On the Informativeness of Asymmetric Dissimilarities
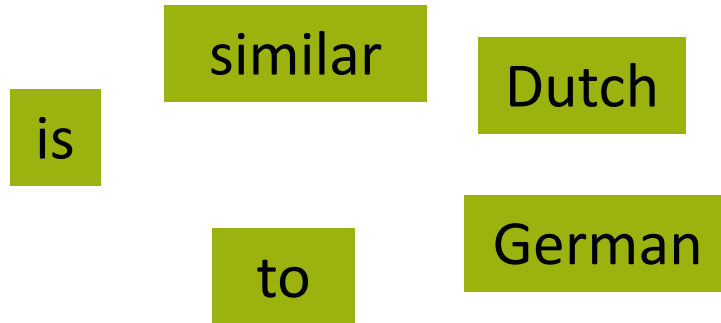
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Asymmetric dissimilarities

- Live example!

Asymmetric dissimilarities

- Live example!

similar

Dutch

is

to

German

Asymmetric dissimilarities

"Dutch is similar to German"

11,000 hits

"German is similar to Dutch"

1,000 hits

Contents

- Causes of asymmetry

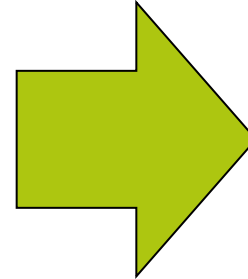- What people do about it

- How we can do it better

Causes

Experts

	German	Dutch
German		1000
Dutch	11000	

Causes

Matching

- Shapes = Strings of angles

- Incorporating invariance

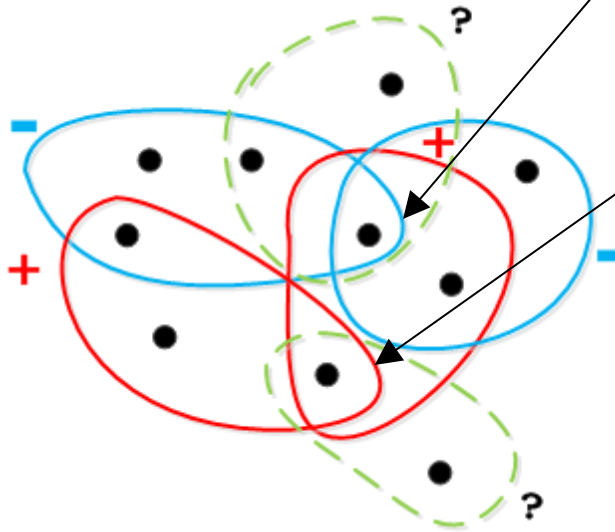- Inexact procedures

- Different search path

{90, 90, 0, 135, 135…}
starting at top left

{225, 225, 0, 270, 270…}
starting at arrow tip

Causes

Multiple Instance Learning

- Bags are **sets** of feature vectors

- Instance labels are not given
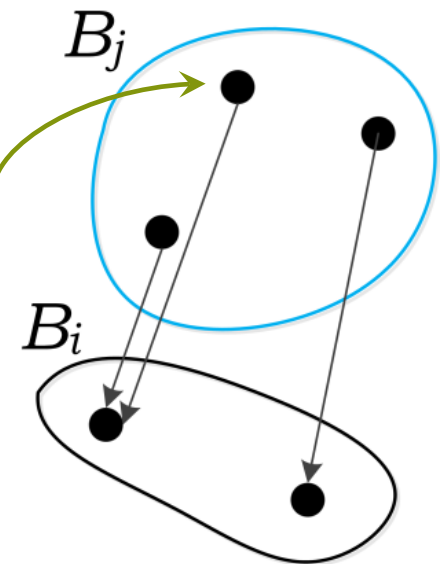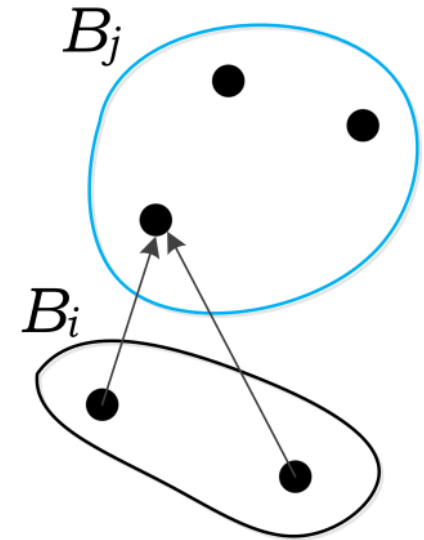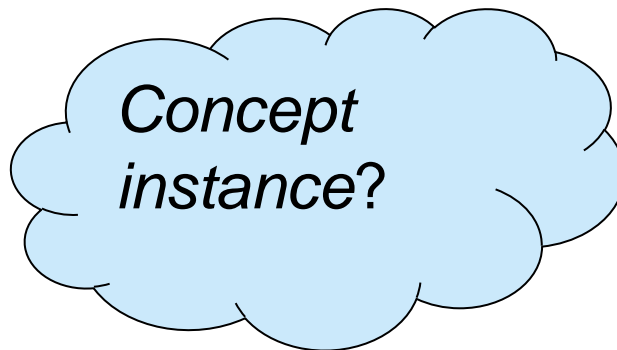
- **Concept instances** important for bag label

Causes

Multiple Instance Learning

- (Modified) Hausdorff distance

$$d(B_i, B_j) = \max_{\mathbf{x}_k \in B_i} \min_{\mathbf{x}_l \in B_j} d(\mathbf{x}_k, \mathbf{x}_l)$$

$$d_H(B_i, B_j) = \max(d(B_i, B_j), d(B_j, B_i))$$

Concept instance?

B_j

B_i

B_j

B_i

Asymmetry
What is usually done

- Nearest neighbor, clustering, SVM, embedding …

- Symmetrize dissimilarity

- *What if this throws away information?*

$$D_1 = d(A, B)$$

$$D_2 = d(B, A)$$

$$\max(D_1, D_2)$$

$$\min(D_1, D_2)$$
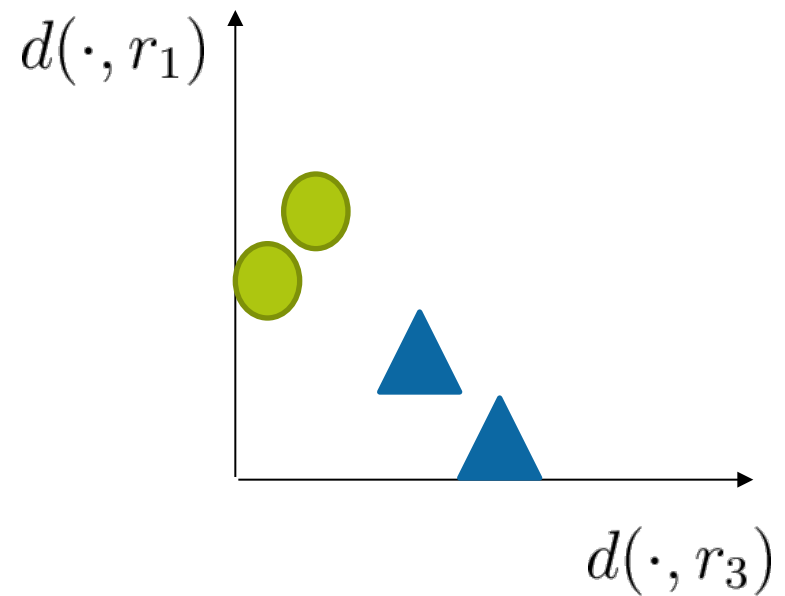
$$\frac{1}{2}(D_1 + D_2)$$

Asymmetry

Alternative

- **Dissimilarity space**

- Distances as features

- Any (even non-square) matrix

- Any supervised classifier

$$R = \{r_1, \ldots, r_k\}$$

$$D_i \in \mathbb{R}^k, i = 1, 2$$

Asymmetry

- **E**xtended **A**symmetric **D**issimilarity **S**pace

- *All information available*

$$[D_1 D_2] \in \mathbb{R}^{k \times 2}$$
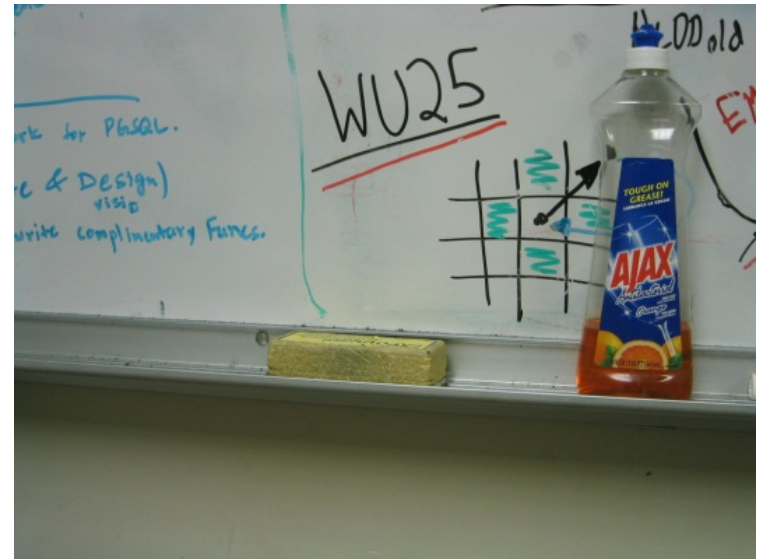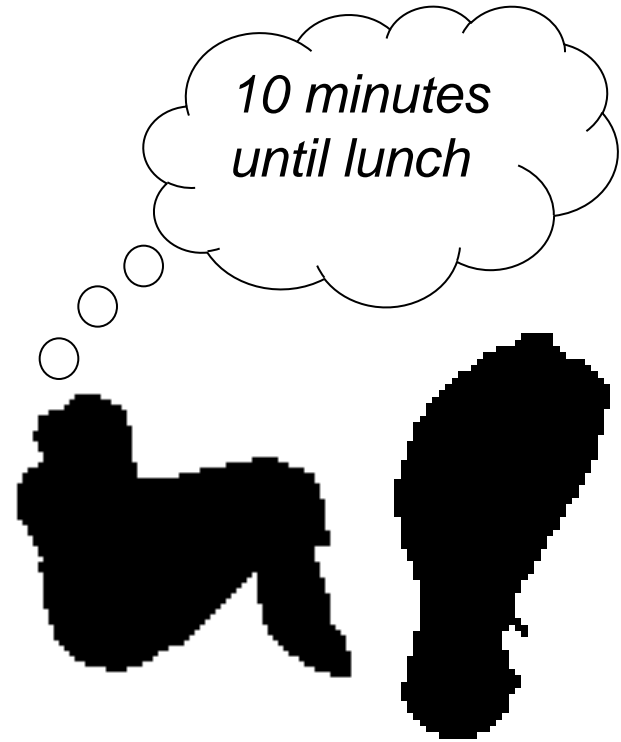
Datasets

10 minutes until lunch

- **Chicken Pieces**
  - 5 classes
  - Edge segments of 35 pixels
  - String of angles
  - Edit distance
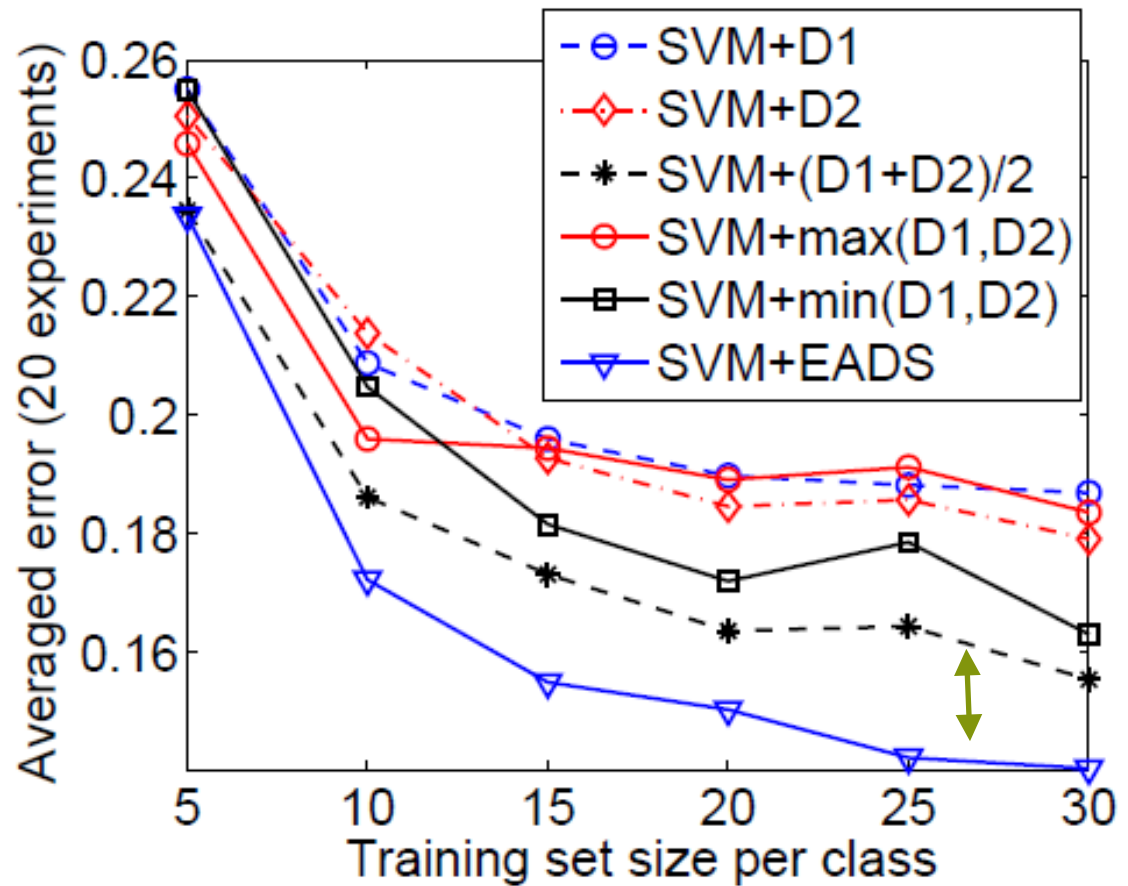
- **Ajax Orange**
  - 25 objects, 10x6 backgrounds
  - 1 against all
  - Segments + simple features
  - Modified Hausdorff
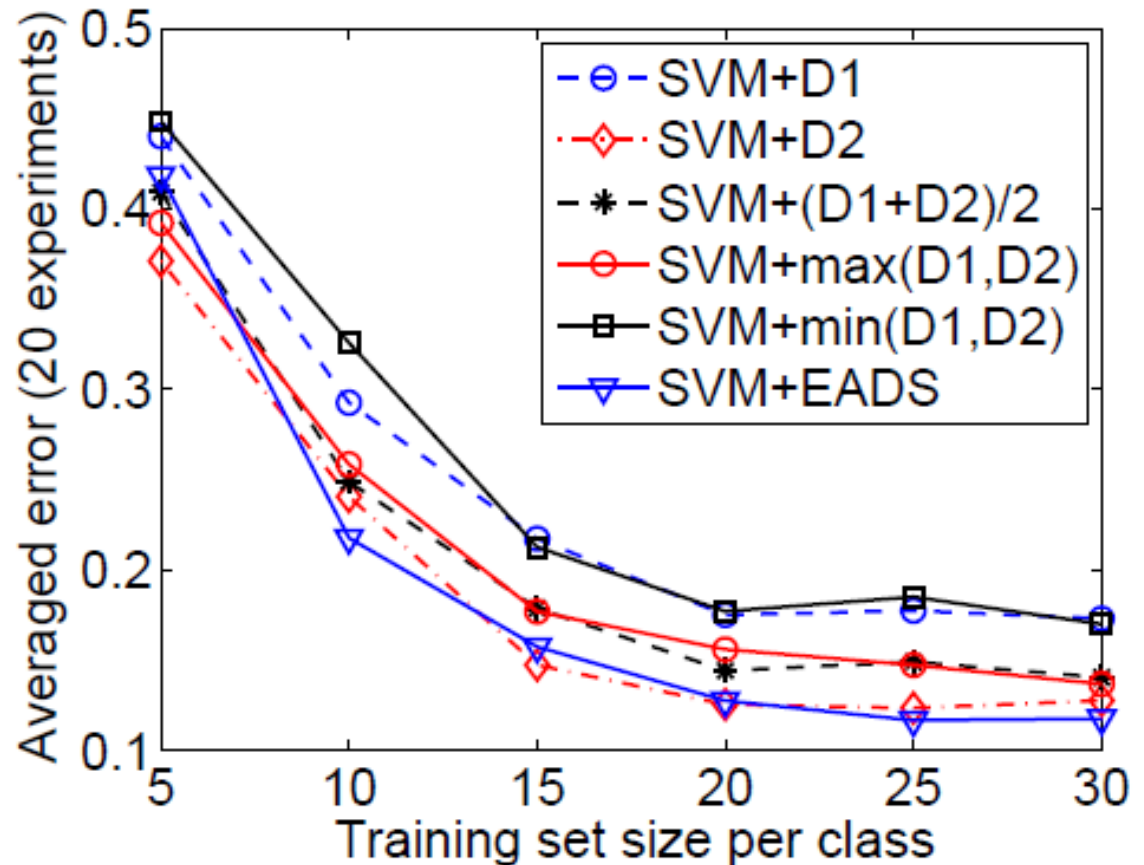
Results

Chicken pieces

- D1 and D2 comparable

- EADS best, Averaging good

- Gap EADS & average smaller with more prototypes

Results

AjaxOrange

- D2 much better than D1 (Concept instances!)

- Averaging worse than best!

- EADS still good

Conclusions

- Asymmetric dissimilarities occur in many applications

- Asymmetry can be informative

- Dissimilarity space suitable for using asymmetry information

- Preserve most information with
  Extended **A**symmetric **D**issimilarity **S**pace

Do you also have asymmetric dissimilarities?