

# Content Based Multimedia Search: Final Exam

Lecture given by: Prof. Seidl

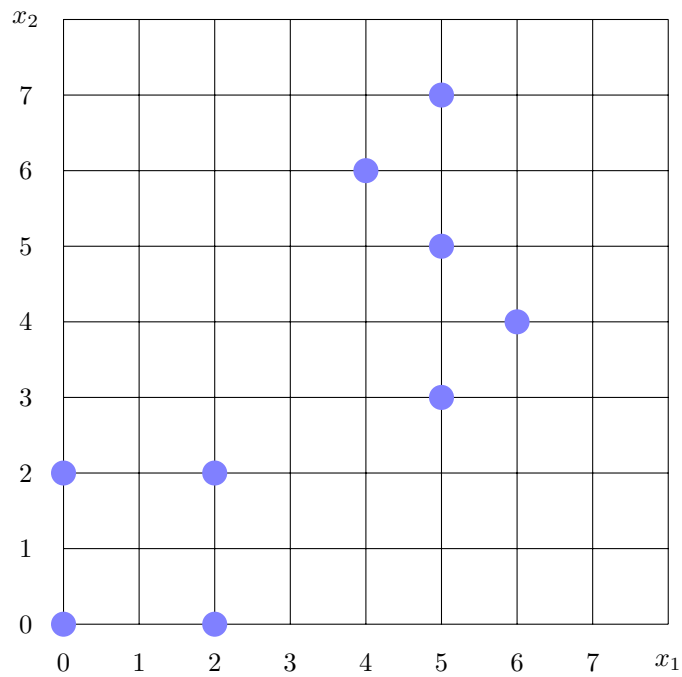
16.02.2016

The following document is a transcript from memory. There is no guarantee for correctness or completeness.

1	10	6	10
2	10	7	10
3	10	8	10
4	10	9	10
5	10	$\Sigma$	90

## 1) Feature Signatures

(a)



Determine a clustering with  $k$ -Means for  $k = 2$  using the Euclidean Distance. Use  $(0, 2)$  and  $(6, 4)$  as initial cluster centroids.

(b)

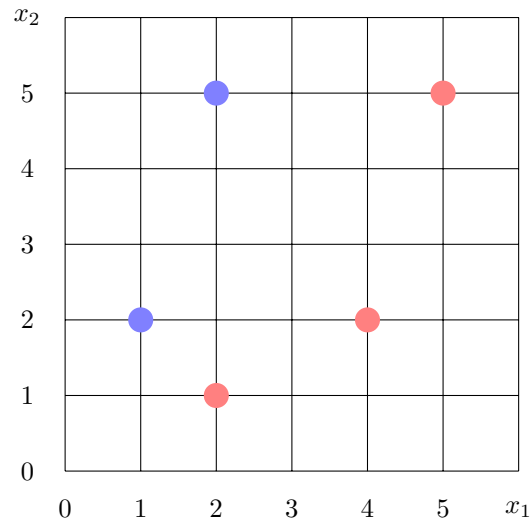
Write the resulting clustering as formal signature definition using the relative cluster frequency as weight.

## 2) Matching Distances

(a)

Define the Signature Matching Distance and explain its components. What effect has the bidirectional term?

(b)



Calculate using Manhattan distance

- $m_{X \rightarrow Y}$
- $m_{Y \rightarrow X}$
- $m_{X \leftrightarrow Y}$

(c)

Calculate the Hausdorff Distance between the two signatures given in (b).

### 3) Earth Mover's Distance

(a)

Formally define the Earth Mover's Distance.

(b)

Given: 3 flows. Why are these flows not feasible (name the violated constraint).

### 4) Quadratic Form Distance

(a)

Under which condition is  $QFD_S(x, y) = L_2(x, y)$ . (Define  $S$ ) + explain.

(b)

Is there an extension of QFD to signatures. If not, explain why. Else, give a formal definition and explain the components.

### 5) Edit Distance

(a)

How is the Edit Distance defined and what operations are used.

(b)

Under which conditions is the Edit Distance equal to the Hamming Distance.

(c)

Given the words *FIREPLACE* and *AIRSPACE*. Compute the Edit Distance between the two words (Shape of matrix already given). Show the resulting alignment of the two words in the matrix.

### 6) Range Queries

(a)

Give the formal definition of a range query. What are the domains of the components?

(b)

Give the Pseudocode for multi-step range query processing.

(c)

Prove completeness of the filter step if the filter distance is a lower bounding distance.

(d)

ICES criteria + explain.

## 7) *k*-NN queries

(a)

Formally definite a *k*-NN-query.

(b)

Give the Pseudocode for multi-step *k*-NN query processing.

## 8) Evaluation

(a)

Define precision & recall (and explain them).

(b)

Rank	1	2	3	4	5	6
Picture <sup>a</sup>	pear	apple	ball	banana	boomerang	house

<sup>a</sup>The pictures were "real" pictures instead of words.

Draw precision-recall curve for fruit query (pear, apple, banana) and give exact values.

(c)

rank	1	2	3	4	5	6
prec.	1.0	0.5	2/3	0.75	0.8	2/3
rec.	0.25	0.25	0.5	0.75	1.0	1.0

How man relevant objects are in the database? Give a ranking of relevant and non-relevant objects yielding the given table.

## 9) Metric Indexing

(a)

Formally define the properties of a metric distance function.

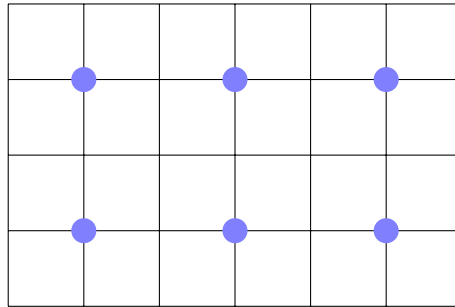
(b)

Given distance functions with  $x, y \in \mathbb{R}^d$ ,  $\epsilon \in \mathbb{R}^+$ .

- $\delta_1(x, y) = \sum_{i=1}^d \begin{cases} 0, & |x_i - y_i| \leq \epsilon \\ 1, & \text{else} \end{cases}$
- $\sqrt{\sum_{i=1}^d [x_i - y_i]^2}$

Prove or disprove that those functions are metric distance functions.

(c)



Given the above depicted points. Which points are "good" pivot elements? Explain why!