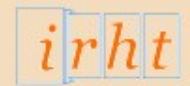


## Spatial Exploration Tools in the Graphem Project

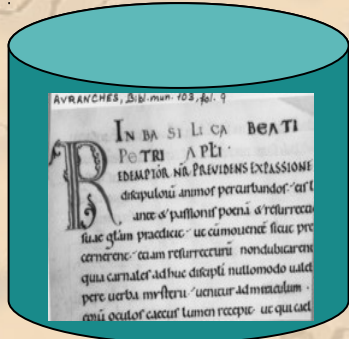
Matthieu EXBRAYAT

Laboratoire d'Informatique Fondamentale d'Orléans



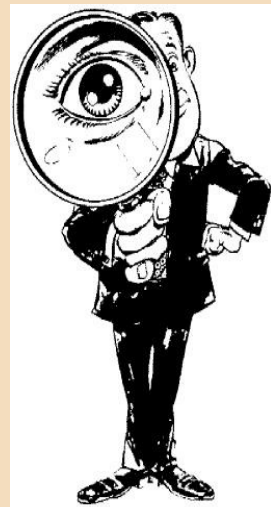
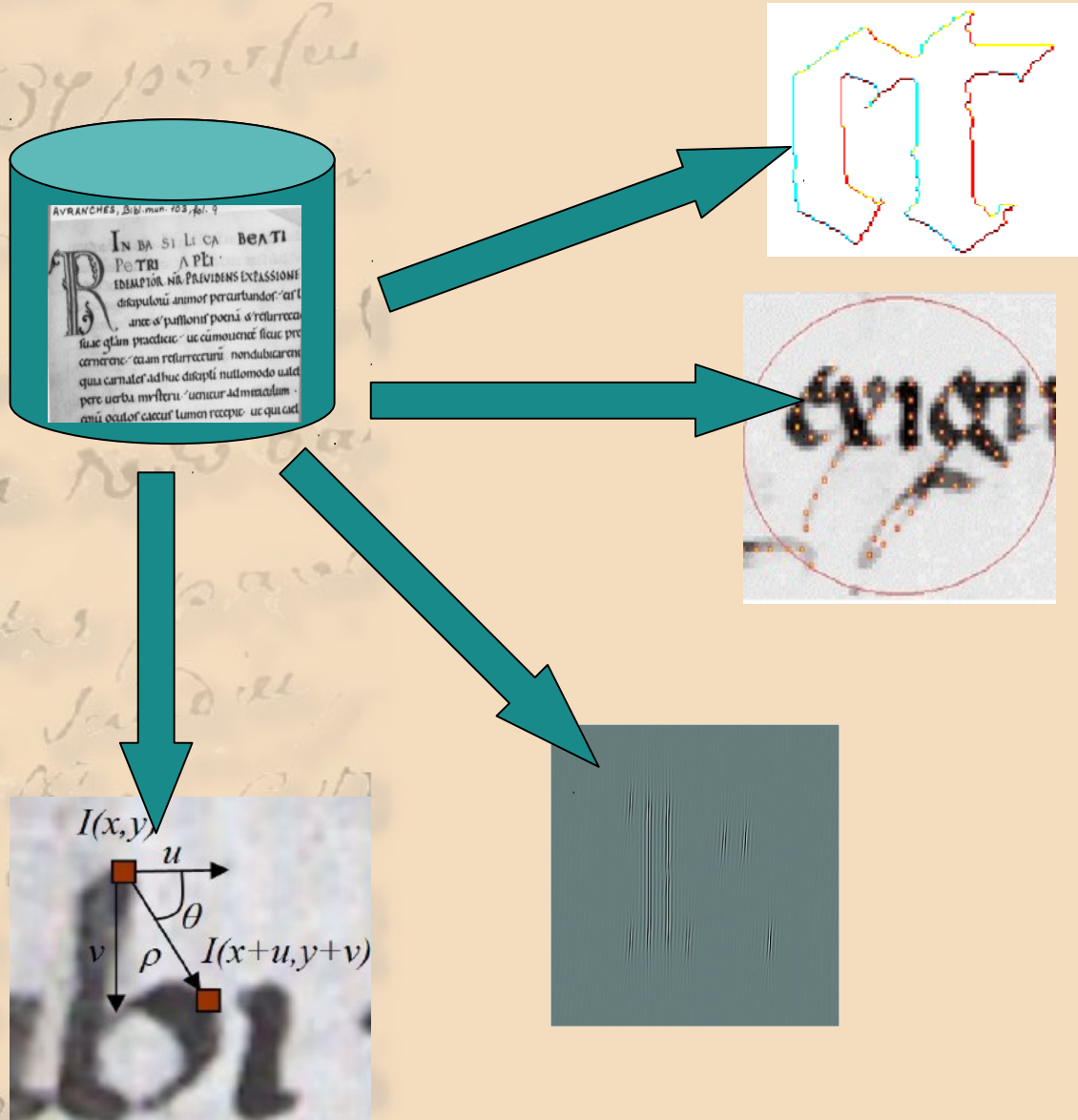
# Overview

Graphem



# Overview

Graphem



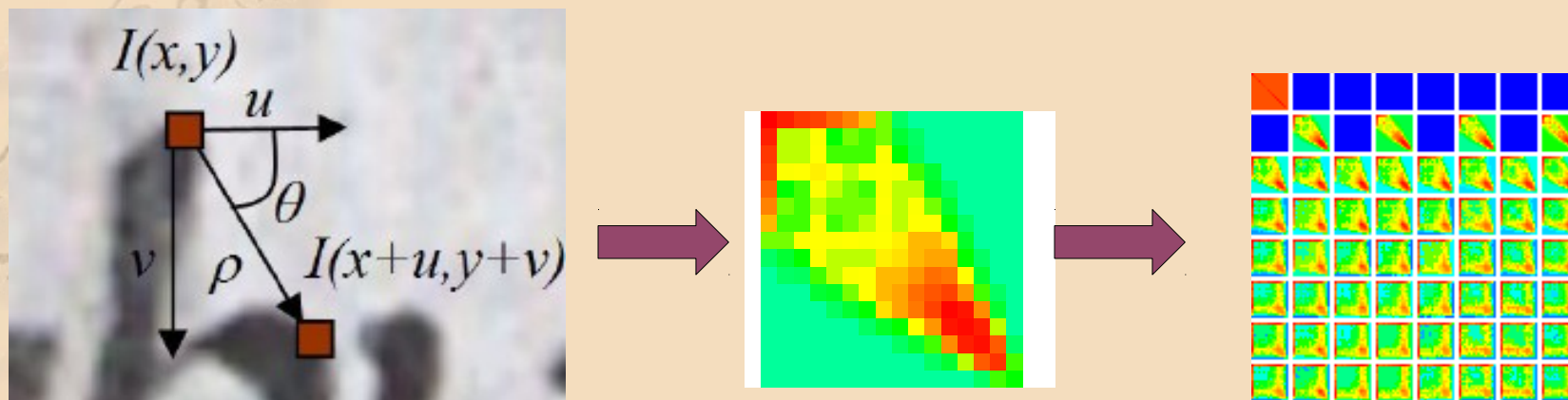
# Co-occurrence matrix (LIRIS)

Describing the texture of a picture

- How do pixels compare to their neighbors ?

At various scales

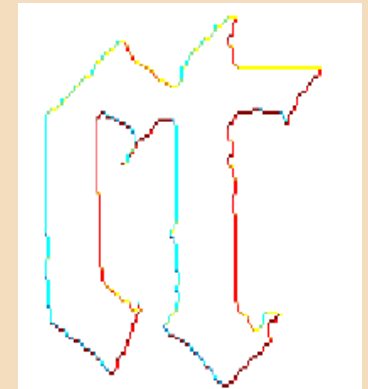
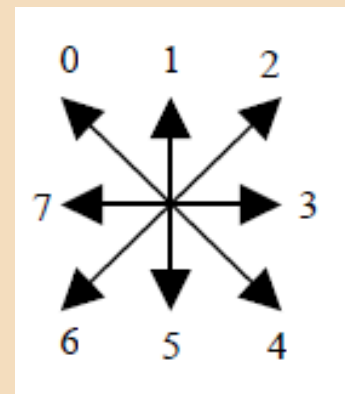
- Very close neighbors and not-so-close ones



# Contours and Freeman's codes (LIPADE)

How to describe the contour of a shape ?

- Starting from a given pixel
- How to go to the next one ? (8 directions)



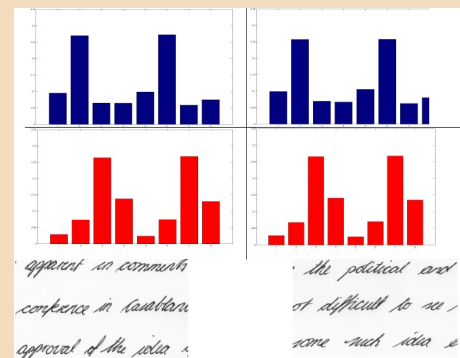
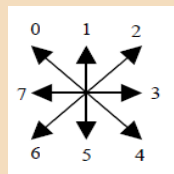
4	4	3	3	1	1	2	2
---	---	---	---	---	---	---	---



# Using Freeman's codes

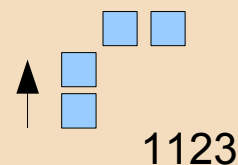
Samples must be described by features

- Counting the percentage of each direction
- Counting the changes in direction



Is this enough ?

- More sophisticated features are needed
- Identifying and counting longer patterns
  - e.g. three or four successive pixels
  - How many and which ones are relevant ?

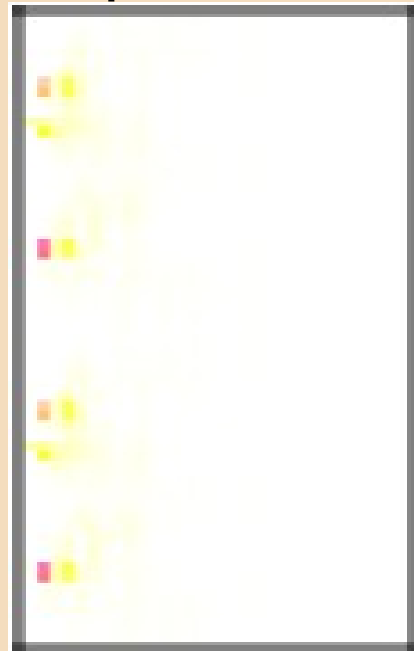
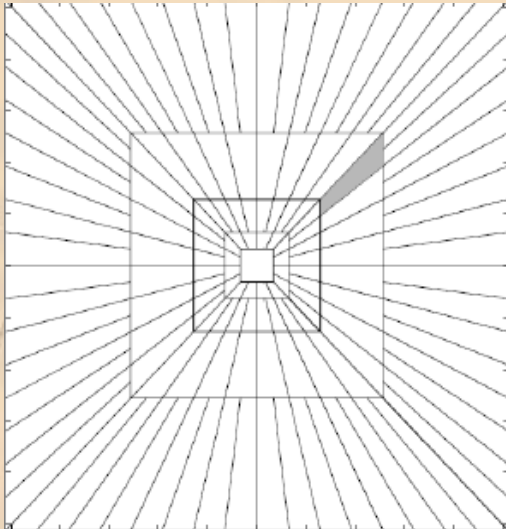


# Curvelets in two words (LIRIS)

A picture can be seen as a set of signals

Curvelets are a (powerful) way to express these signals

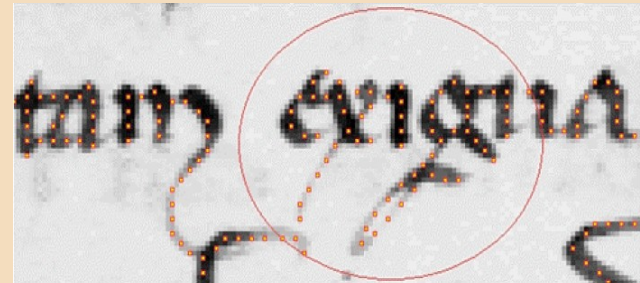
- Frequency, direction, place



# Strokes and median-axis (LIPADE / LIRIS)

## Detecting and viewing strokes

- Moving along the median axis
  - Skeletonizing vs. directional inertia



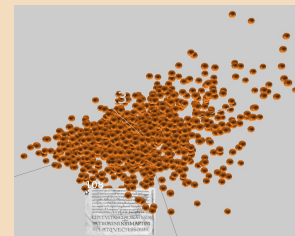
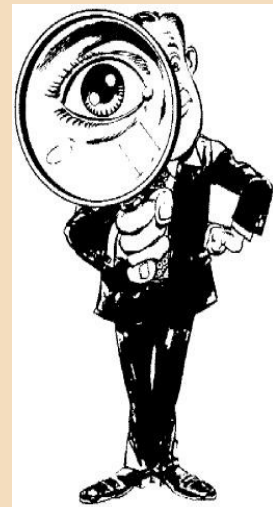
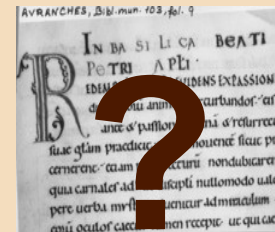
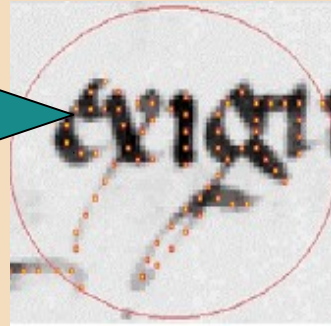
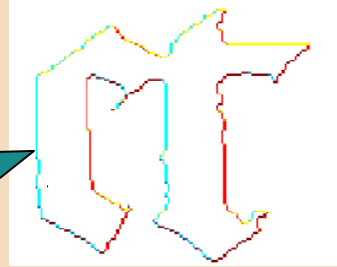
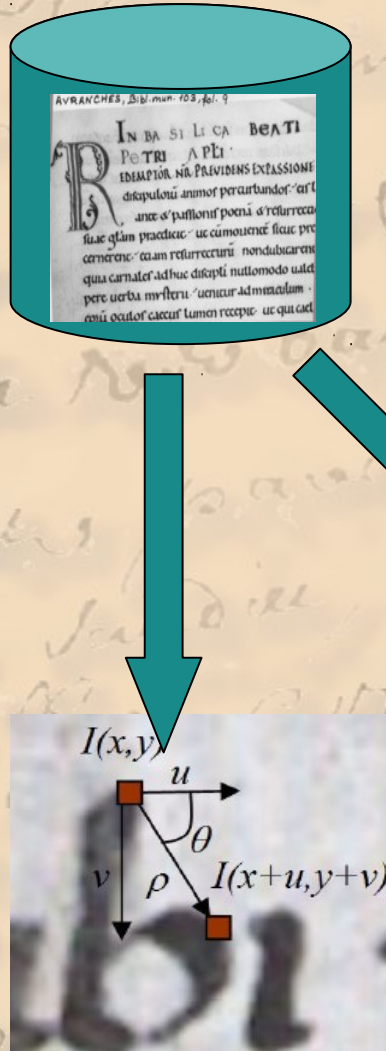
## Stroke-based comparison ?

- Extracting features from the shape of strokes



# Overview

Graphem



# Image retrieval (LIPADE / LIRIS)

Query

IRHT\_P\_000821.jpg\_yosef.jpg Open

Parameters

F1 1 F2 1 F3 1

F4 1 F5 1 F6 1

F10 1 F11 1 F12 1

F13 1 F14 1

Number of Results to Show 10 GO

Results

Rank	Image Name	Distance
1	IRHT_P_000821.jpg_...	0.0248344
2	IRHT_P_000164.jpg_...	0.039139
3	IRHT_P_003713.jpg_...	0.0409129
4	IRHT_P_000910.jpg_...	0.0418935
5	IRHT_P_000196.jpg_...	0.04246
6	IRHT_P_000145.jpg_...	0.0430841
7	IRHT_P_000121.jpg_...	0.0432004
8	IRHT_P_000685.jpg_...	0.0440552
9	IRHT_P_000872.jpg_...	0.0452475
10	IRHT_P_000019.jpg_...	0.06313
25	IRHT_P_003750.jpg_...	0.06313
50	IRHT_P_003859.jpg_...	0.0779638
100	IRHT_P_002131.jpg_...	0.108886
150	IRHT_P_000089.jpg_...	0.143952
200	IRHT_P_002100.jpg_...	0.199134
250	IRHT_P_000351.jpg_...	0.252744
300	IRHT_P_000166.jpg_...	0.52087

Images

Query Image

Z:\Work\Graphem\Images\IRHT\_P\_000821.jpg\_yosef.jpg

View

100%

Full

40 %

Result Image:

Z:\Work\Graphem\Images\IRHT\_P\_003713.jpg\_yosef.jpg

View

100%

Full

48 %

Classification

Select as Query

Stop

Distance: 0.039139

Weights for each of the features

Retrieved list of similar images: Ranks, Image Names & Distances

Query Image

Image selected from the retrieved list

# Online image retrieval



CBIR - Cooccurrence  
*Graphem*

[Accueil](#) | [Choix du moteur](#) | [Site web du projet](#)

0 > >> >>>

Requête :

Número d'image  
IRHT\_P\_000001

[Nouvelle recherche](#)

+

-

1:1

11%





Résultats avec les cooccurrences :

IRHT\_P\_000001



IRHT\_P\_005910



IRHT\_P\_004113



IRHT\_P\_002677



IRHT\_P\_003985



IRHT\_P\_004456



IRHT\_P\_002822



IRHT\_P\_004160



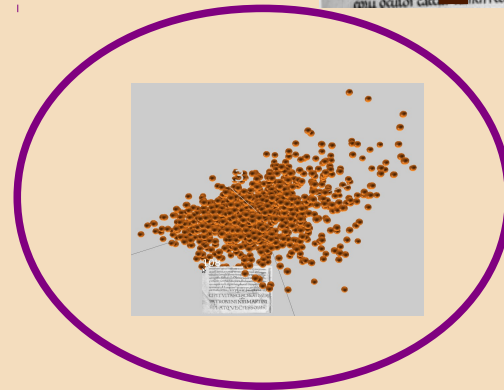
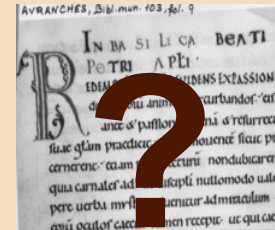
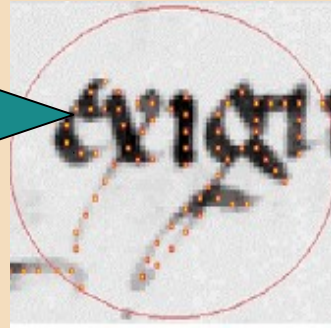
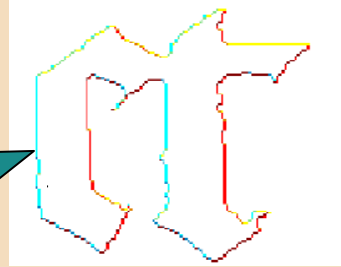
Moteur : Ikram Moalla, Frank LeBourgeois. Interface : Yann Leydier, Guillaume Joutel

# Results

- Cooccurence matrices work at best
- Some more results with strokes awaited
- Parameterizing is neither always available, nor clearly explainable / connectable with paleographic elements



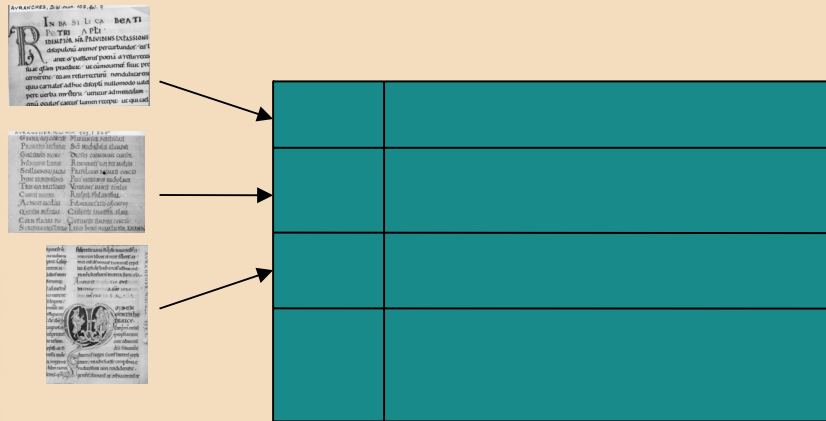
# Frankfurt



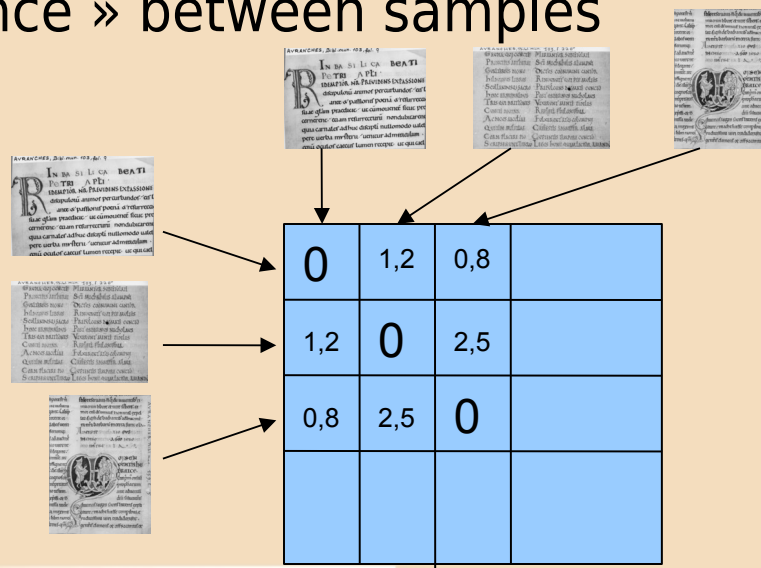


# Data exploration (LIFO)

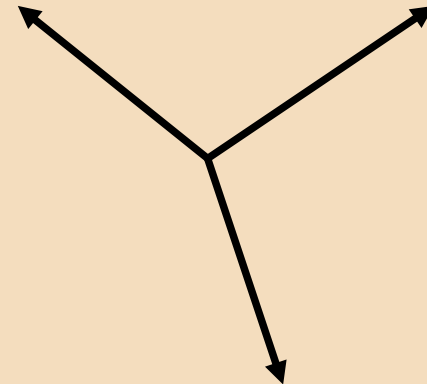
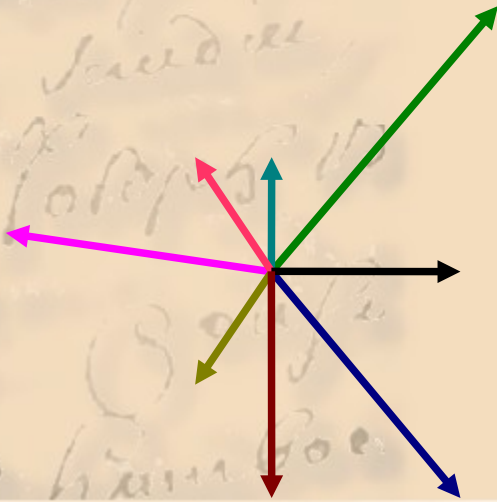
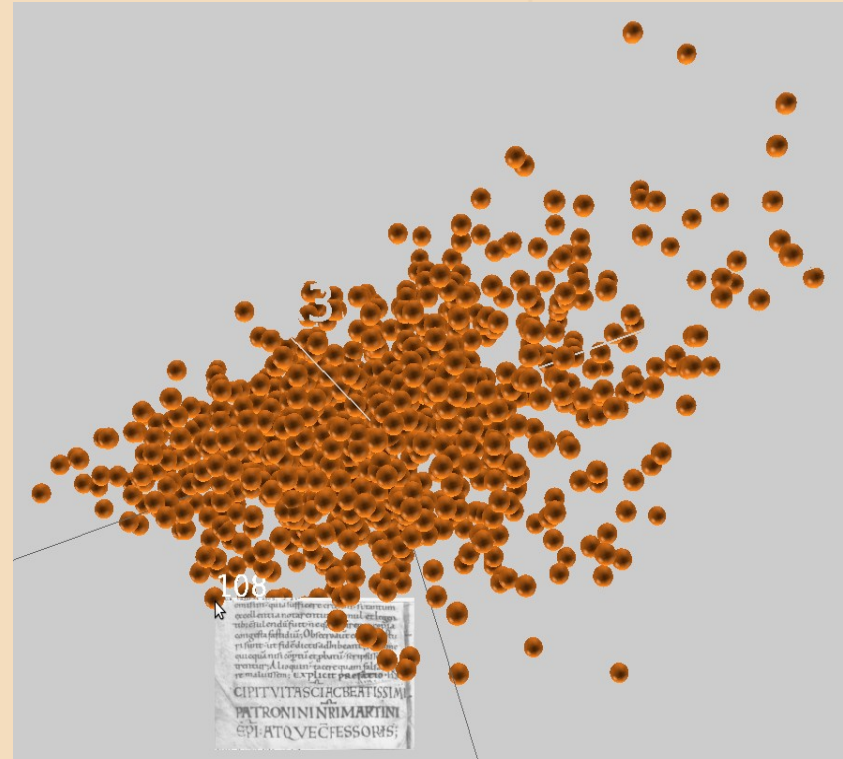
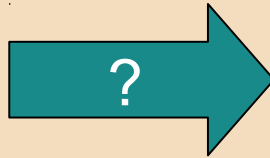
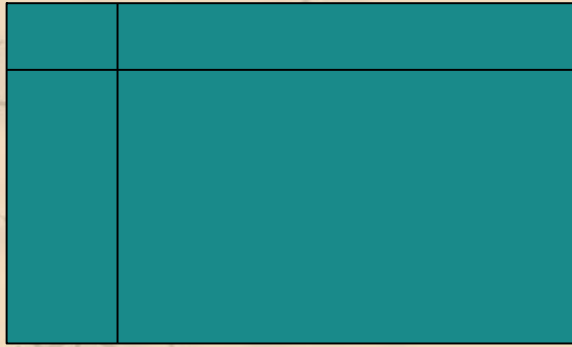
- Input : data in spreadsheets / tables
  - Numerical features



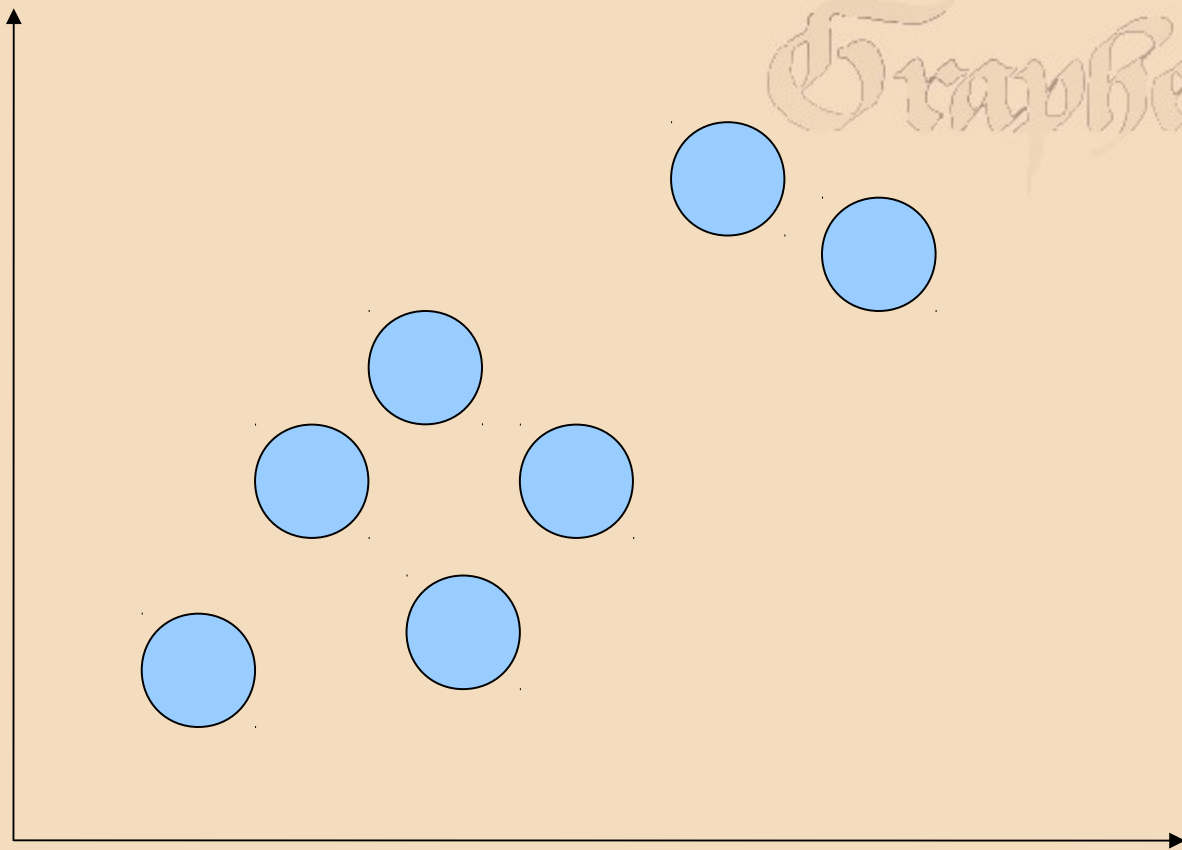
- « Distance » between samples



# 3D projection : Principle

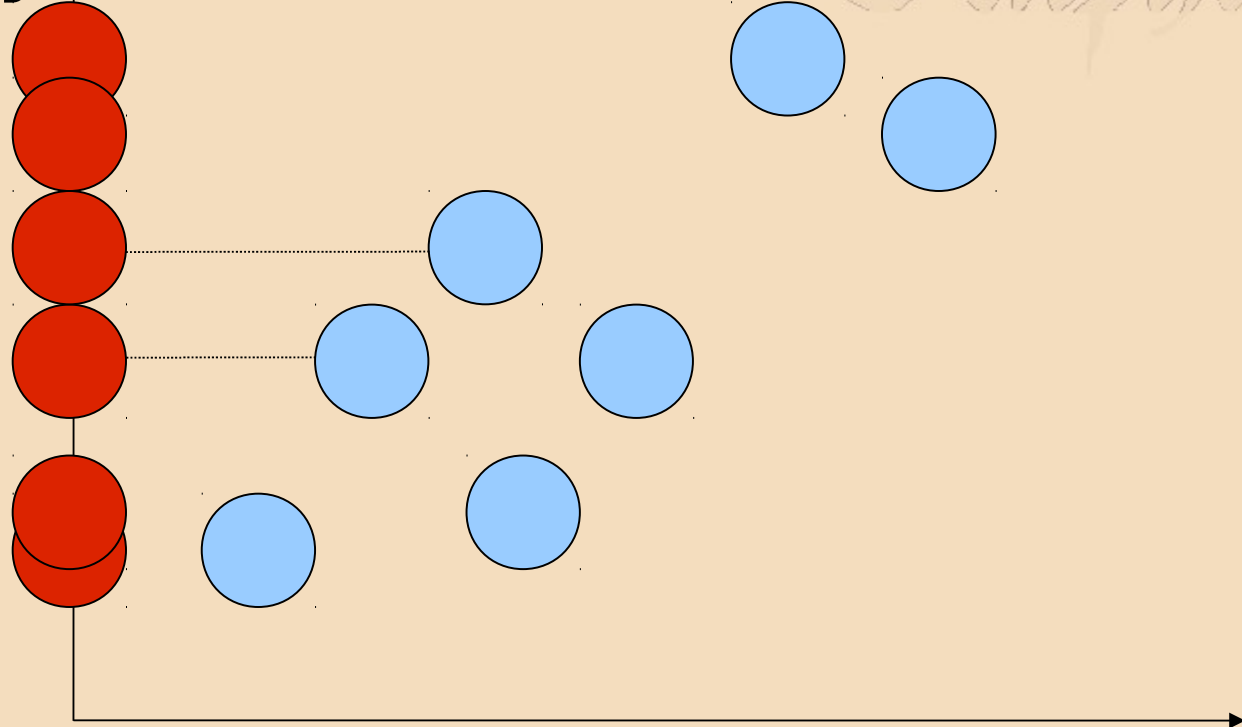


# Intuitively



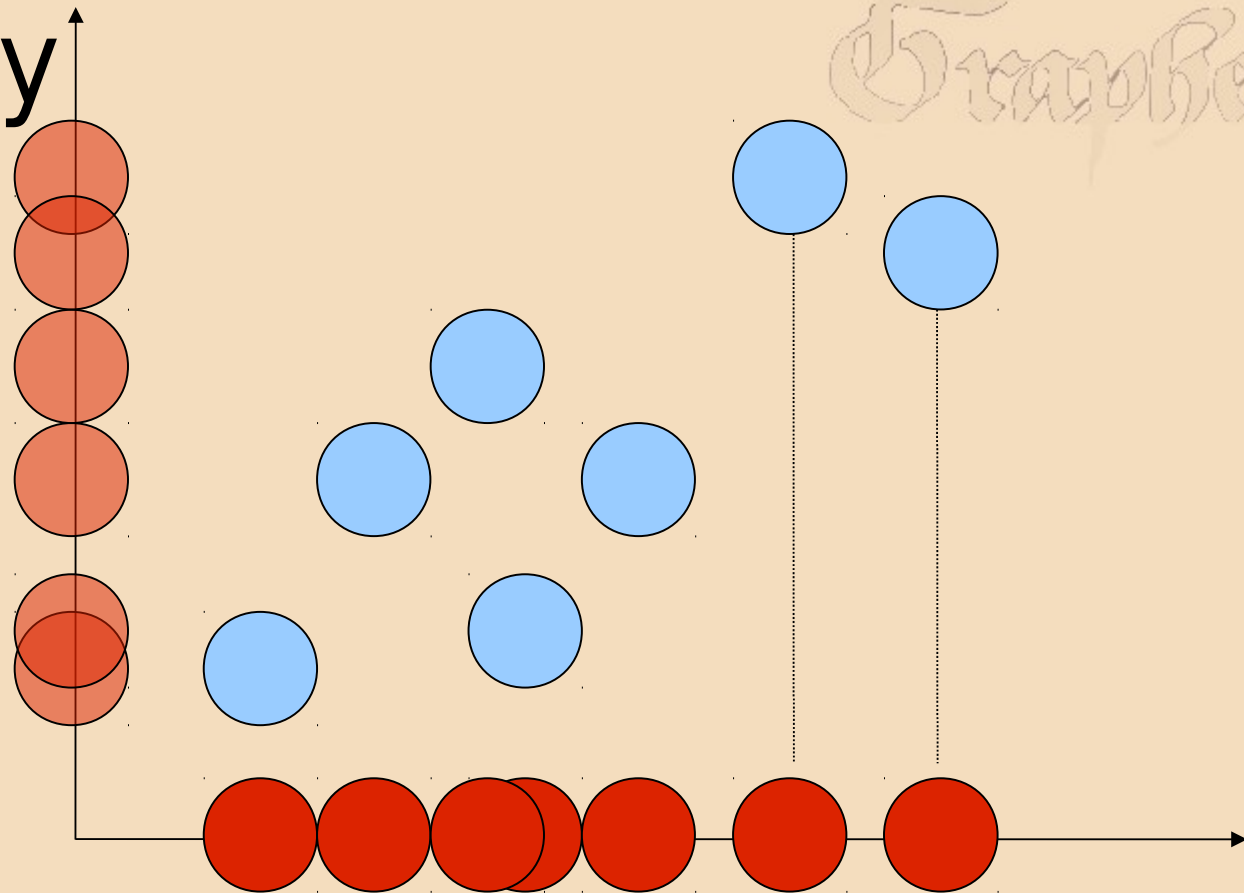
- Objects described by two (numerical) features
- How to « keep » a single dimension

# Intuitively



- choosing a subset of features
  - *feature selection*

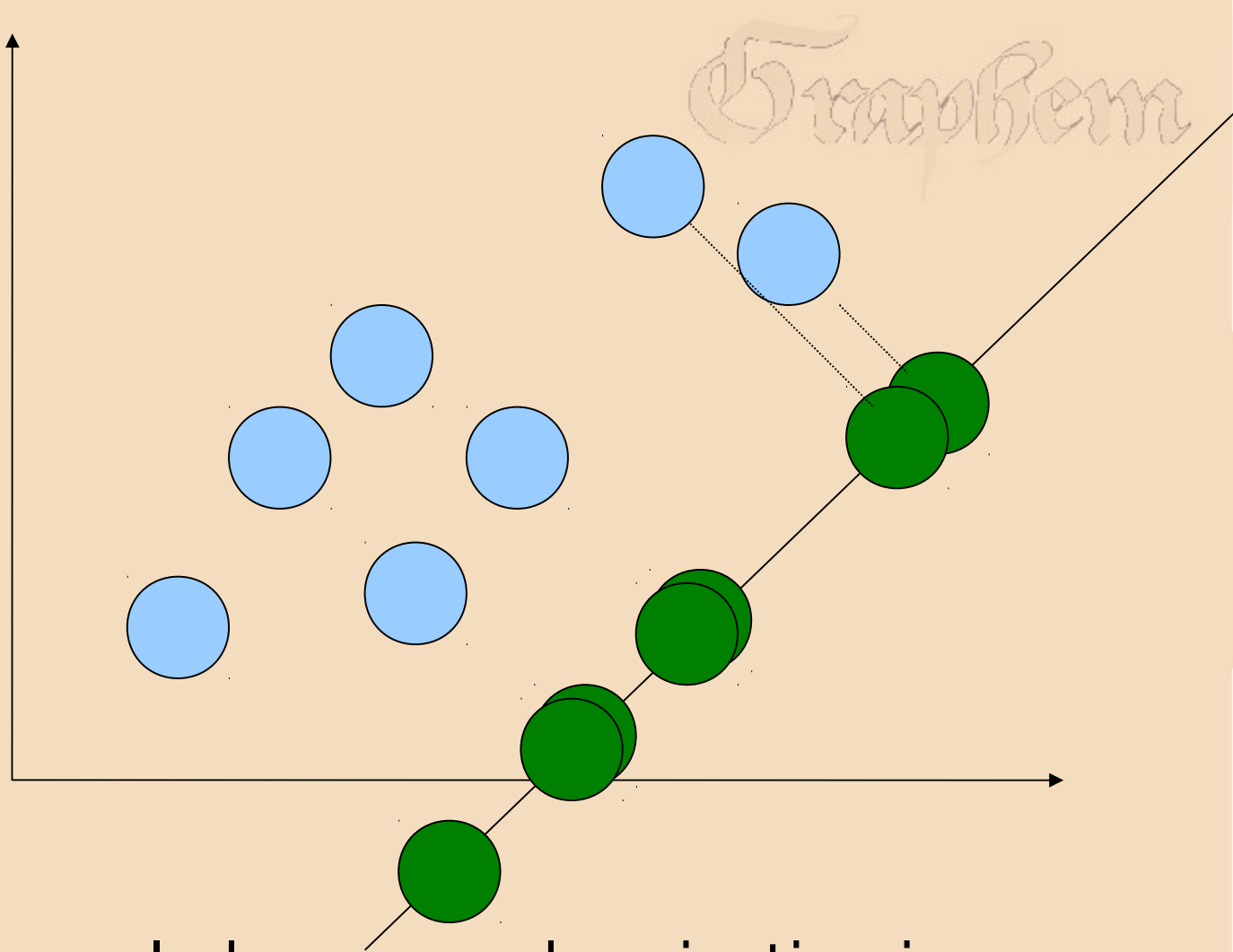
# Intuitively



- Feature selection might not fit
- What are we looking for ?



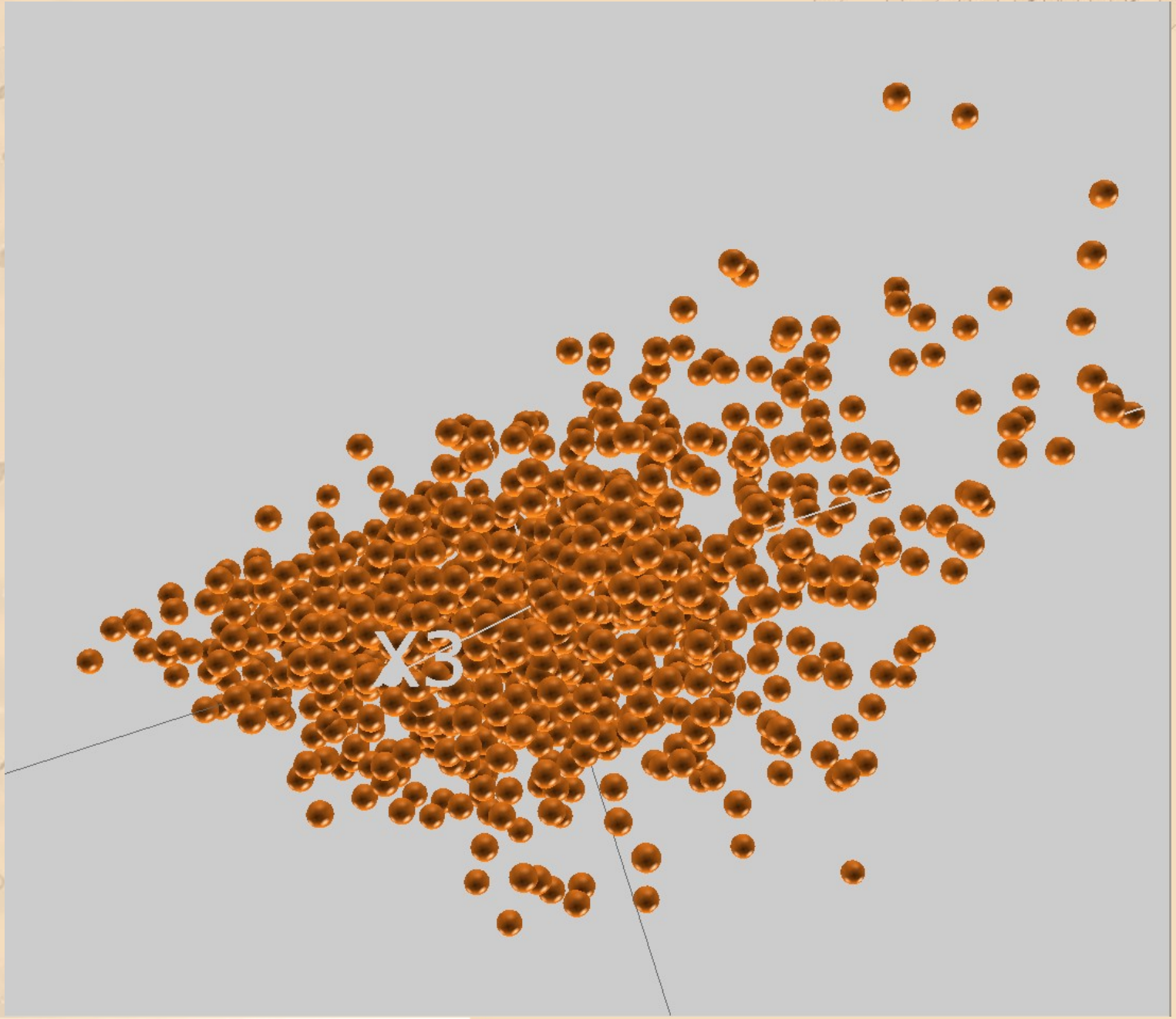
# Intuitively



With no extra knowledge, a good projection is one that preserves scattering / variance at most

Principle Component Analysis (and it's relatives)

# Results



# Results

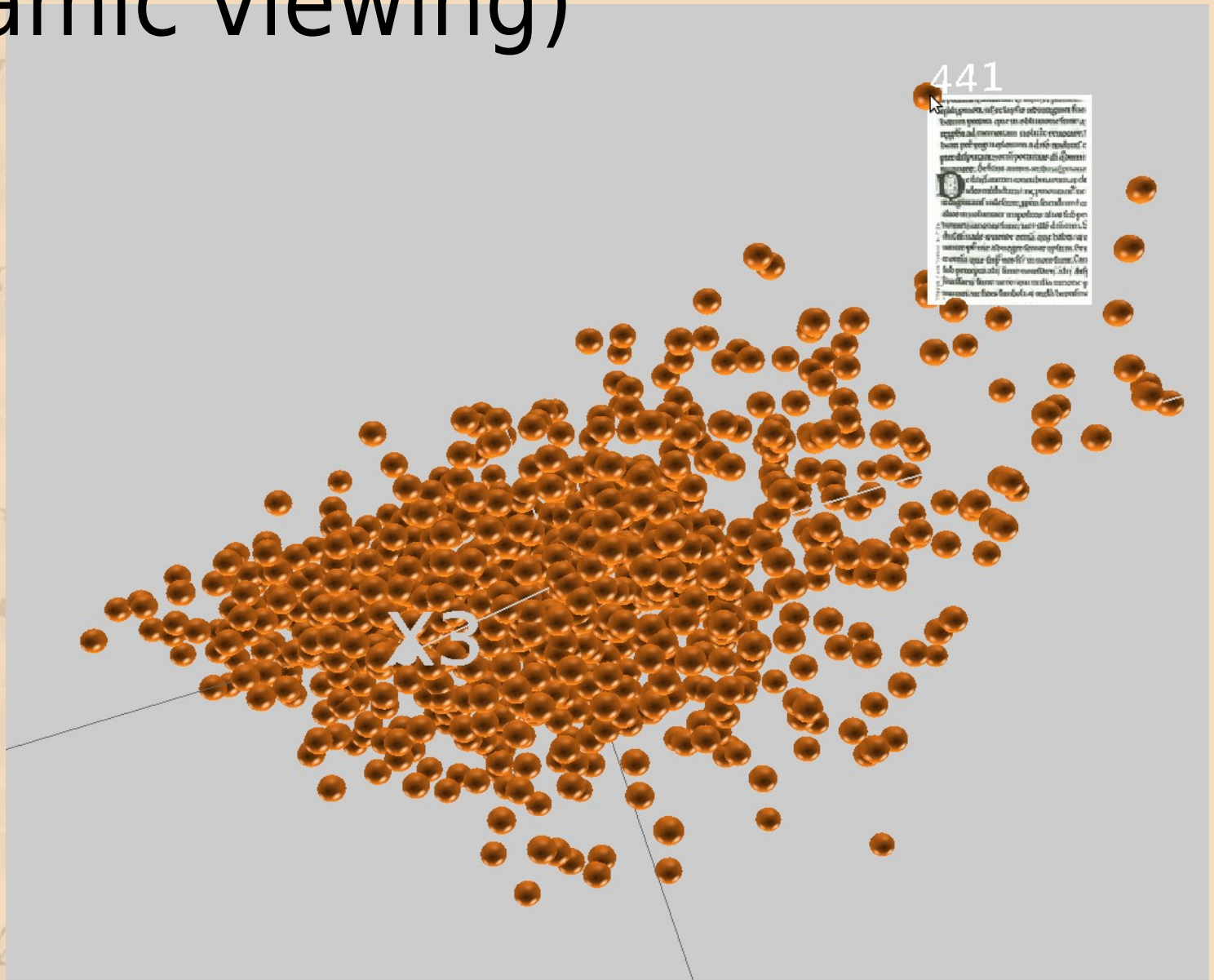
Ergebnis

- ✓ **A global overview**
  - ✓ **Macro-structure**
- × **Readability ?**
  - × **Density**
  - × **Associated data ?**
  - × **Meaning of a global view ?**
- **Additional tools**



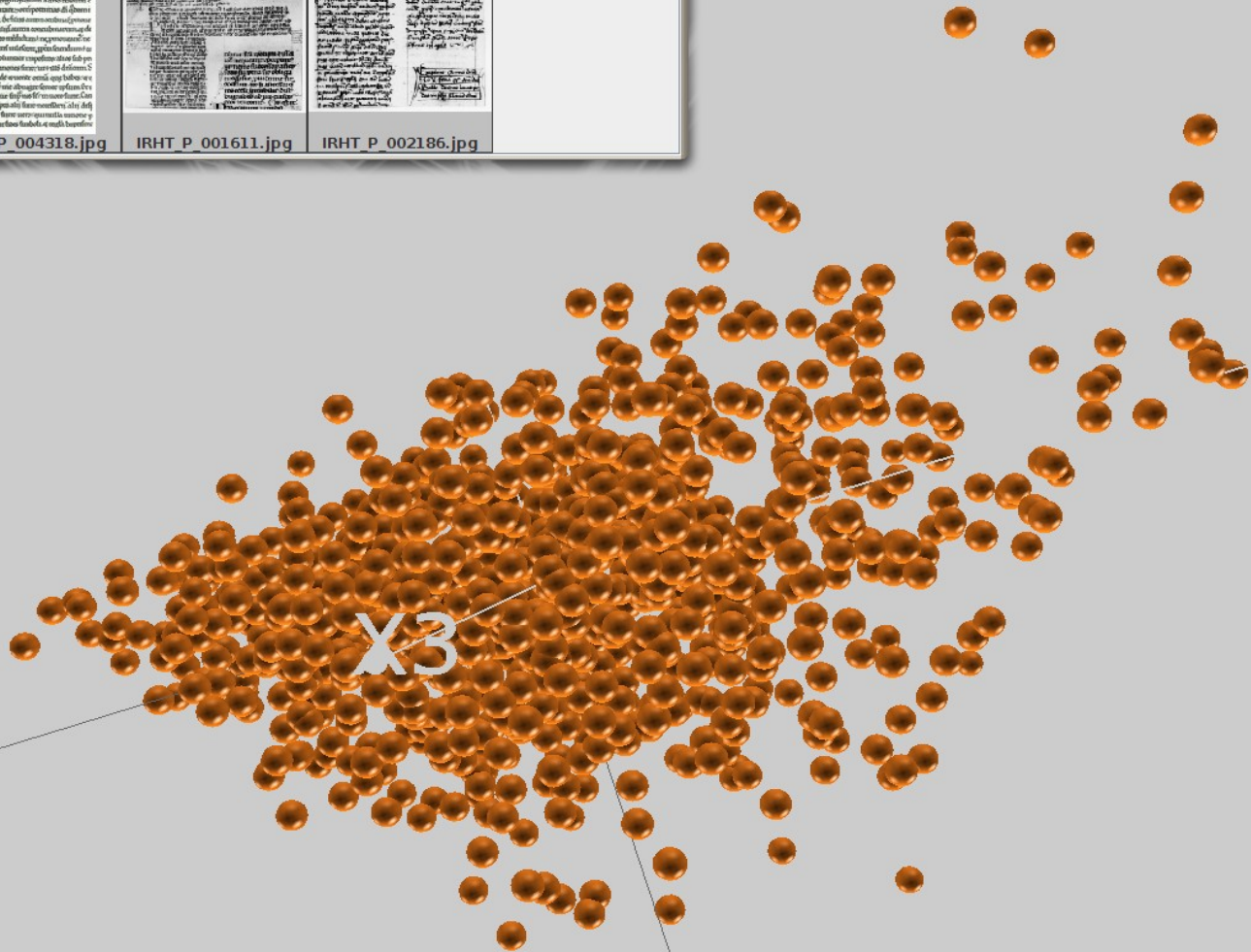
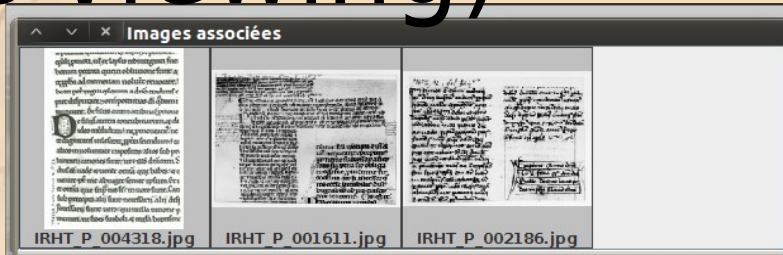
# Corresponding picture (dynamic viewing)

Graphem



# Corresponding picture (static viewing)

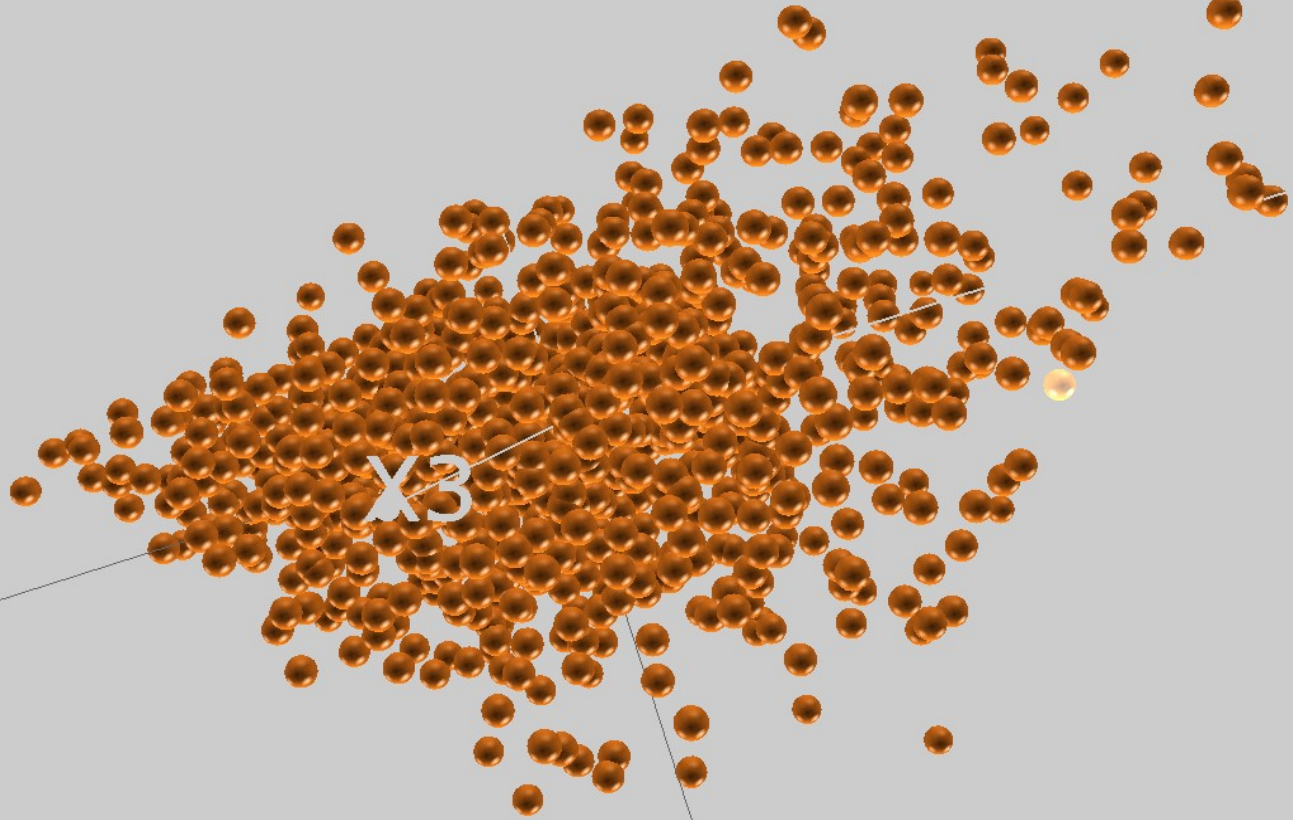
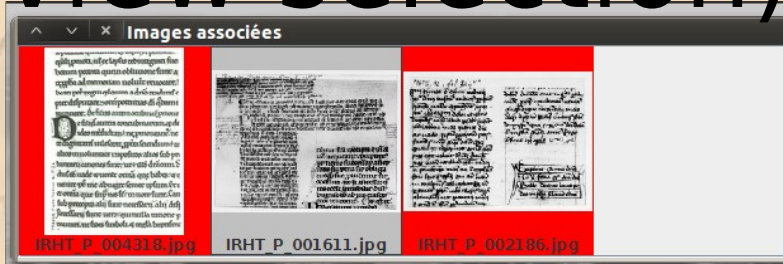
Graphem



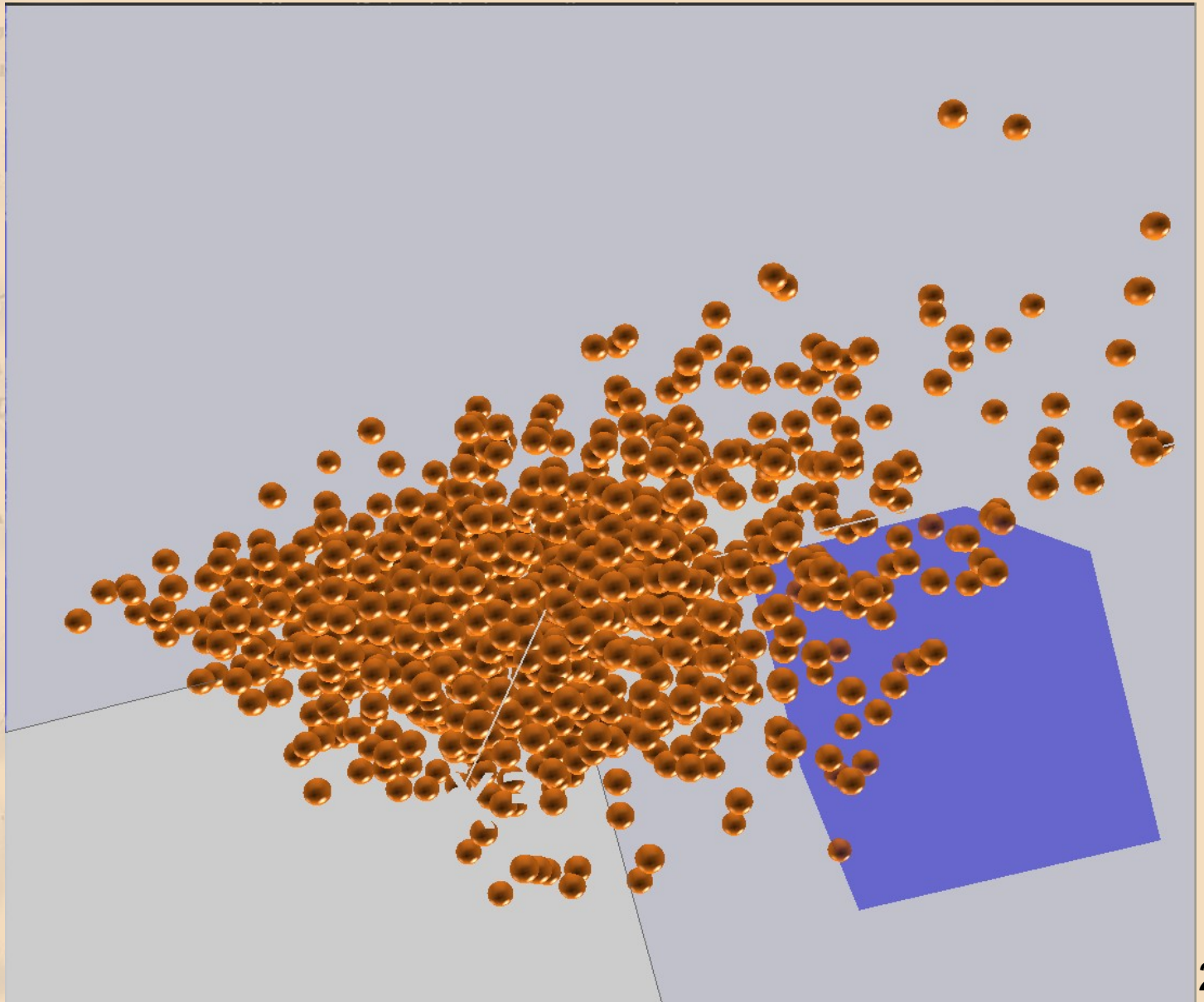


# Corresponding picture (multiview selection)

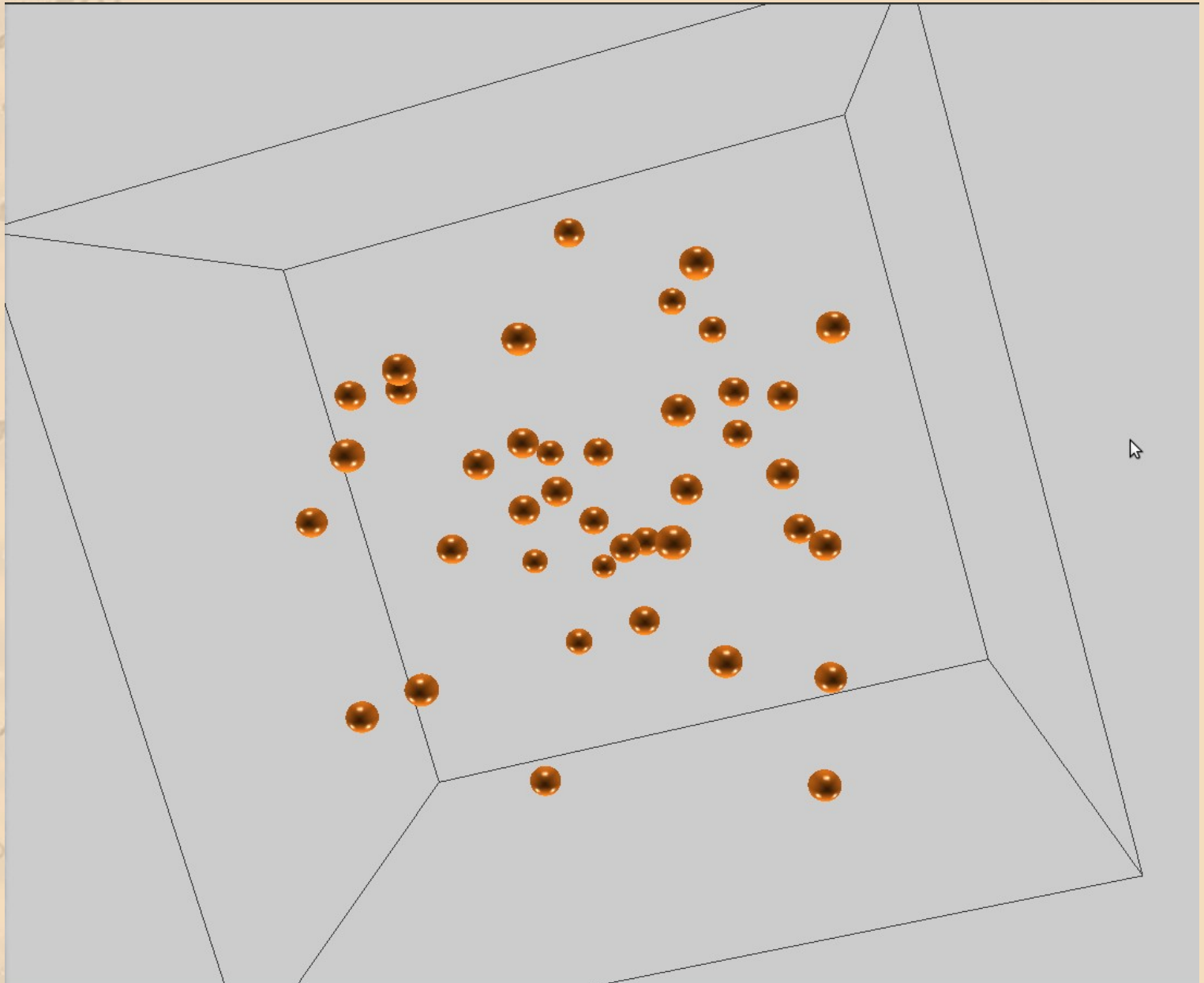
Graphem



# Local subprojection (zoom)

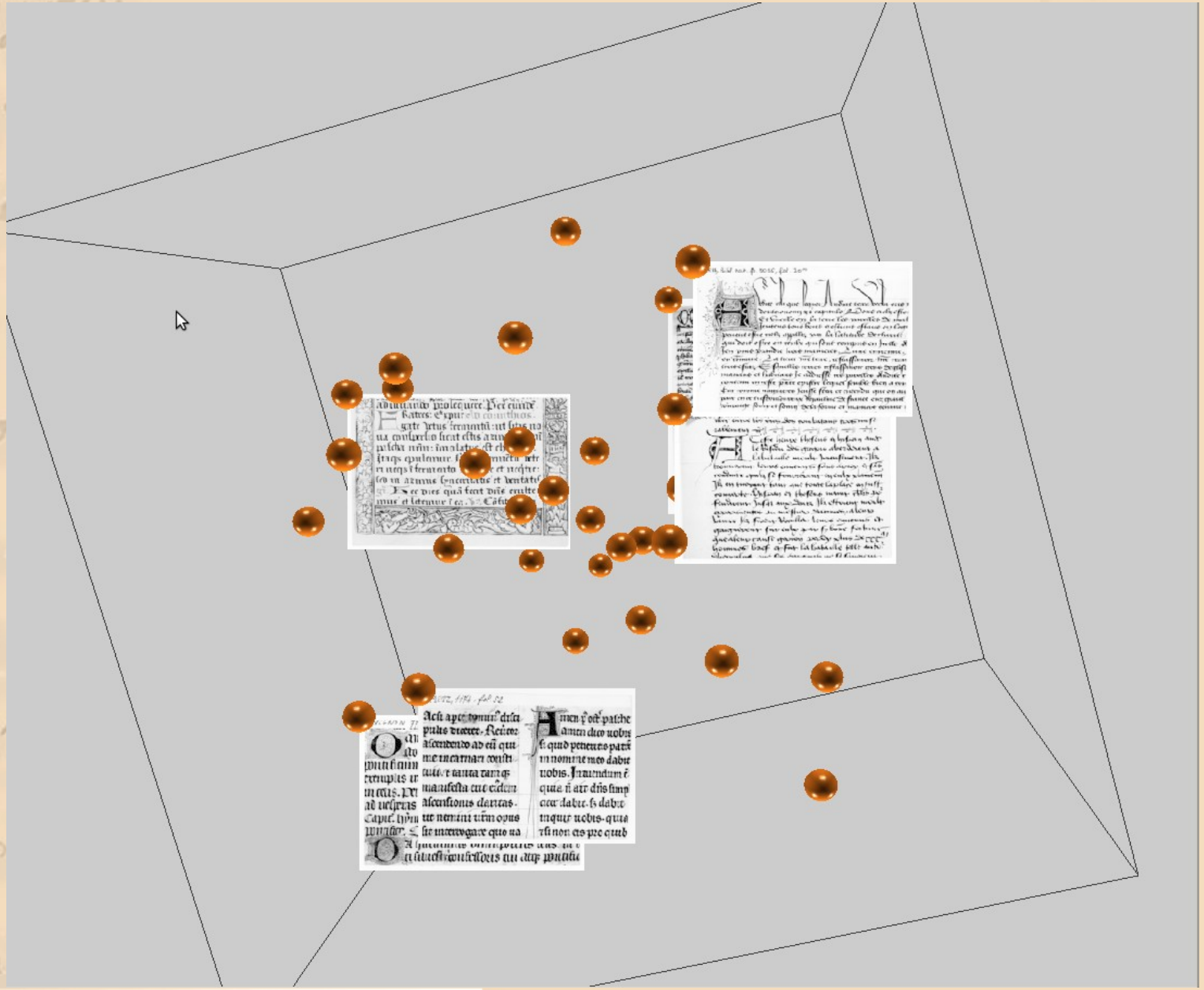


# Local subprojection (zoom)





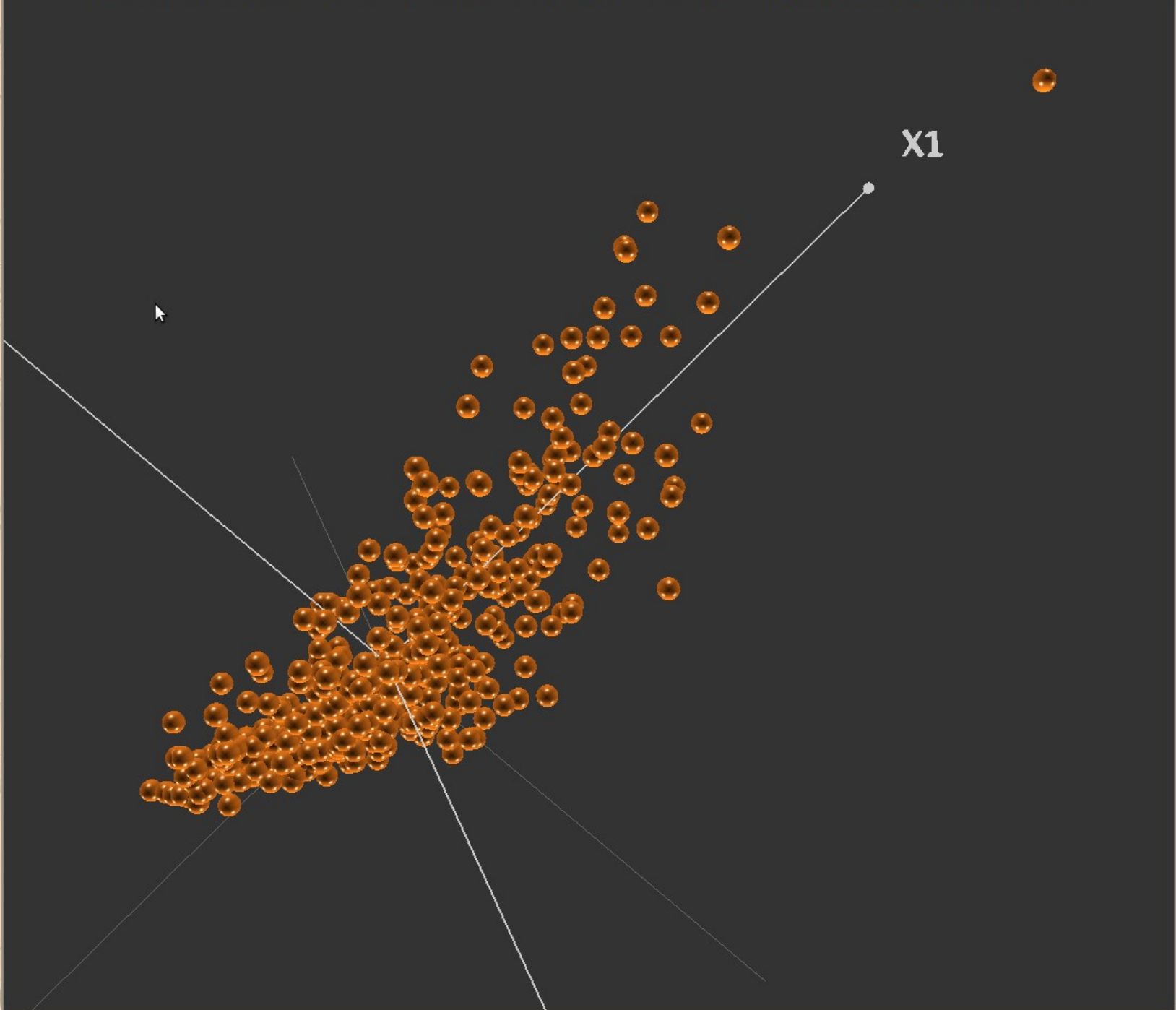
# Local subprojection (zoom)



# Exploring from pictures

- Starting point
  - Global view is too dense
  - Local zoom is disconnected from global view
- Proposal
  - Show a selected subset of objects
  - Have a mean to select these (e.g. list)
  - Show their neighbors
  - View the corresponding pictures





### Exploration à partir des images

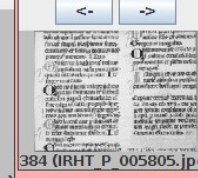
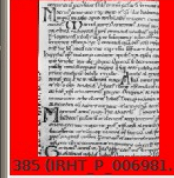
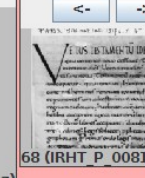
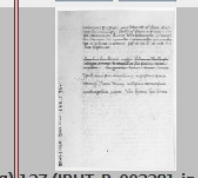
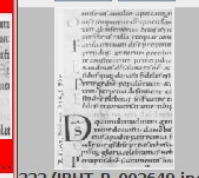
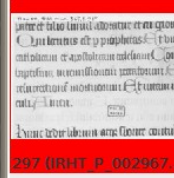
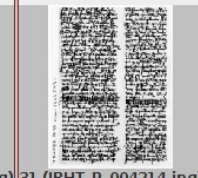
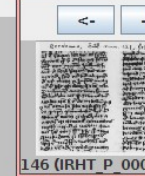
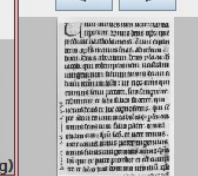
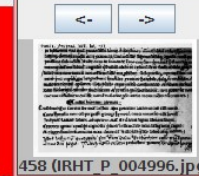
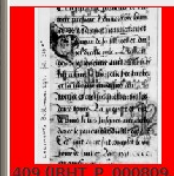
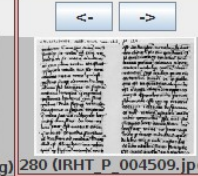
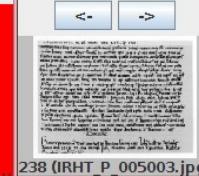
Liste	Nom	Voisins	Zoom
IRHT_P_006981.jpg		<input type="button" value="Valider"/>	
 <p>334 (IRHT P_000496...)</p>			
 <p>409 (IRHT P_000809...)</p>			
 <p>308 (IRHT P_001276...)</p>			
 <p>297 (IRHT P_002967...)</p>			
 <p>385 (IRHT P_006981...)</p>			

X1

Liste Nom Voisins Zoom

Nombre de voisins : 10

Valider



Reprojeter!

Réinitialiser

Fermer

# Semi-supervised projection

- Two ways to use projection :
  - Looking at the scattering of writings
    - Are features relevant ?
  - A low dimension description
    - a fast and « clean » similarity measure
- If projection seems to be poor ?
  - Search for new features
  - Adapt projection



Liste Nom Voisins Zoom

Zoom : ☒

334 (IRHT P. 000496)

238 (IRHT P. 005003.jpg) 280 (IRHT P. 004509.jpg)

314 (IRHT P. 001838.jpg) 324 (IRHT P. 001838.jpg)

409 (IRHT P. 000809)

458 (IRHT P. 004996.jpg) 272 (IRHT P. 000143.jpg) 146 (IRHT P. 000243.jpg) 26 (IRHT P. 000243.jpg)

308 (IRHT P. 001276)

260 (IRHT P. 002351.jpg) 31 (IRHT P. 004214.jpg) 151 (IRHT P. 002410.jpg) 170 (IRHT P. 002410.jpg)

297 (IRHT P. 002967)

322 (IRHT P. 002649.jpg) 127 (IRHT P. 003281.jpg)

68 (IRHT P. 008187.jpg) 199 (IRHT P. 008187.jpg)

385 (IRHT P. 006901)

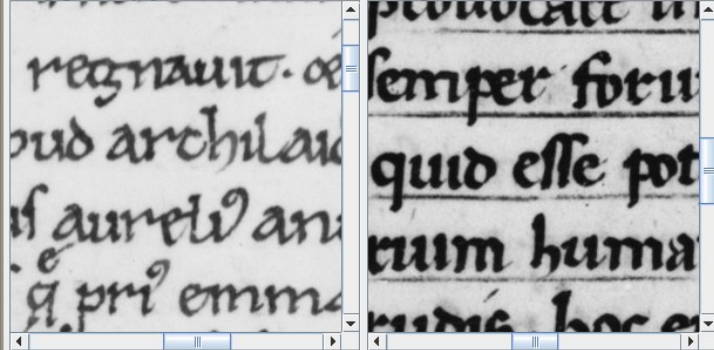
310 (IRHT P. 006384.jpg) 384 (IRHT P. 005805.jpg) 408 (IRHT P. 006907.jpg) 50 (IRHT P. 006907.jpg)

Reprojeter! Réinitialiser Fermer

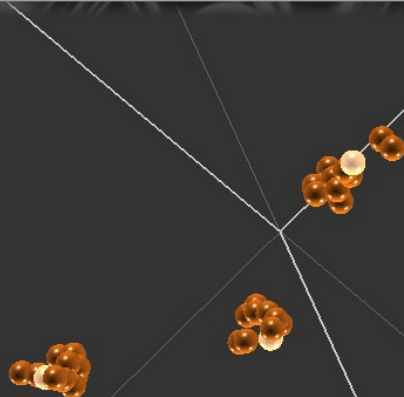
Comparateur d'Images

IRHT P. 006981.jpg

IRHT P. 007311.jpg



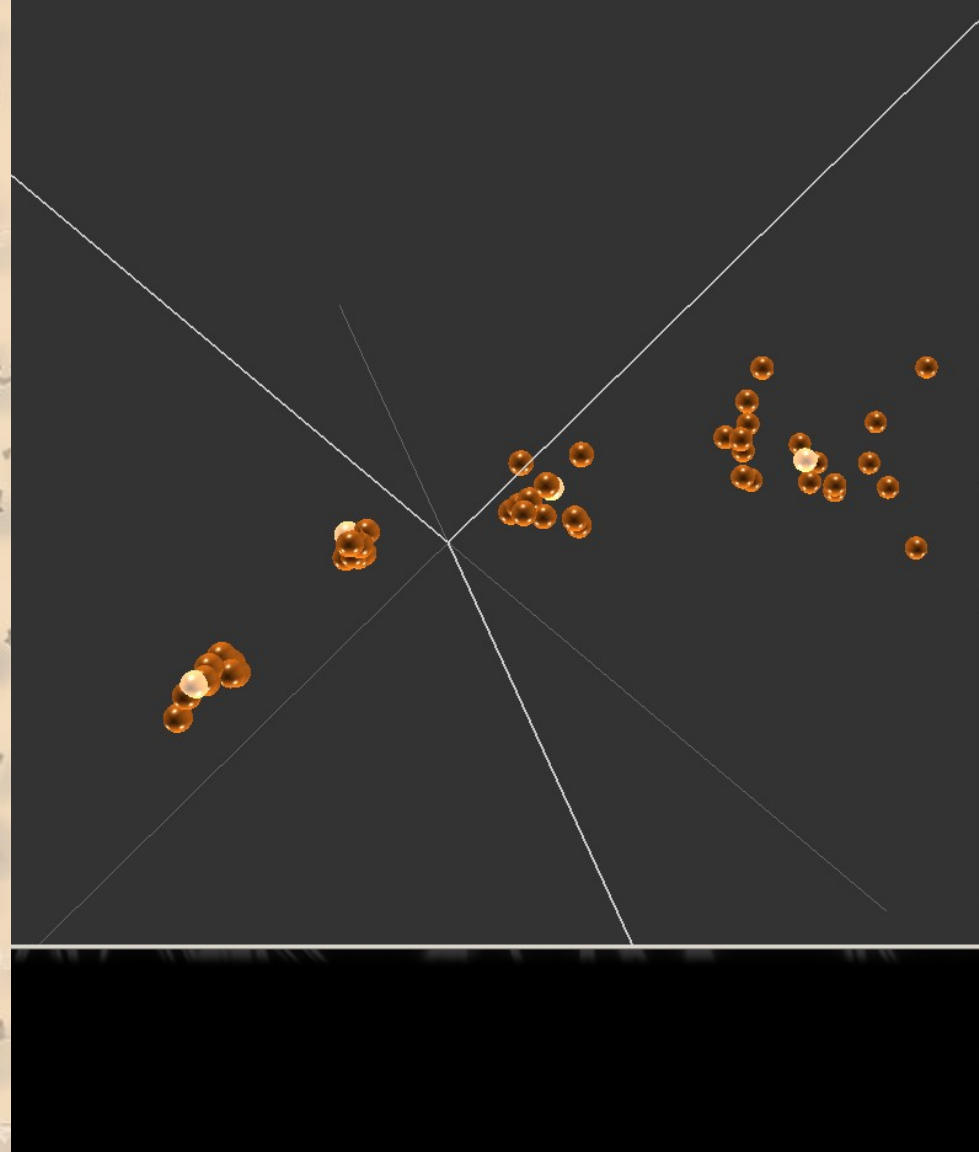
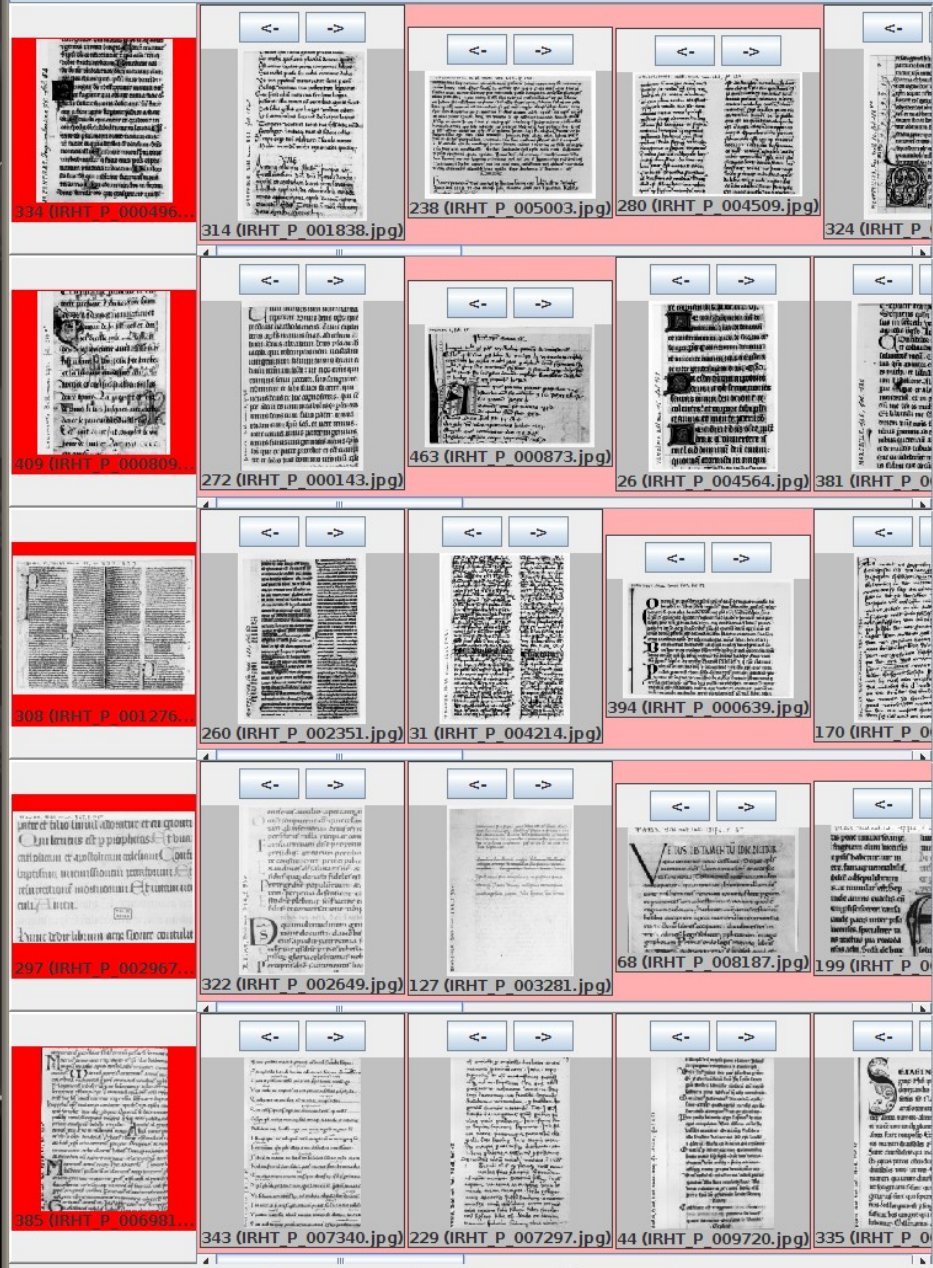
Zoom HQ 100%





Liste Nom Voisins Zoom

Zoom :



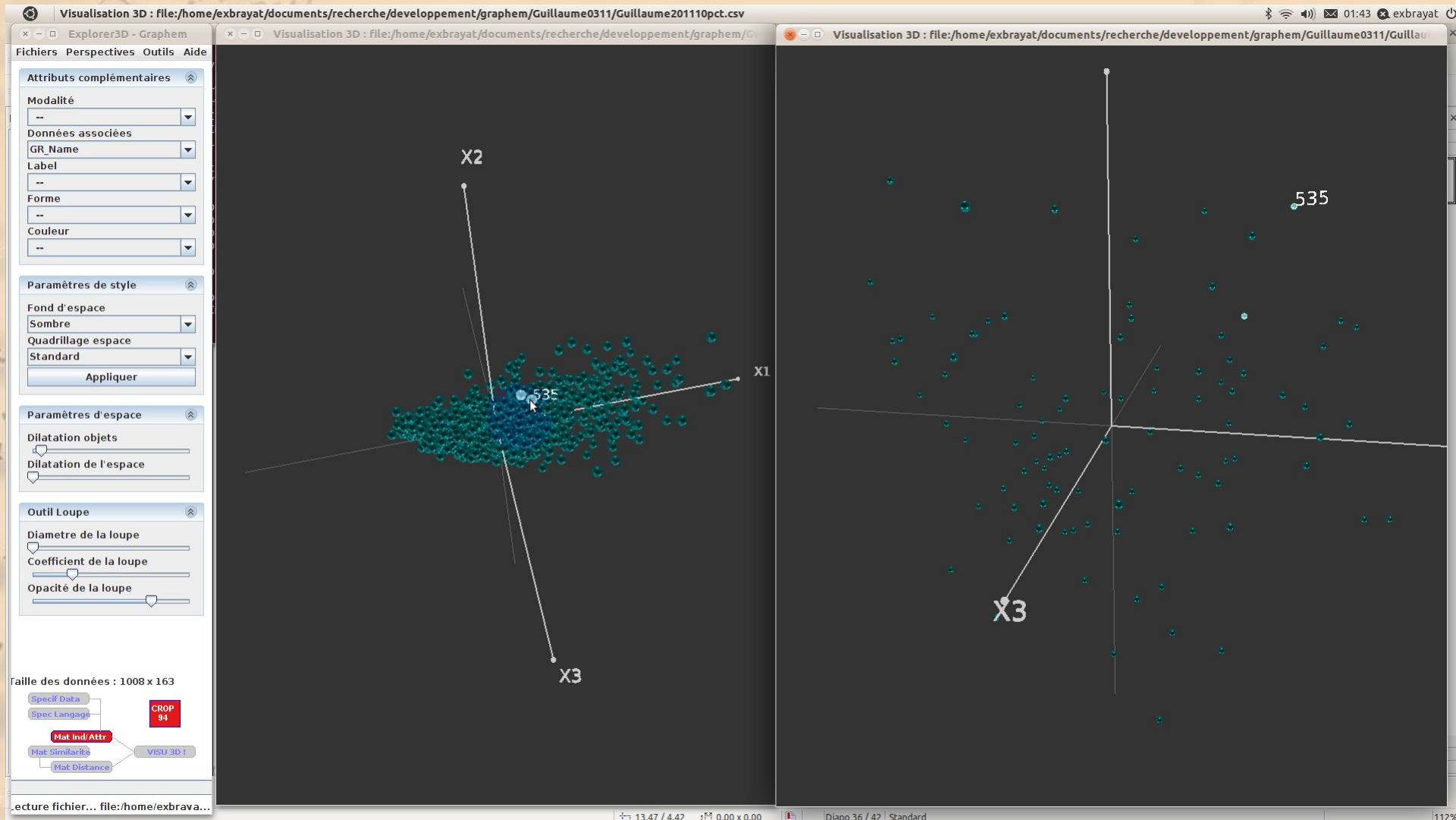
# Underlying method



- Consider projection as a balanced mix of
  - Global scattering
  - Specific constraints
- Available constraints
  - Get a pair of objects closer / away
  - **Modify the distance ratio of a triple**
  - Move an object to a new neighborhood

# MultiView visualization

- Until now, we consider only one set of features each time
- What about comparing them ?
  - From a image retrieval point of view
    - Online tools
  - From a visualization point of view
    - Multiple sources
- This leads to multiple views










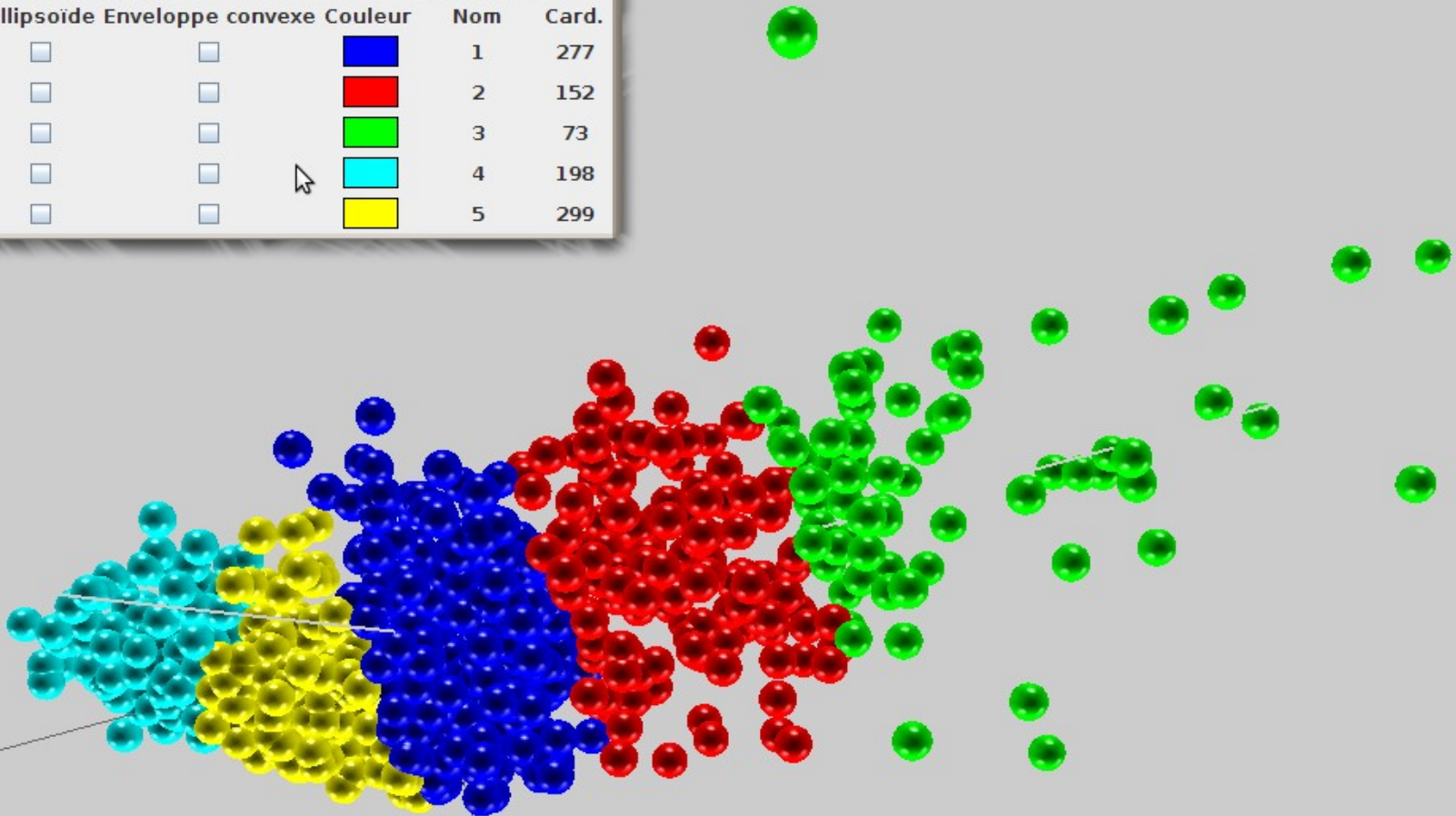
# Additional functionalities

- Clustering
- Non linear projections

# Clustering

Graphem

Légende				Infos mod.	
Visualisation			Couleur	Nom	Card.
Modalité	Ellipsoïde	Enveloppe convexe			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		1	277
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		2	152
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		3	73
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		4	198
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		5	299







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 2014-15-16  
 2015-16-17  
 2016-17-18  
 2017-18-19  
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 2019-20-21  
 2020-21-22  
 2021-22-23  
 2022-23-24  
 2023-24-25  
 2024-25-26  
 2025-26-27  
 2026-27-28  
 2027-28-29  
 2028-29-30  
 2029-30-31  
 2030-31-32  
 2031-32-33  
 2032-33-34  
 2033-34-35  
 2034-35-36  
 2035-36-37  
 2036-37-38  
 2037-38-39  
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# Summary



- Various kinds of features
- Two ways to compare them
  - Image retrieval
  - (semi)Global view
- Next step
  - Real multisource viewing
  - A better understanding of the feature-to-style link

# Graphem

Questions ?

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