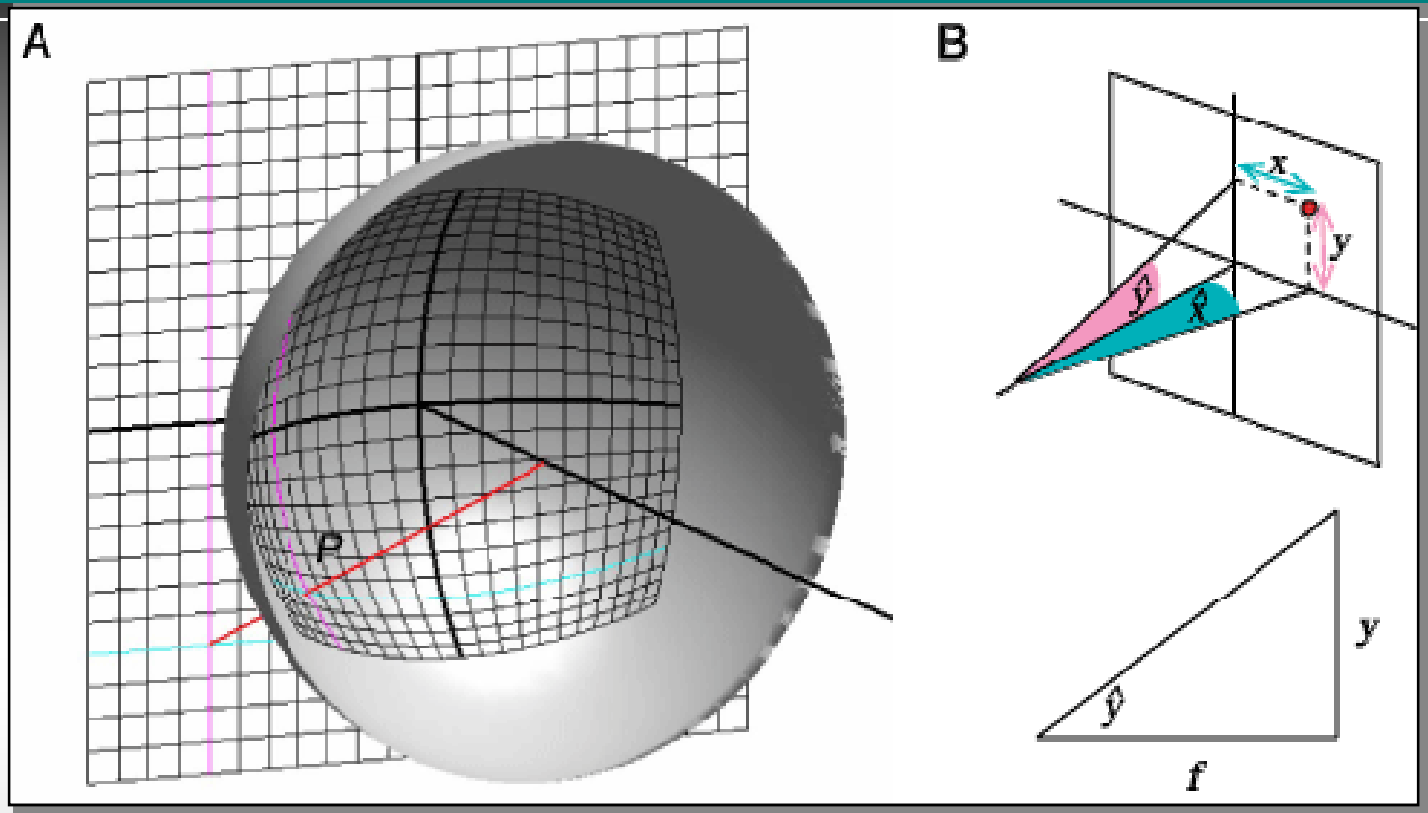
symmetric

curved surface has more topological possibilities

sphere is easy for navigation and retrieval processes

Sphere is natural for perception and cognition





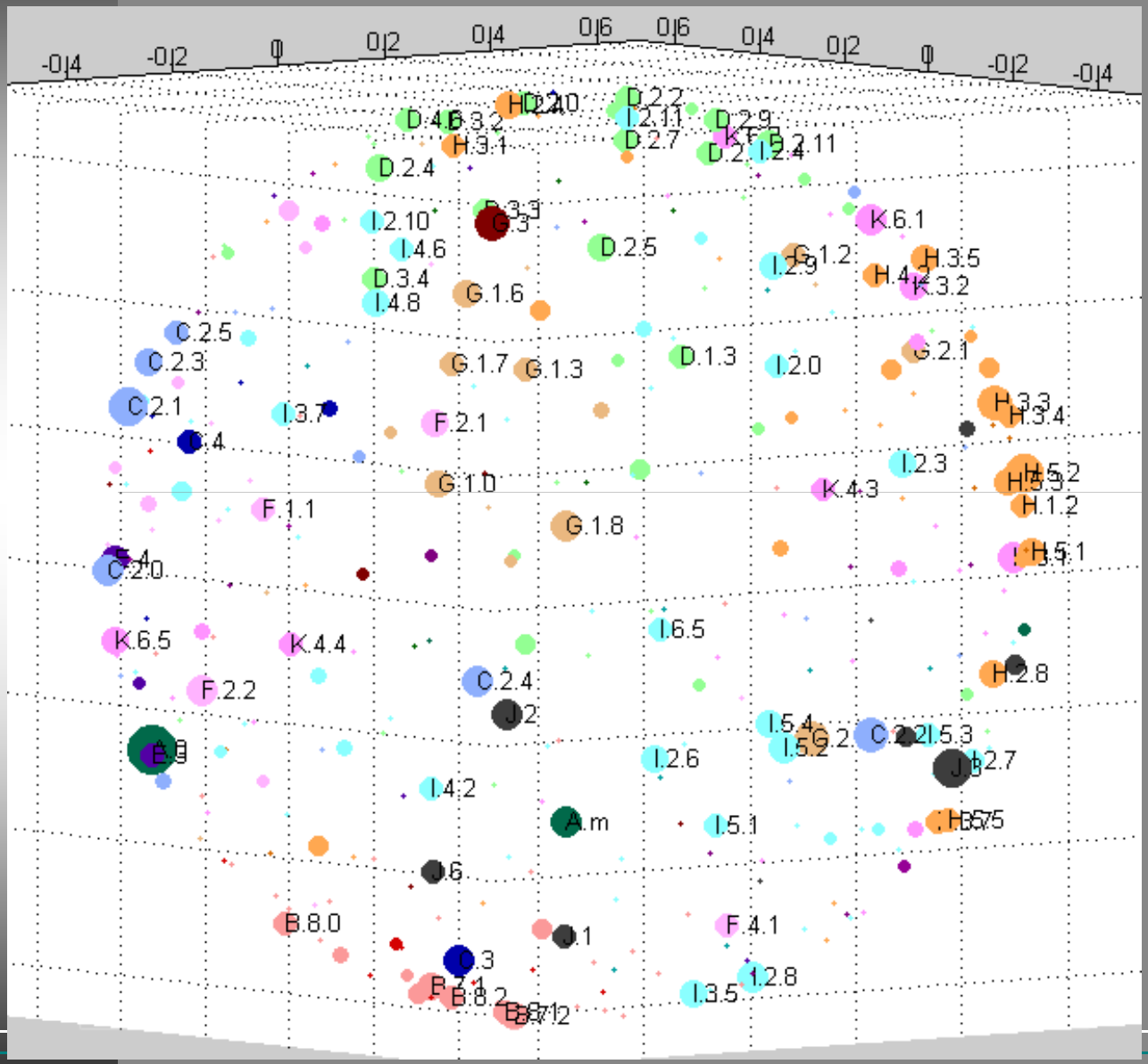
Cognitive problems of human vision:

How the 3D space arise from plane picture?

What about human brain must know computer graphics?

How our vision systems work?

Classes visualization



Atributes:

1. **main class (color) 11**
2. **level 1,2,3 (luminosity)**
3. **population (size)**

Documents Visualization principle

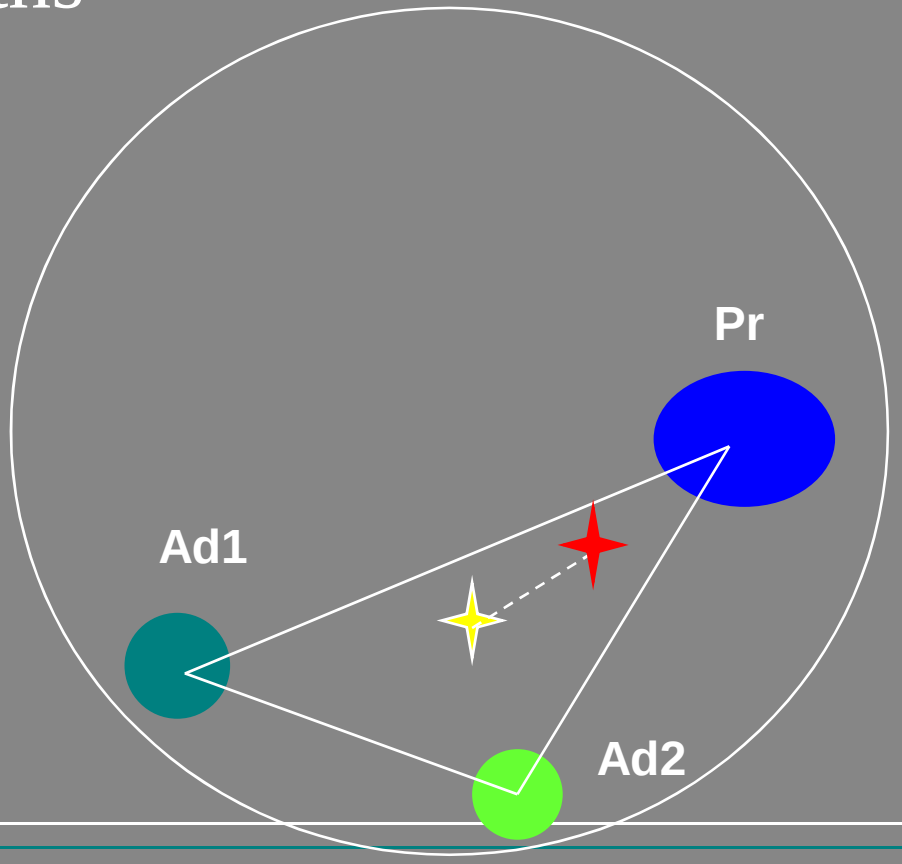
Classifications weigths

Main: Additional

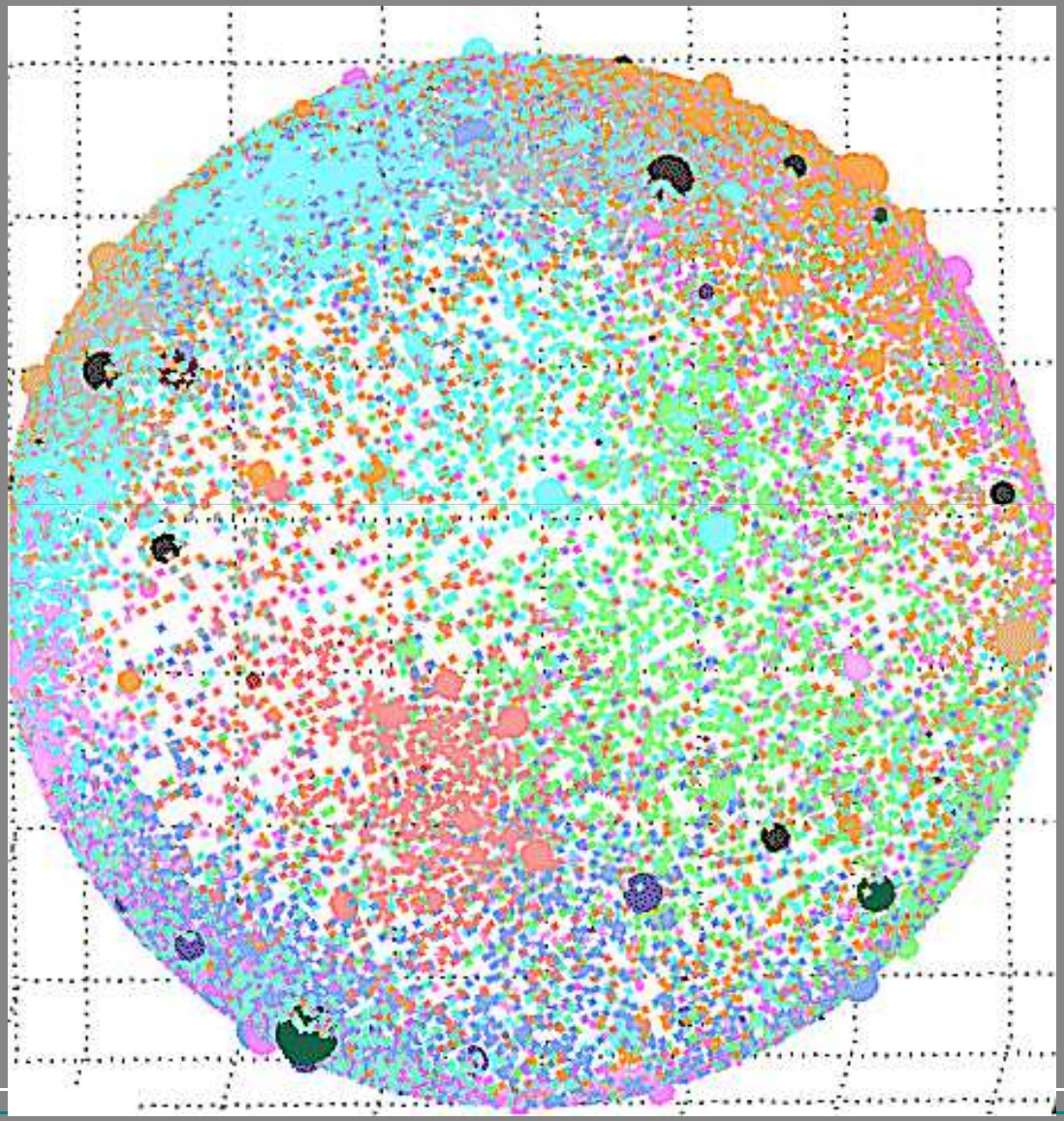
0.6:0.4

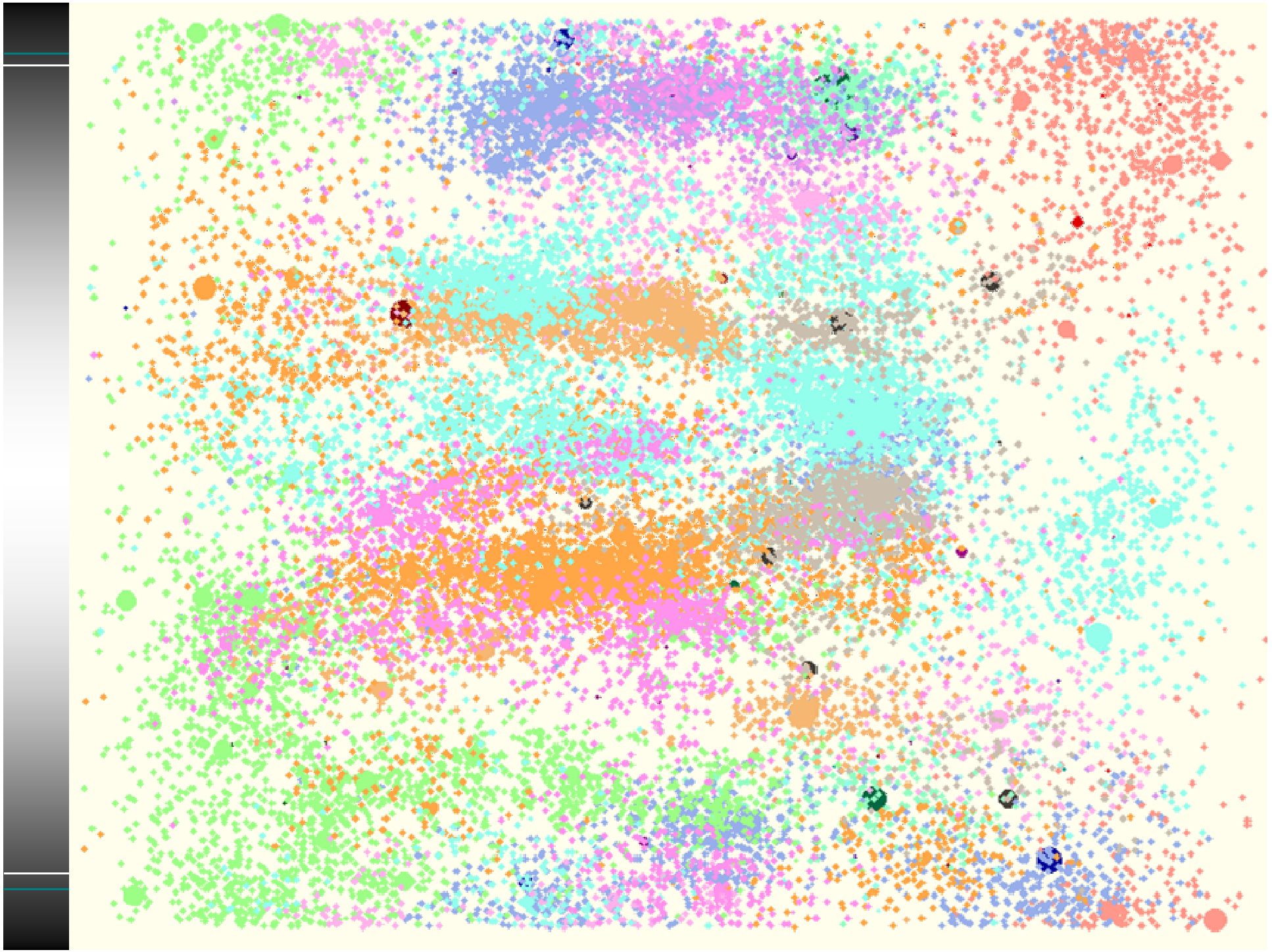
0.7:0.3

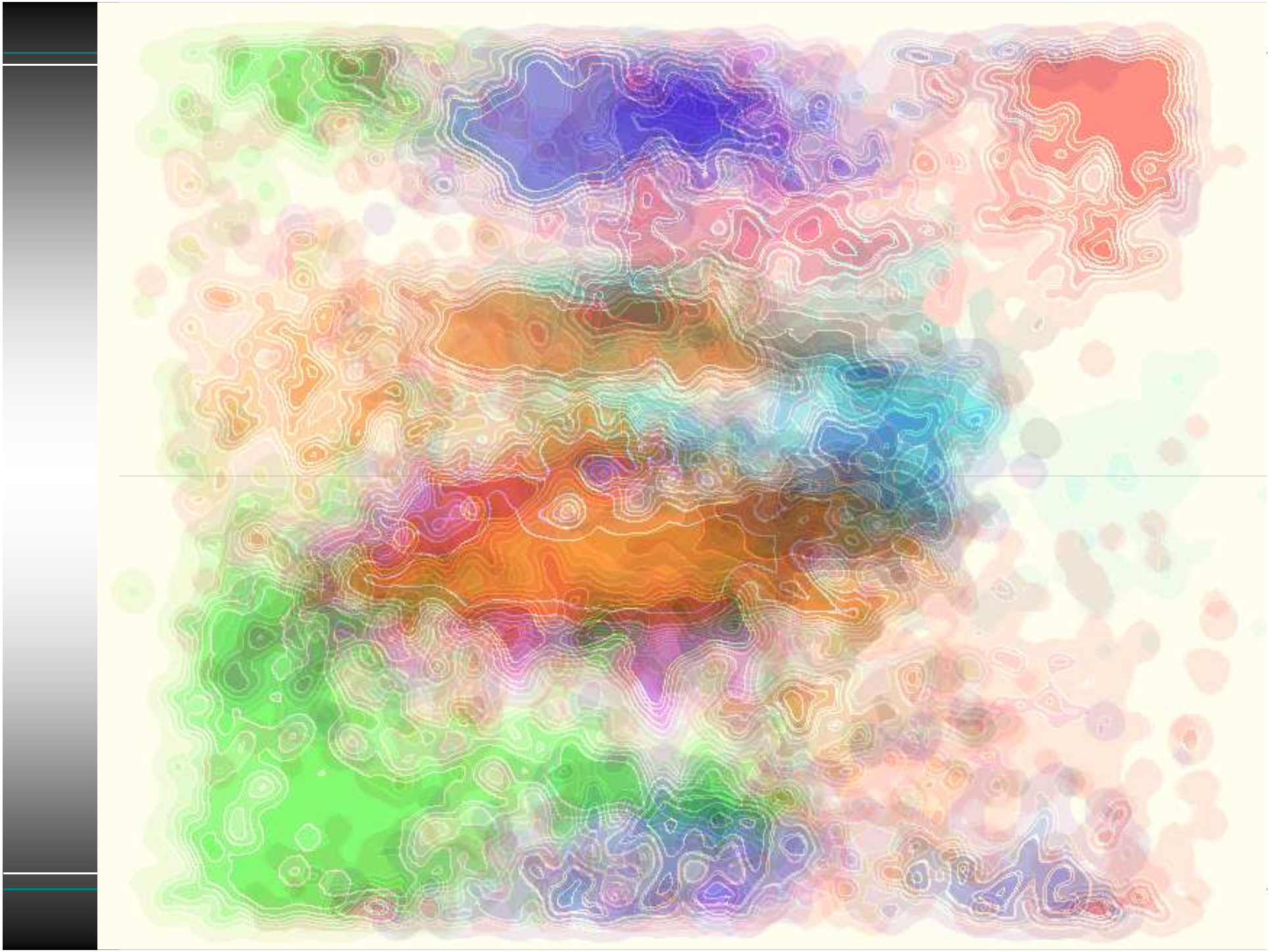
0.5:0.5



Visualization sphere

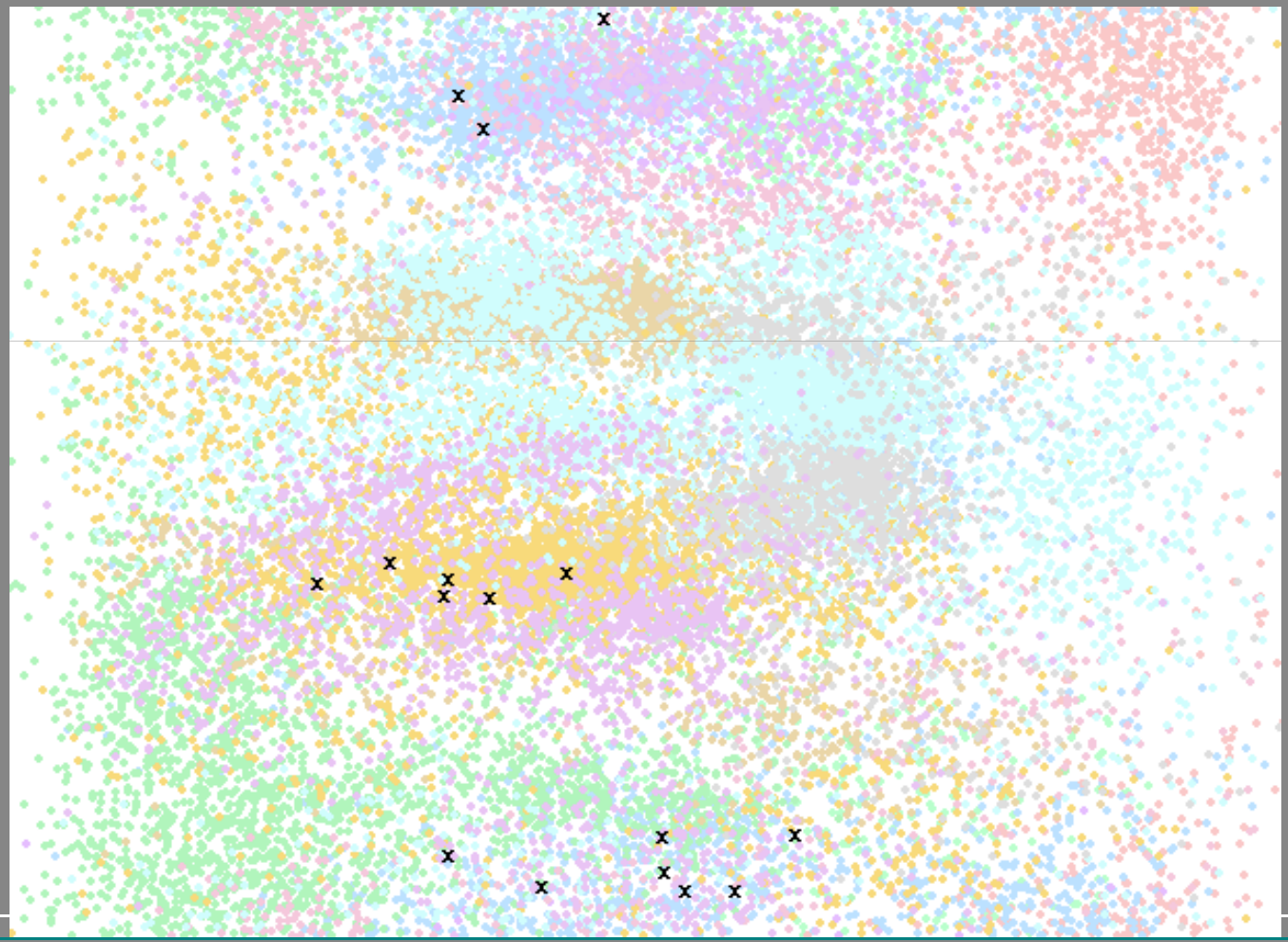






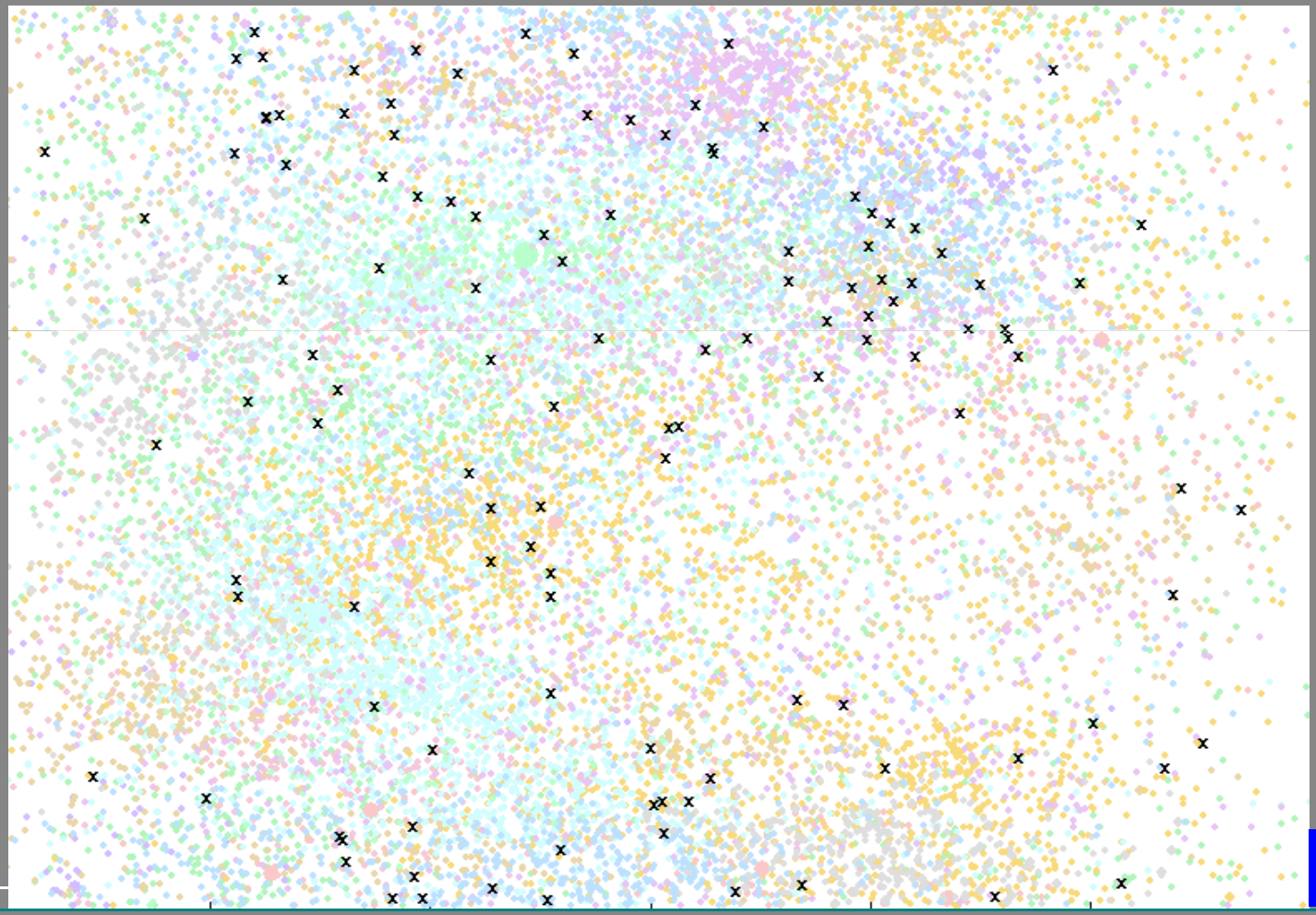
Keywords Map – Semantic map of Universum

Cloud Computing



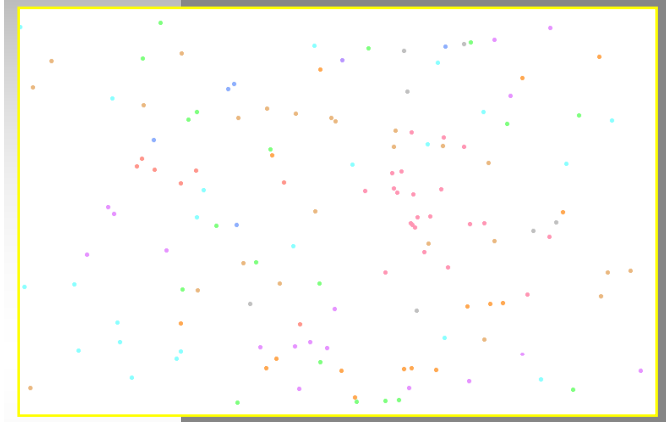
2007

Cloud Computing (2)

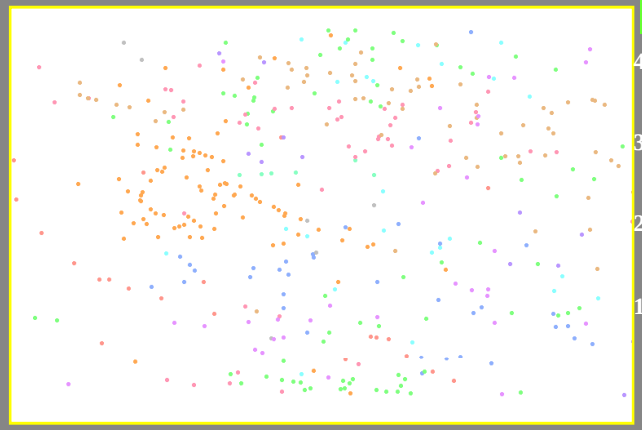


2010

Evolution of CCS Scheme

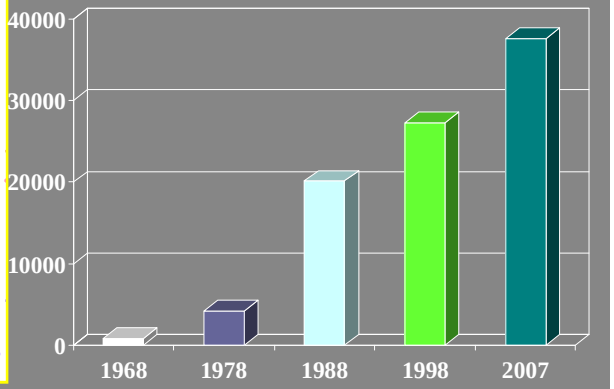


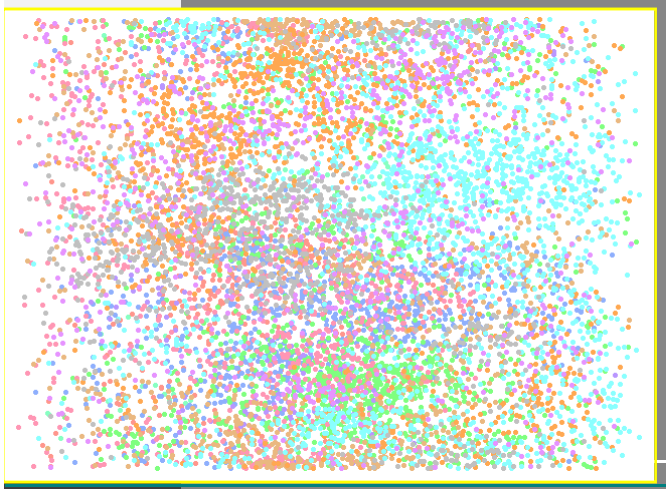
1968



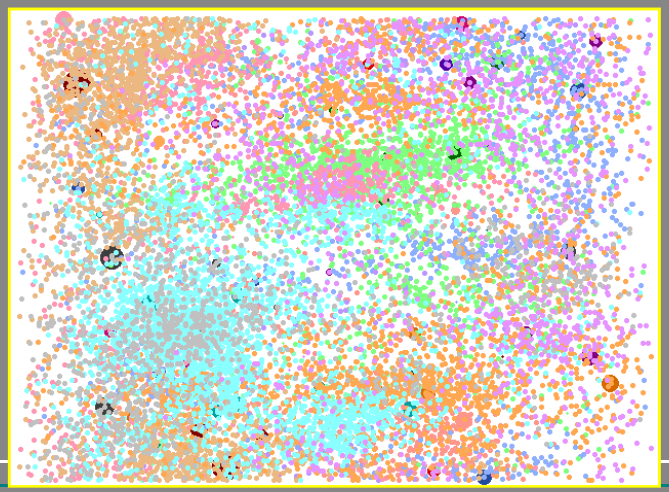
1978

Longitudinal mapping

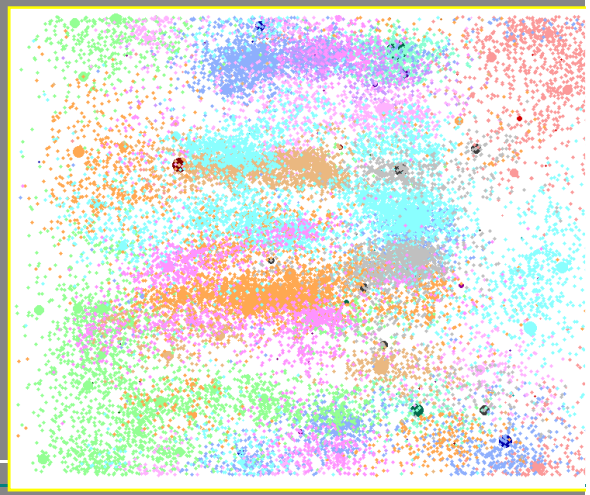




1988

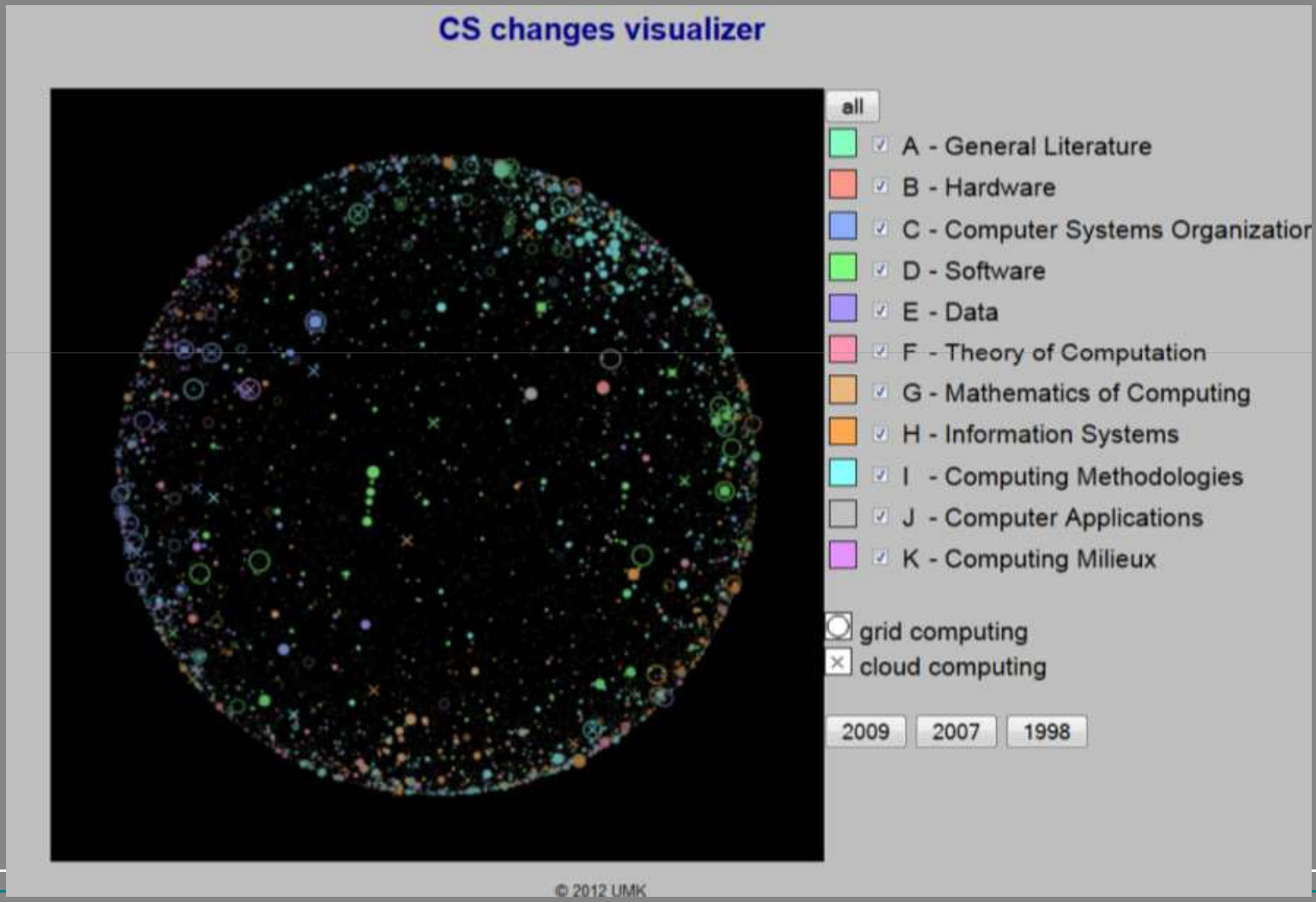


1998



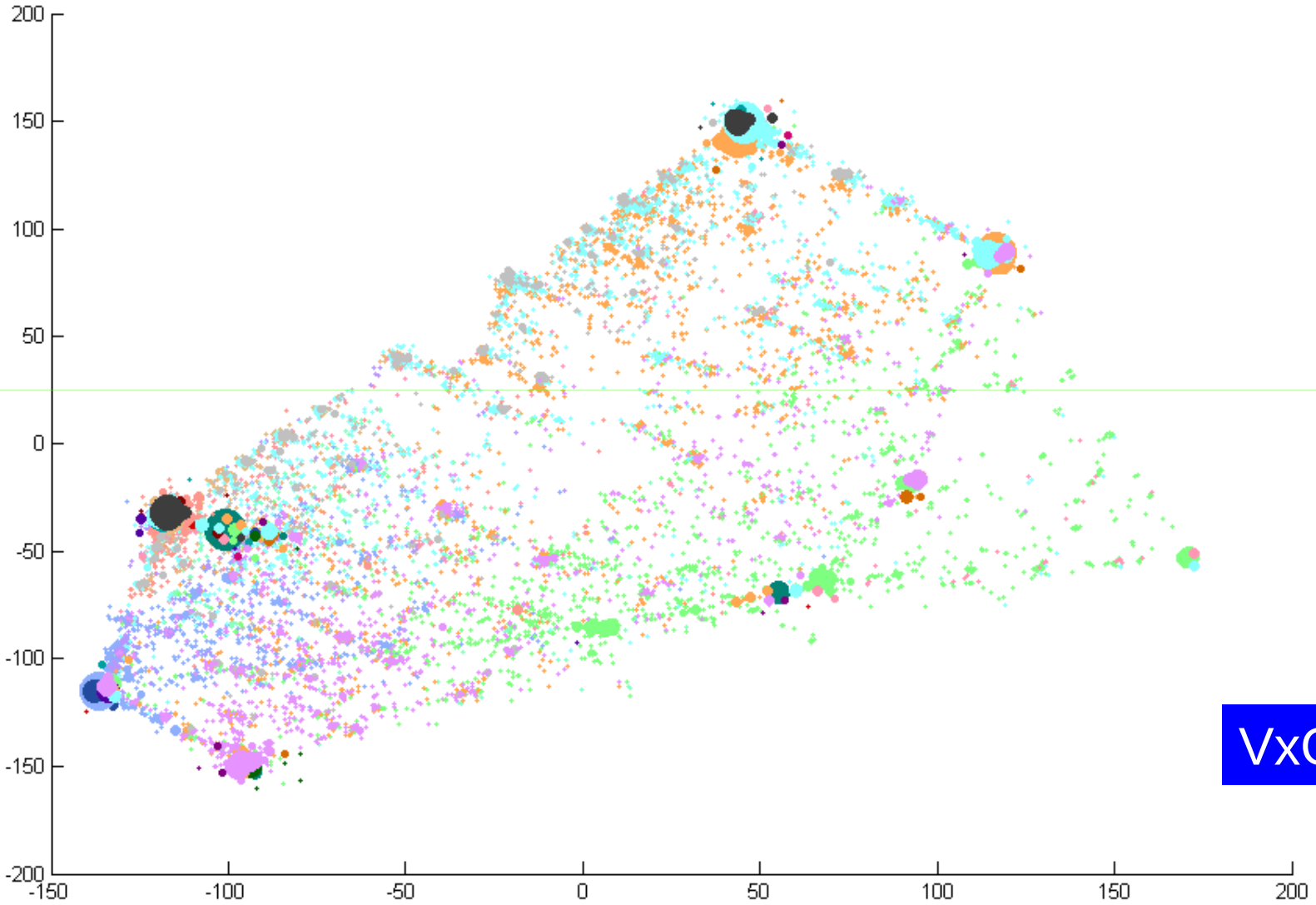
2007

Visual Interface

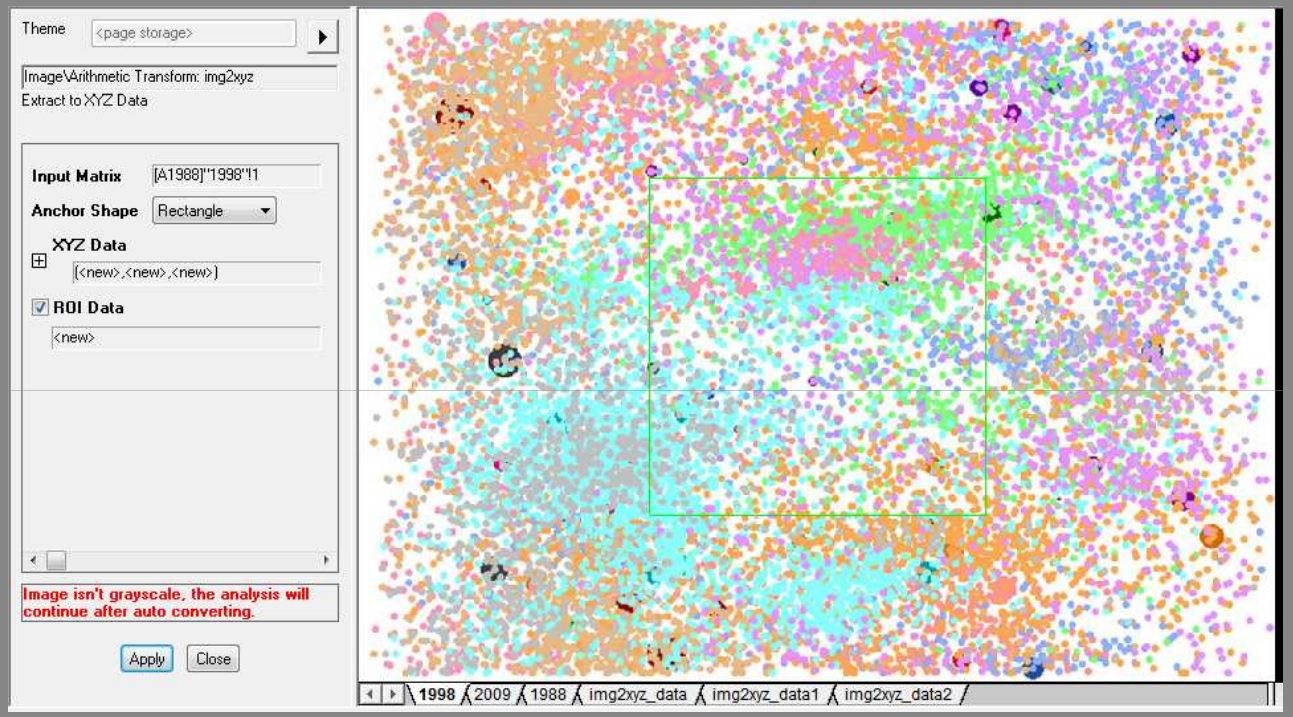


http://www-users.mat.umk.pl/~garfi/vis2009v3/

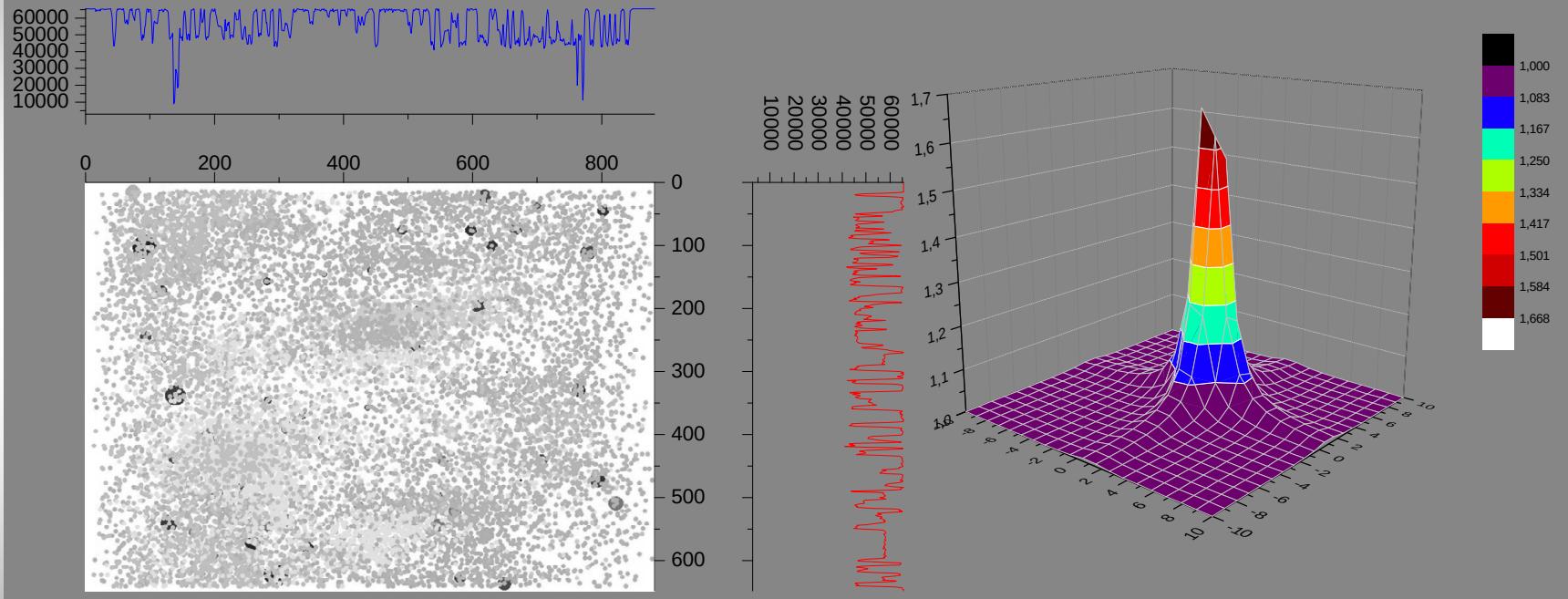
Classical mapping

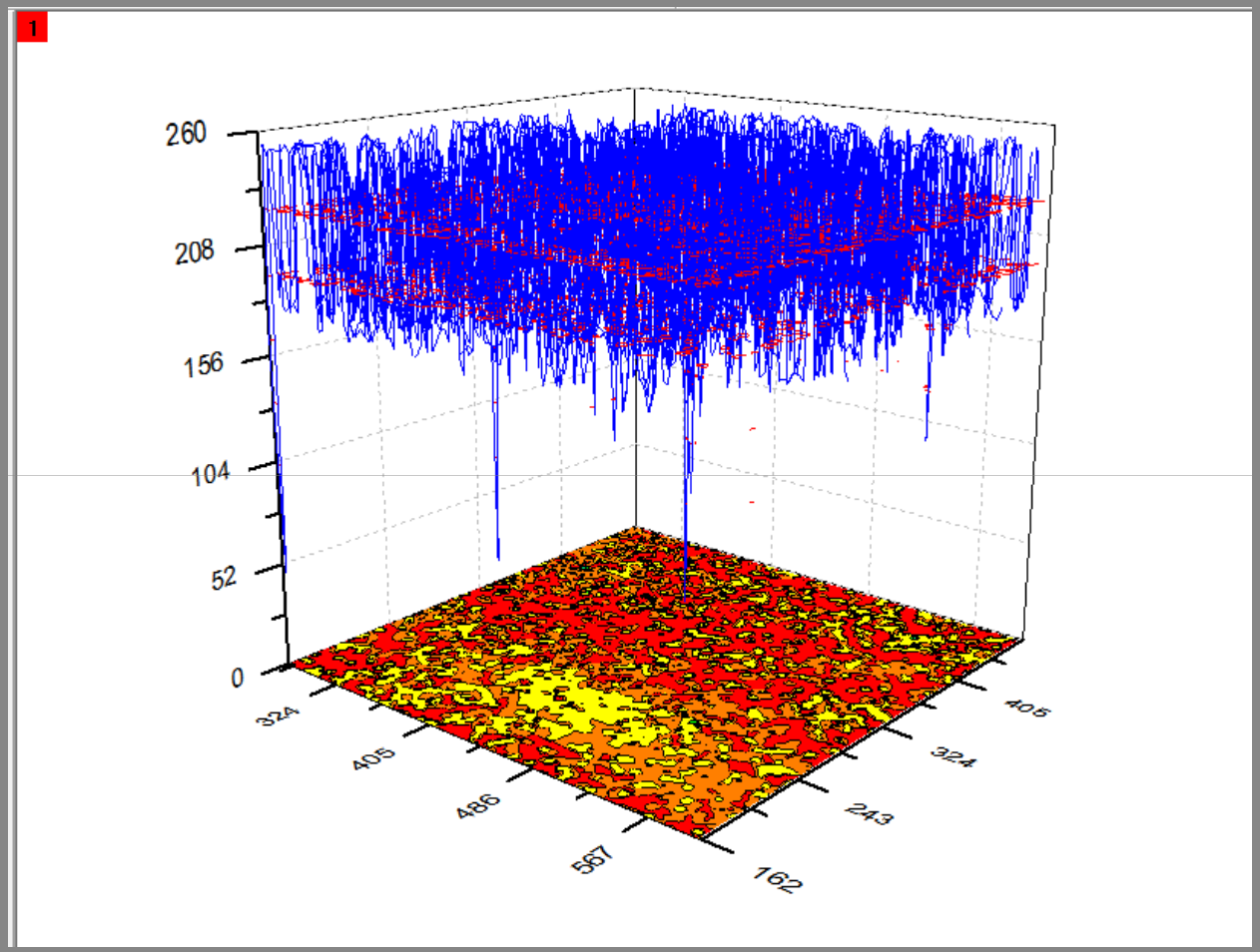


Topological transformations

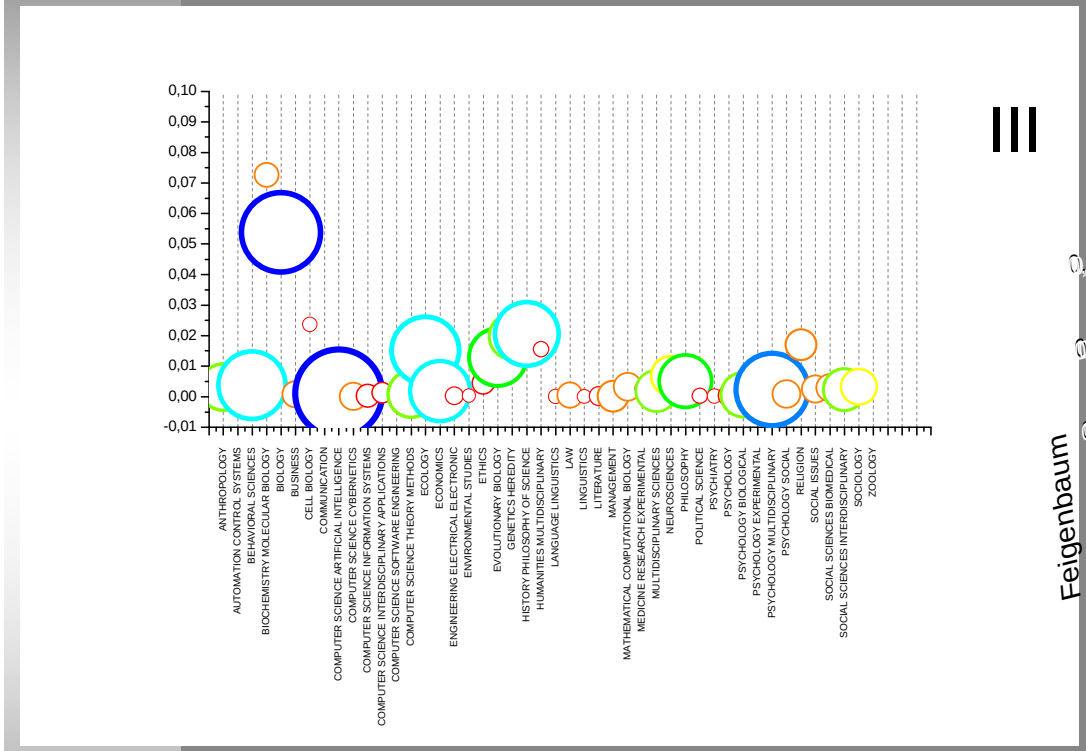


Topological transformations

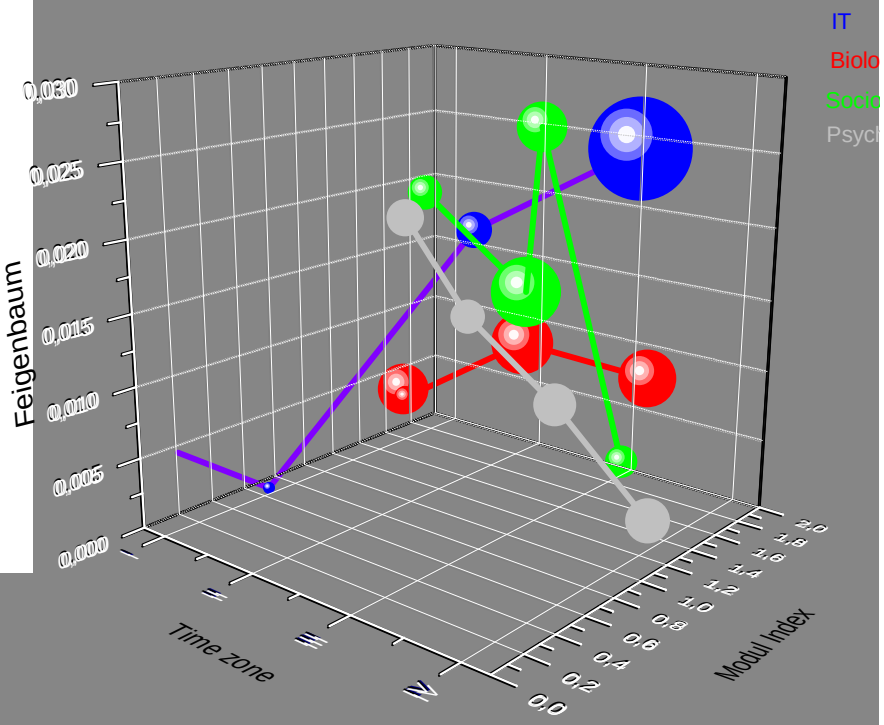



1
260
208
156
104
52
0
324
405
486
567
162
243
324
405

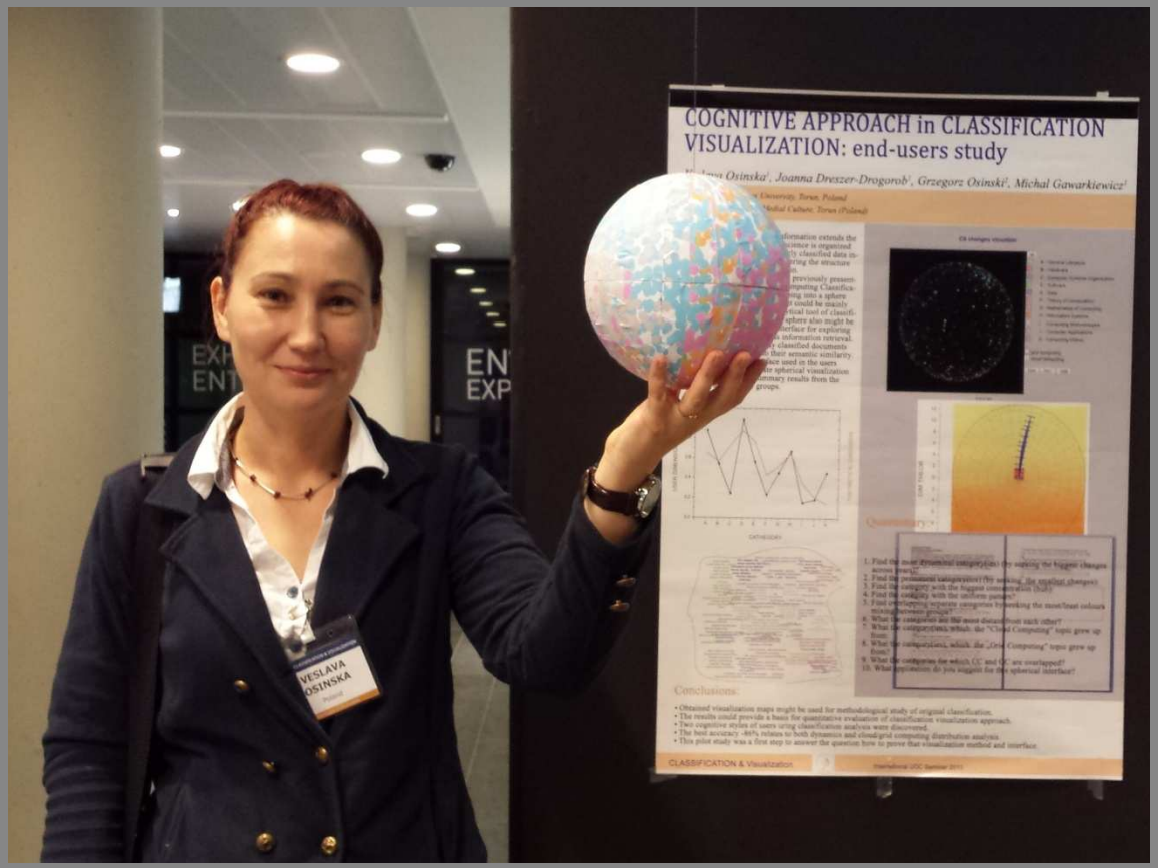
Memetics tracks – current research



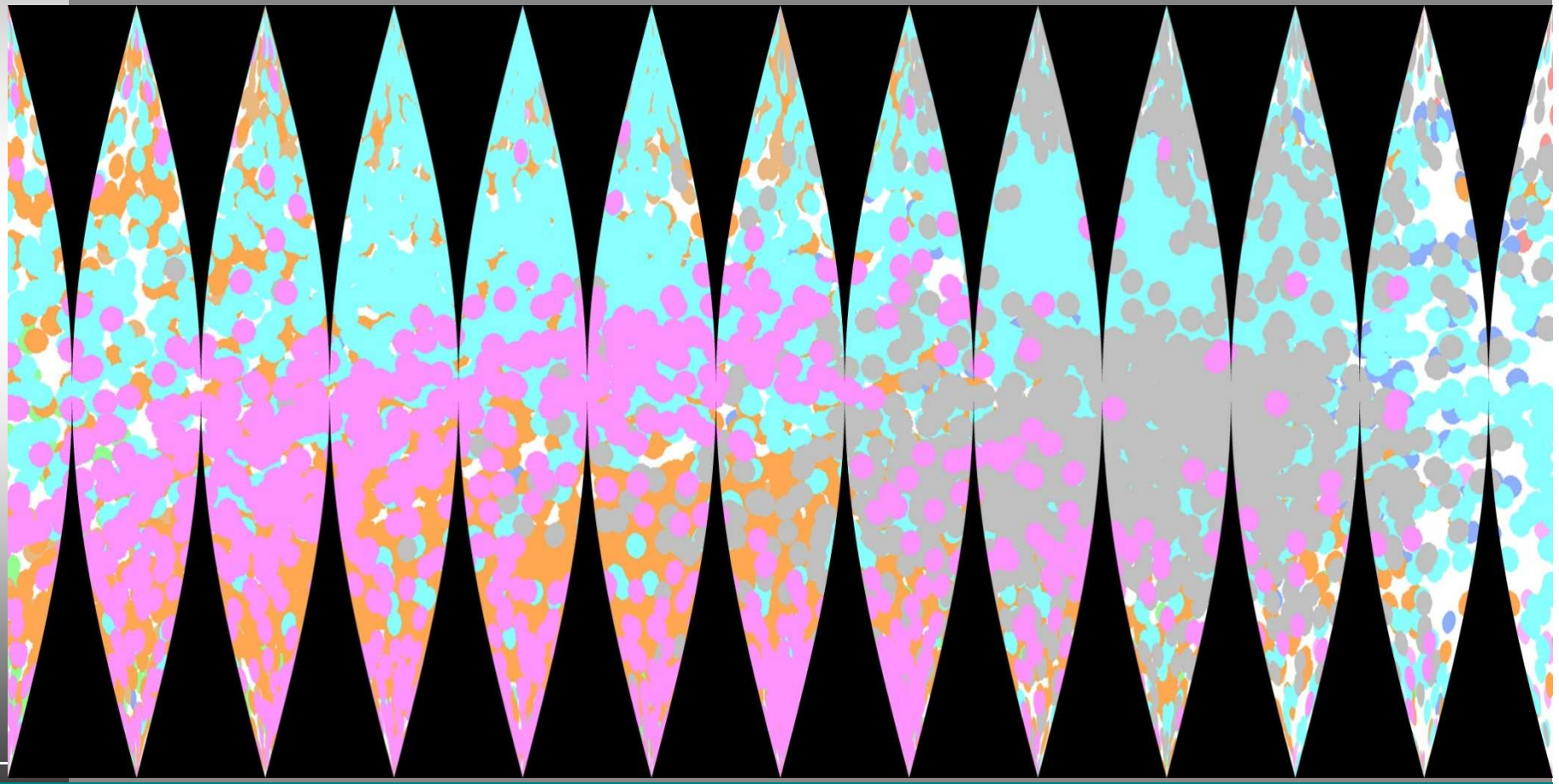
III



3D Model


COGNITIVE APPROACH in CLASSIFICATION VISUALIZATION: end-users study
Conclusions:
CLASSIFICATION & Visualization

3D Model. Gore projection



Discussions

- Visualization maps have an underestimated potential in domain analysis
- Dynamics of changes (not only in time)
- Topology, geography knowledge
- Visualization interface
- Additional quantitative parameters for maps evaluation

Thank you for attention

wieo@umk.pl