On the Informativeness of Asymmetric Dissimilarities

Yenisel Plasencia Calaña, Veronika Cheplygina, Robert P.W. Duin, Edel B. García Reyes, Mauricio Orozco Alzate, David M.J. Tax, Marco Loog

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Asymmetric dissimilarities

""Italy is similar to France""

1270 hits

"France is similar to Italy"

63 hits

Contents

- Causes of asymmetry
- What people do about it
- How we can do it better

Causes
Experts

	Italy	France
Italy		63
France	1270	

Causes
Matching

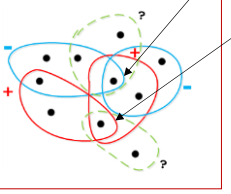
- Shapes = Strings of angles
- Incorporating invariance
- Inexact procedures
- Different search path

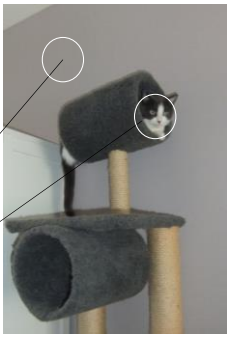
{90, 90, 0, 135, 135…}
starting at top left

{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

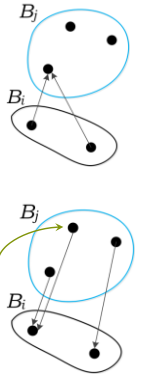
Multiple Instance Learning

- (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?



Asymmetry

What is usually done

- Nearest neighbor, clustering, SVM, embedding …
- Symmetrize dissimilarity
- *What if this throws away information?*

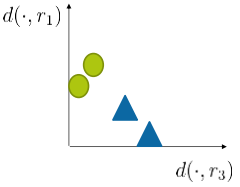
$$D_1 = d(A, B)$$
$$D_2 = d(B, A)$$
$$\max(D_1, D_2)$$
$$\min(D_1, D_2)$$
$$\frac{1}{2}(D_1 + D_2)$$

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

Our idea

- **E**xtended **A**symmetric **D**issimilarity **S**pace
- *All information available*

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

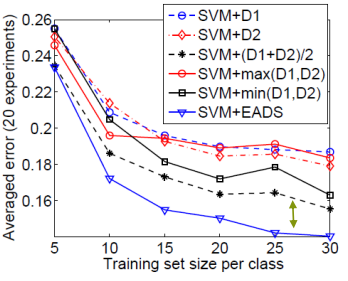
Datasets

- **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

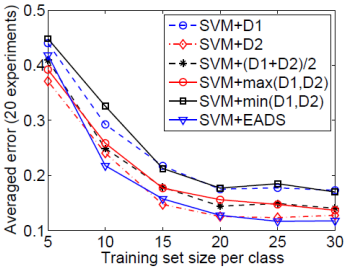
- D1 and D2 comparable
- EADS best, Averaging good
- Gap EADS & average smaller with more prototypes



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?