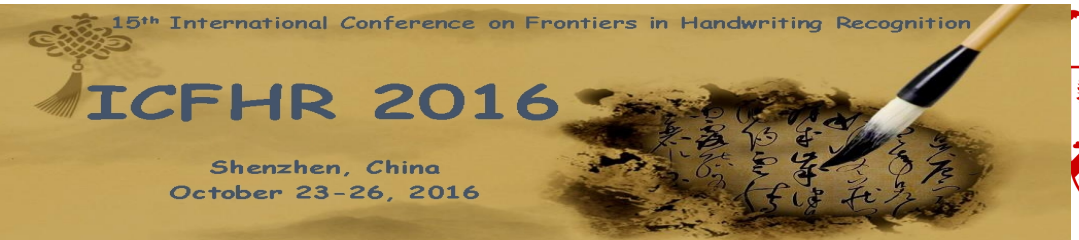
Discovering Visual Element Evolutions for Historical document dating

Sheng He, Petros Samara,
Jan Burgers, and Lambert Schomaker
University of Groningen
University of Amsterdam

ICFHR2016, 24th, Oct.



university of groningen

Basic assumption:

Visual element patterns are strongly correlated with temporal information.

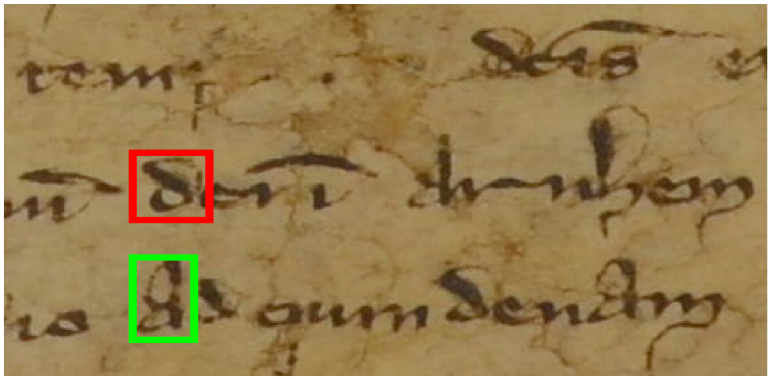
Evolution of visual word:

Evolution of visual word:

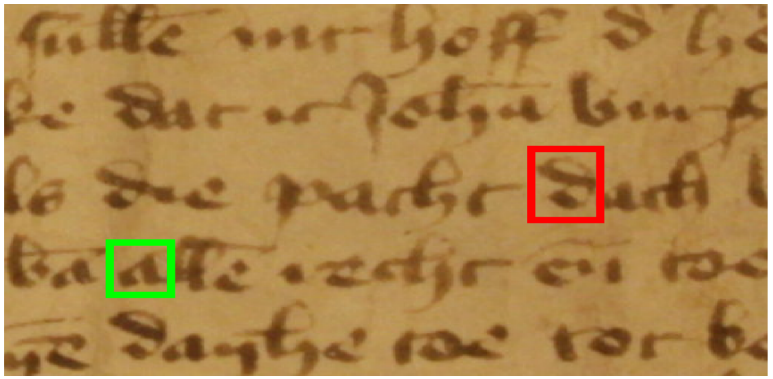
Evolution of visual word:

Evolution of visual word:

Writing styles undergo a gradual, continuous change.



1300



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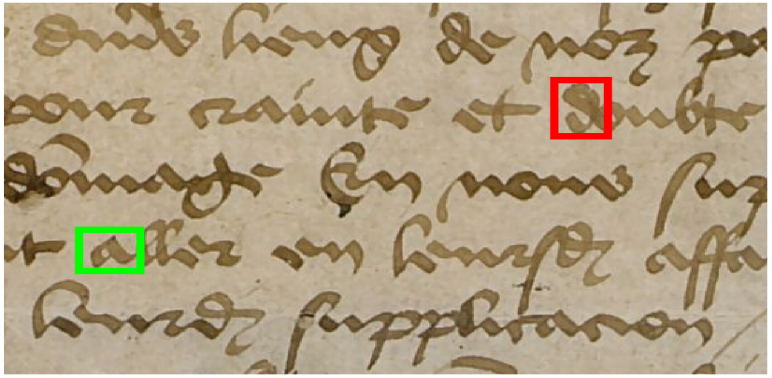

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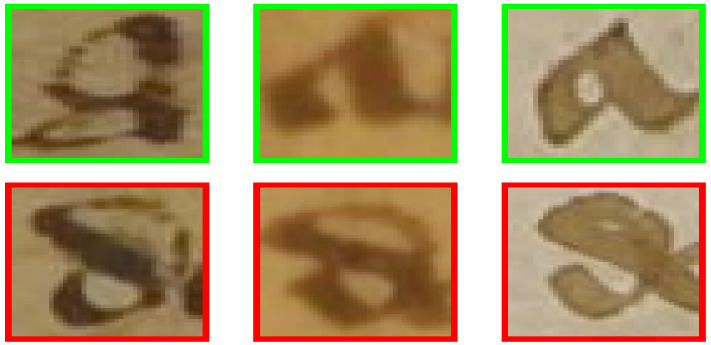
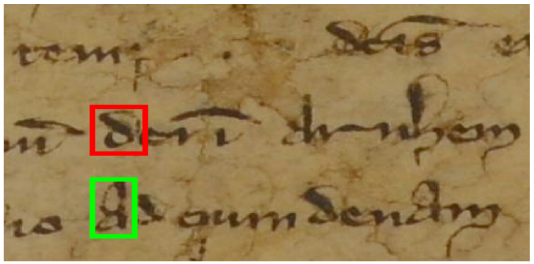


Questions?

(1) How to extract visual elements?
(word? character? grapheme?)

(2) How to model the gradual and continuous change?
(regression?)



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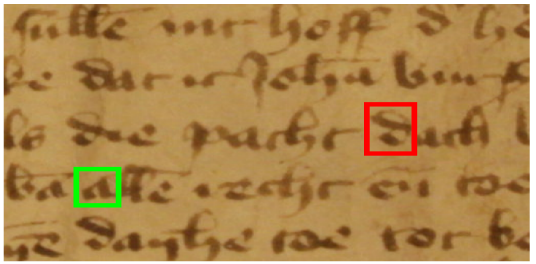

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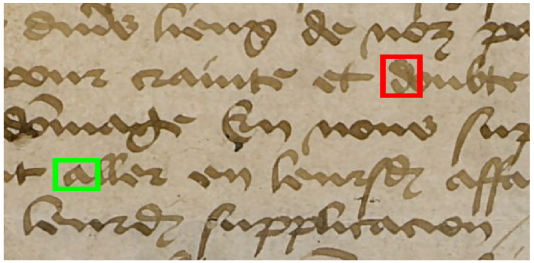

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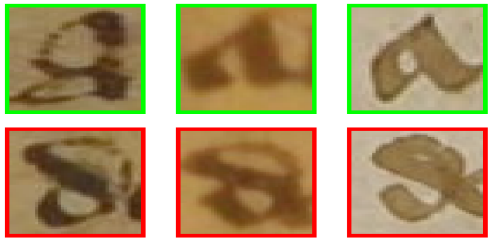
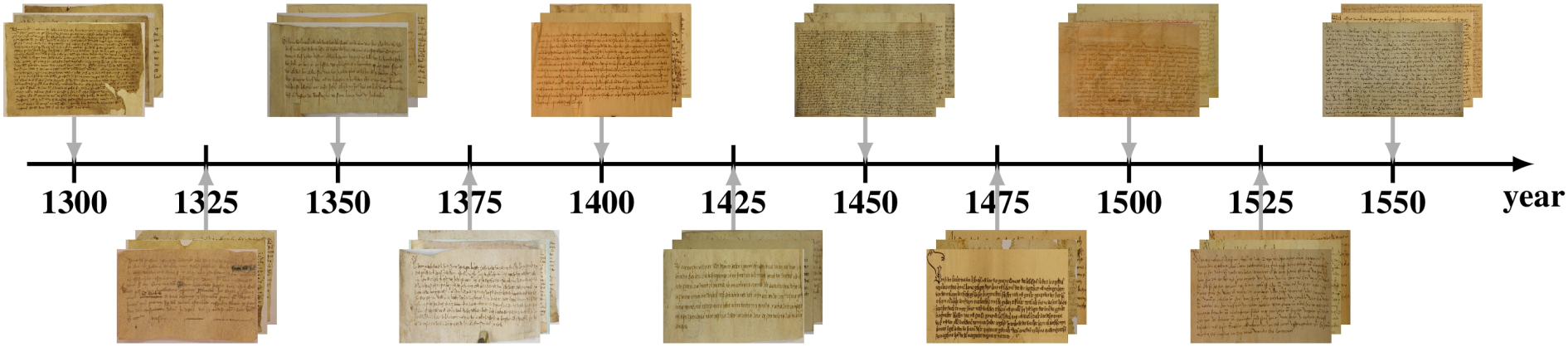


MPS data set:

The MPS data were carefully evaluated as regards their ground truth (year of origin) by experienced historians/paleographers (Petros Samara and Jan Burgers). The data sets are spaced 25 years apart, from 1300 to 1550 A.D., under the assumption that style evaluation is not taking place at a much faster pace.

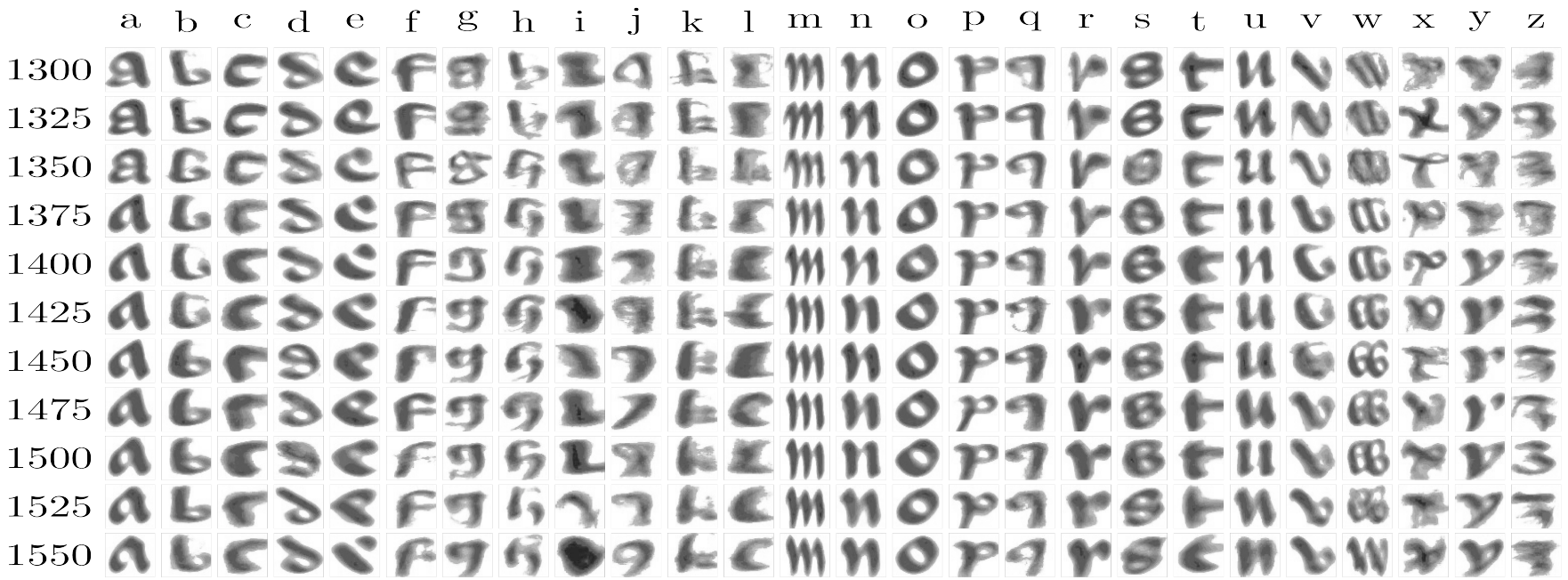


Visual elements:

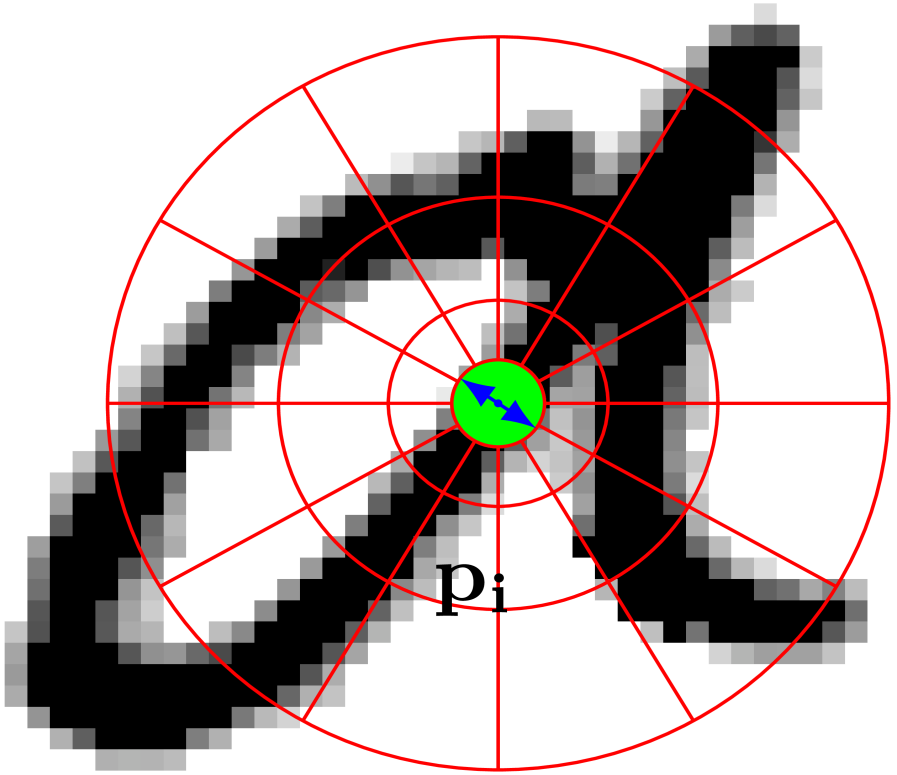
Word: not always appear in each document hard to segment

Character: not every character is style-sensitive hard to segment

Grapheme: shared with different characters easy to segment

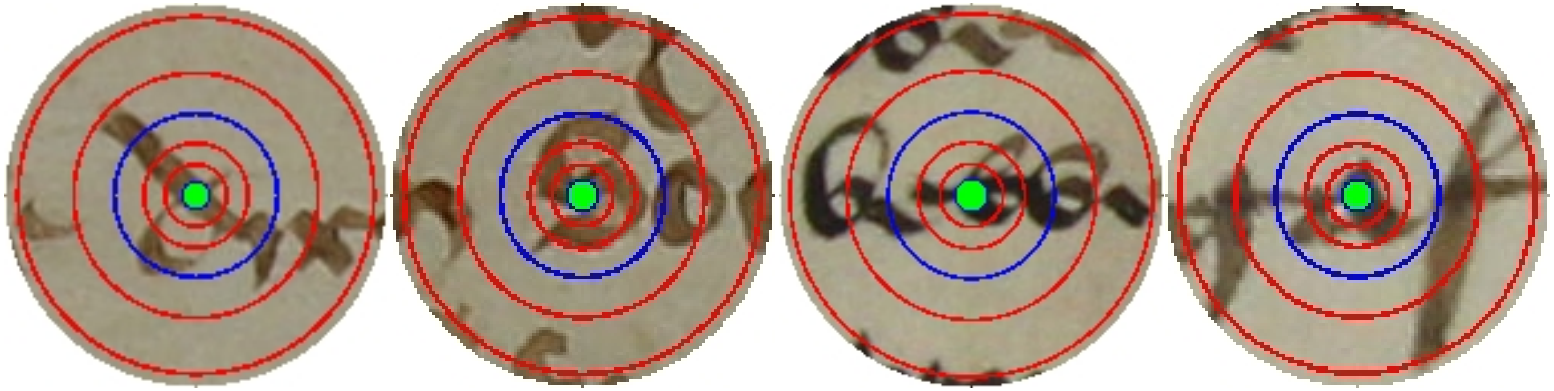


Histogram of orientations of handwritten stroke descriptor (HOHS):



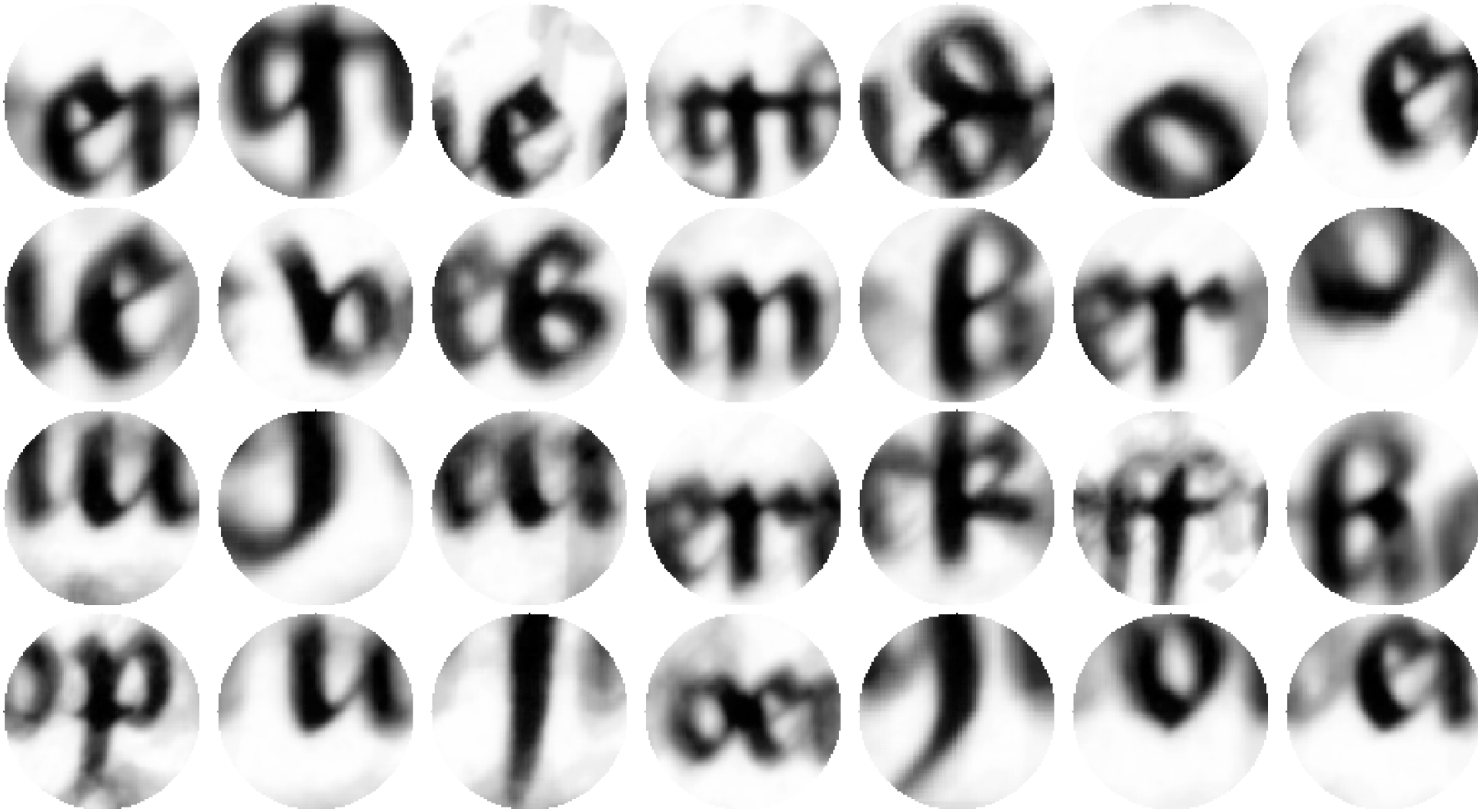
Scale-invariant
Orientation information
Robust to degradations

Histogram of orientations of handwritten stroke descriptor (HOHS):

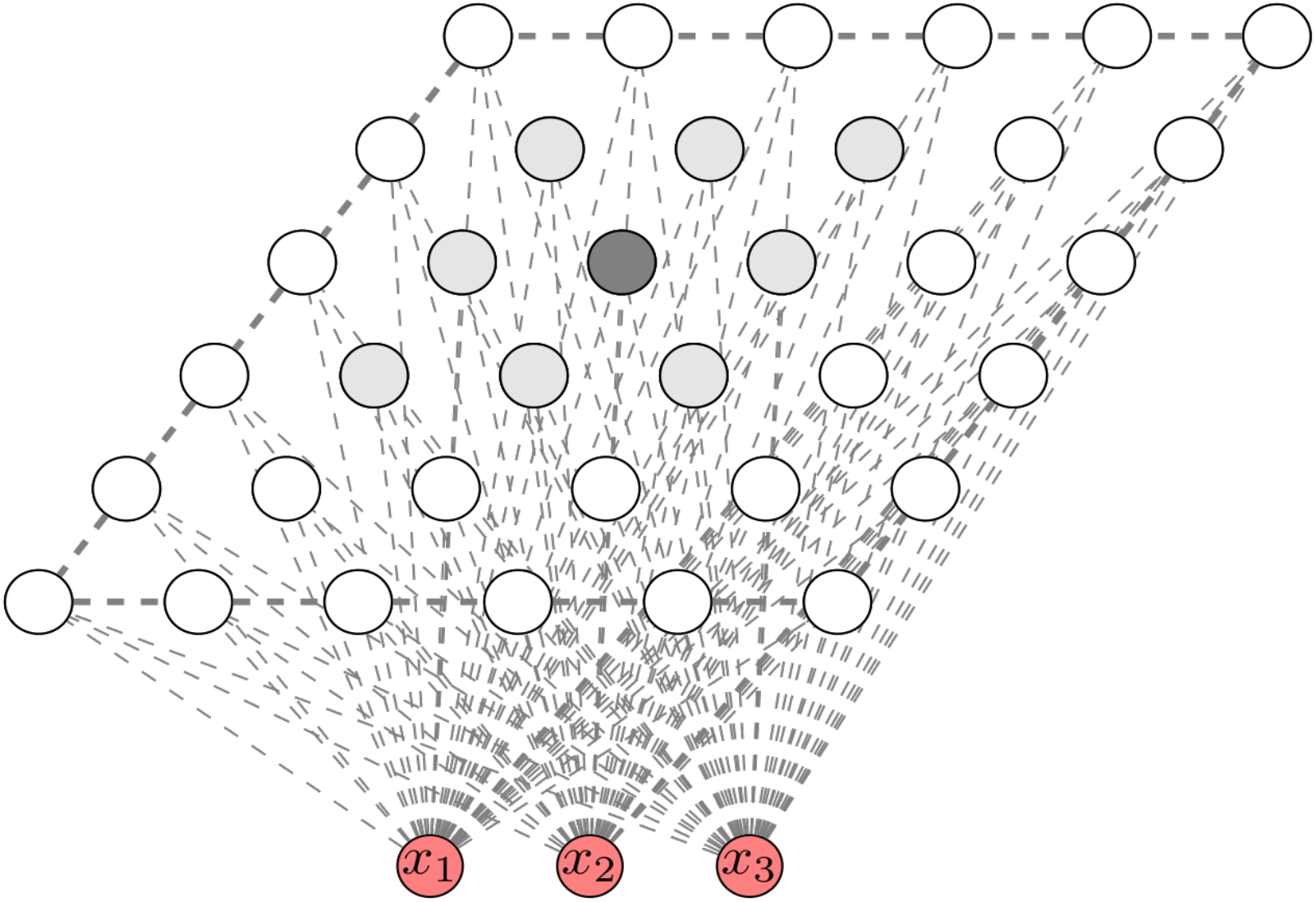


Patches with different number of rings (red circles). Therefore, we set 3 (blue circle) to build the HOHS descriptor.

Stroke shape elements:



Self-organizing map (SOM):



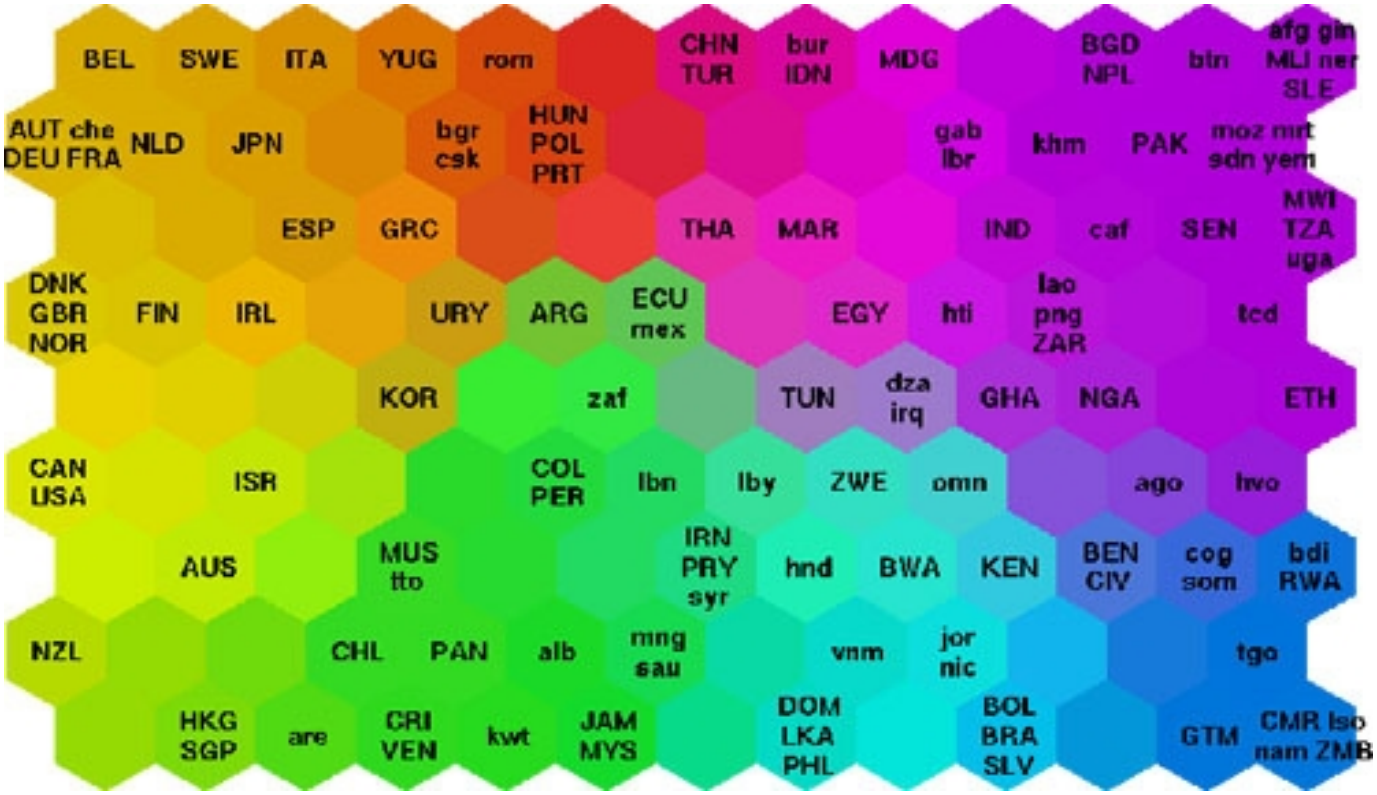
Self-organizing map (SOM):

A cluster method preserves the topology of visual element with two steps:

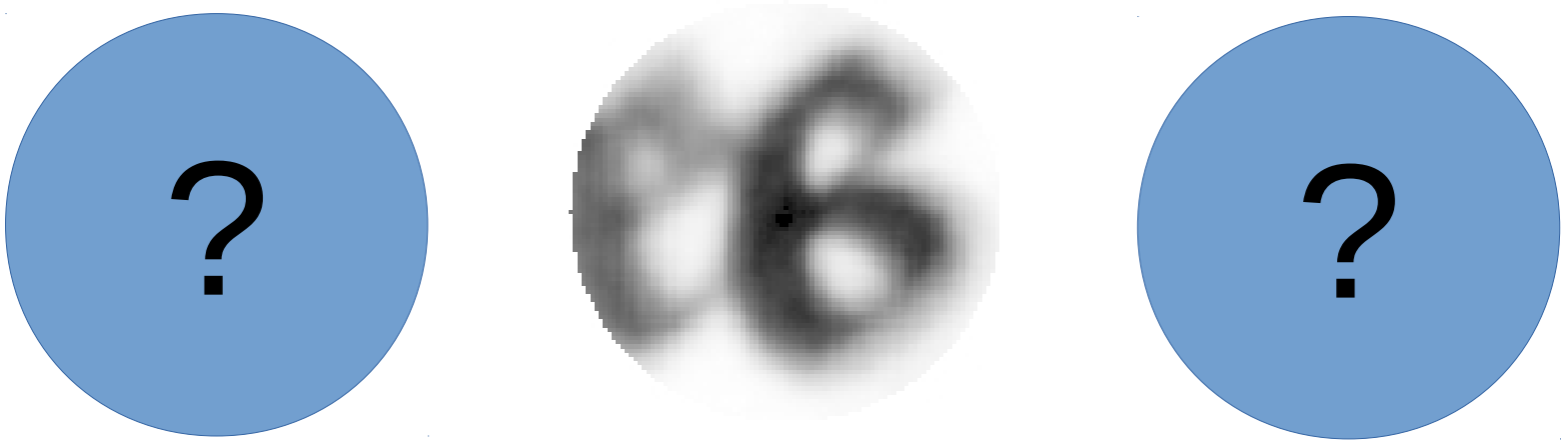
1, Competitive step: only one cell or local group of cells at a time gives the active response to the current input.

2, Cooperative step: Any neurons who are the neighbors of the BMU are updated their weights to preserve the topological order.

Self-organizing map (SOM):

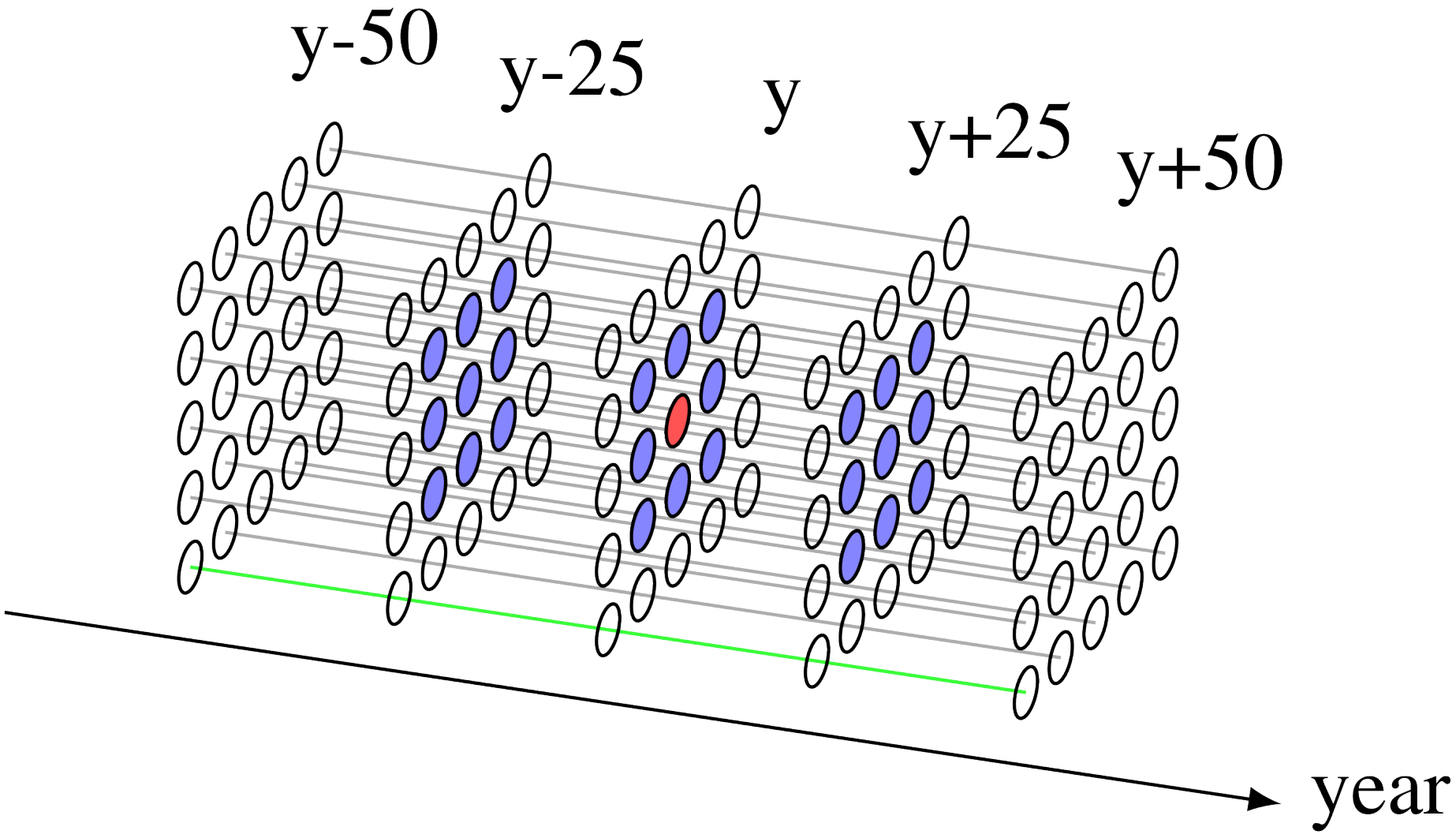


Question:

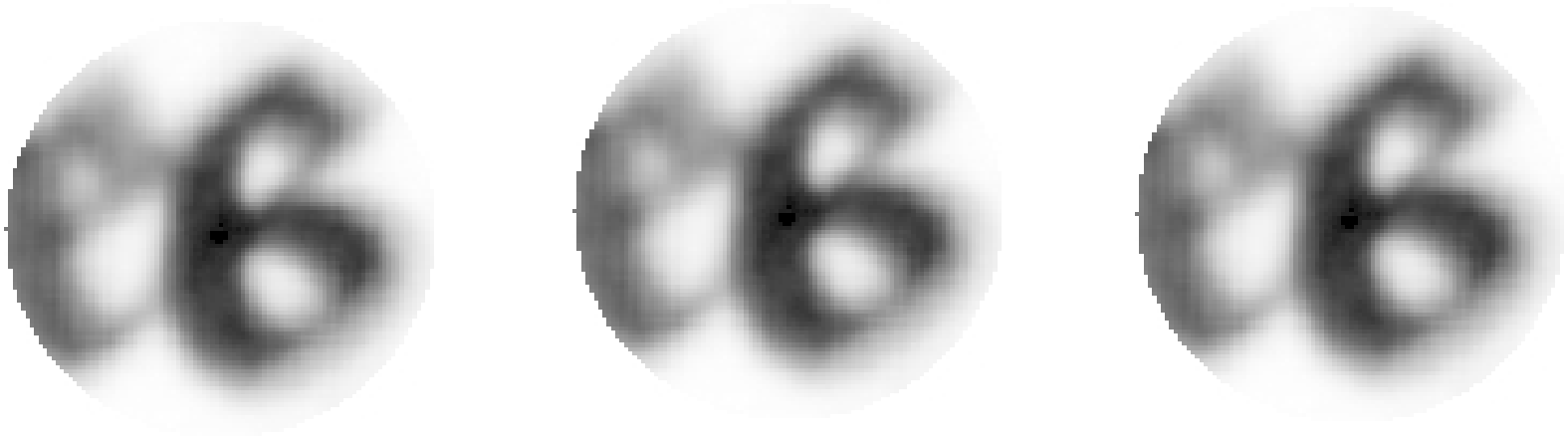


y-25 y y+25

Evolution self-organizing map (ESOM):

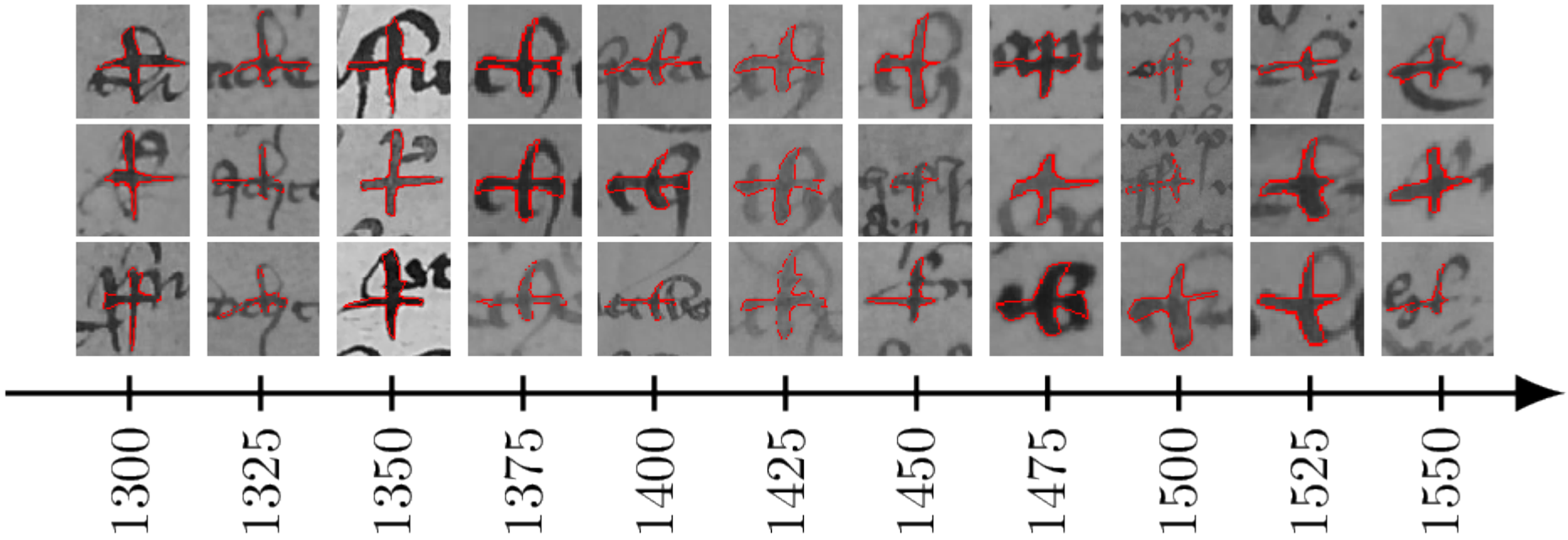


Learning From Neighbors

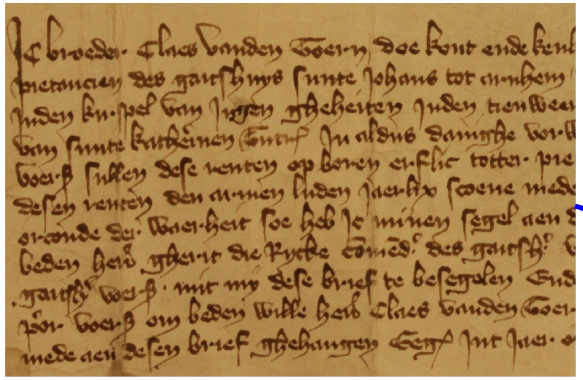


y-25 y y+25

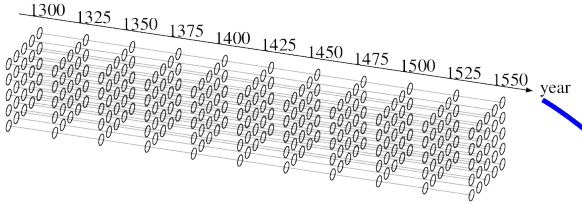
Example



Framework:

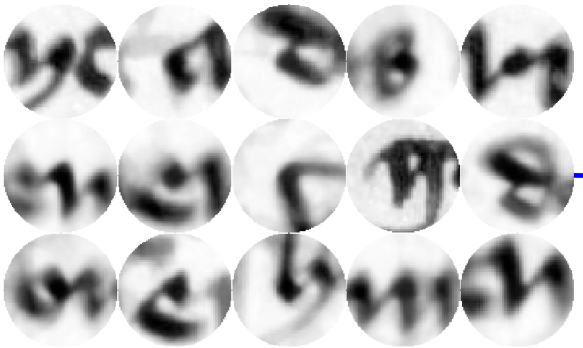


Input Document

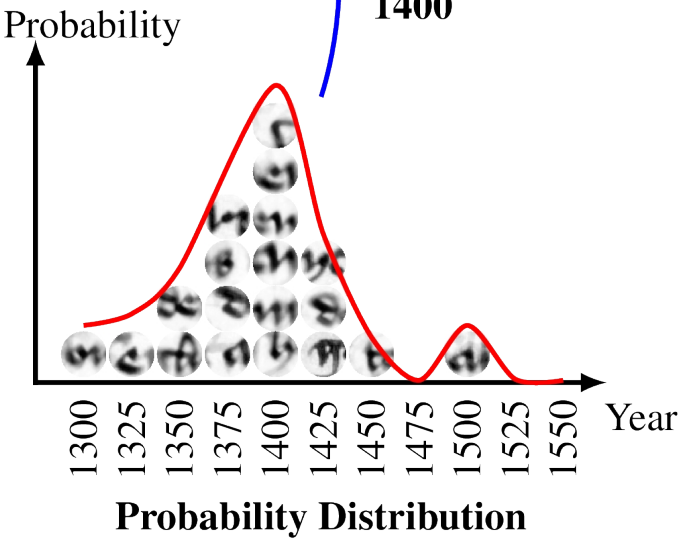


ESOM codebook

1400



Stroke Shape Elements



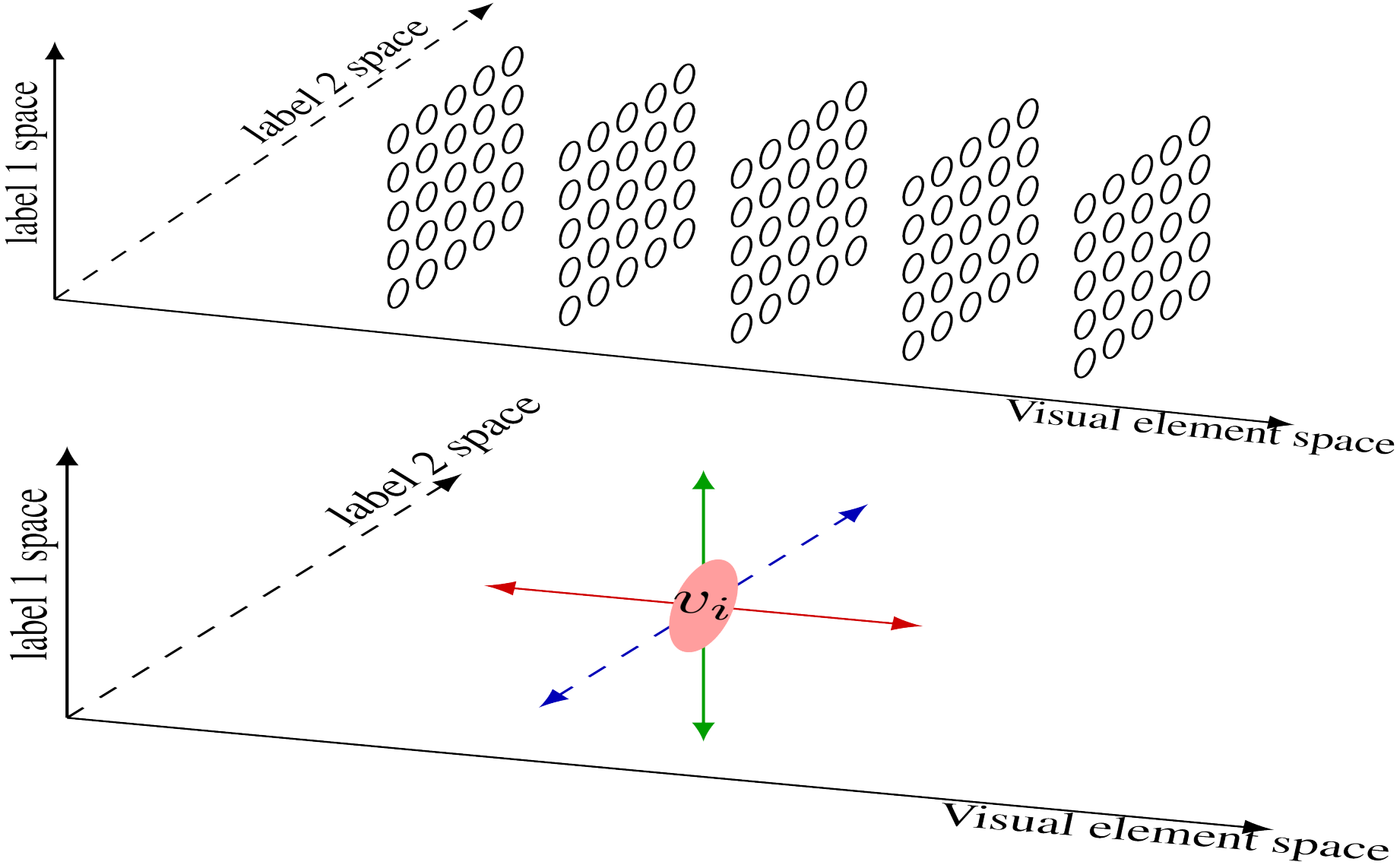
Probability Distribution

Results:

MAE: mean absolute error
CS : cumulative score

Method	MAE	STD	CS(α=25)
Random Guess	85.3	58.5	25.7%
[5]	35.4	32.9	63.5%
[8]	22.4	-	77.5%
Proposed	**17.0**	29.1	**85.1**%

Multiple-label clustering (TIP2016)



Next step:

The project is closed!
The data set is open!

Public on Monk system:

http://application02.target.rug.nl/monk/Projects/MPS/Download/index.html

	README first	MD5 checksum	.tgz file size
1	MPS1300-ppm.tar.gz	650558f7437eb7ea8502455ad527d295	310M
2	MPS1325-ppm.tar.gz	22b81c6dc2983d9576855729eac0add5	528M
3	MPS1350-ppm.tar.gz	c6ad66196ead086c8d48ac28ea88ed16	716M
4	MPS1375-ppm.tar.gz	43e439173397bb33eda09aa1a1ab6898	1.5G
5	MPS1400-ppm.tar.gz	c8499d55277eff557ffc9d4f3f756fbd	1.1G
6	MPS1425-ppm.tar.gz	68ea5940ff7608f90d7397e902670665	1.7G
7	MPS1450-ppm.tar.gz	b6ec683651c52685dba2bc8a72c902eb	3.1G
8	MPS1475-ppm.tar.gz	ae355a1a7298abbc4ba3bd26bd11f239	2.9G
9	MPS1500-ppm.tar.gz	5d405444f6a1dcac76db4f5ec129ad8e	2.8G
10	MPS1525-ppm.tar.gz	da06451e577b7d762411c9661f60d04f	1.8G
11	MPS1550-ppm.tar.gz	46fdd8e3ba737ba554de22575635182d	1.7G

The MD5 checksum was computed with Linux tool md5sum

Thanks for your attention!

Questions ?

Sheng He
University of Groningen
The Netherlands

university of groningen