MLSM 2020 - Quiz 6

20/11/2020 - 02/12/2020 at 23:59

Questions based on lecture 10 (Multi-class classification)

(1) (1.0 pt.) Select all correct statements:

(a) One-vs-all multi-class classification scheme always produces the optimal error rate for a classifier **False, see e.g. slides "Example: sub-optimality of OVA classification"**

(b) One-vs-one is more robust to uneven classes than one-vs-all **True**

(c) Comparing classifier scores in one-vs-all scheme is a meaningful way to break the possible ties **False, the fact that scores returned by individual classifiers are not comparable is called the calibration problem.**

(d) One-vs-one model is more prone to overfitting than one-vs-all **True**

(e) If one-vs-one model misclassifies an example $\mathbf{x}$, at least half of the binary classification models concerning its true class must have made an error **False, at least one of them must have made an error.**

(2) (2.0 pt.) [*Programming exercise*] Implement the ECOC scheme for digits data given by the example code below (also given in materials as a python script). Use the perceptron from sklearn as the binary base classifier with the default parameters (i.e. instantiate it as `classifier = Perceptron()`). Investigate the effect the minimum hamming distance of the random codewords have on the accuracy of the ECOC multi-class classification. In what interval does the difference in accuracy for minimum 10 and 1 Hamming distances (i.e. $mean(acc_{\min(hamming\,dists)=10}) - mean(acc_{\min(hamming\,dists)=1})$) fall? If none, then choose the closest one.

(a) $[0.25, 0.4]$

(b) $[0.1, 0.25[$ **Correct answer (see separate model solution code for details)**

(c) $[0, 0.1[$

(d) $[-0.1, 0[$

Hint: you can calculate Hamming distances between all pairs of elements in `X` and `Y` (on rows) with

```
from sklearn.metrics import pairwise_distances
pdists = pairwise_distances(X, Y, metric="hamming")*X.shape[1]
```

(sklearn's implementation divides with the length of the elements)

Hint: Create a random array of size (number of classes $\times$ length of codeword) by

```
np.round(np.random.rand(nc, rcode_len))
```

Hint: When creating the random codewords of various lengths remember to check if the codeword is suitable; i.e. remove columns where there is only one label, and duplicate columns. Note also that the codewords themselves need to be unique.

Questions based on lecture 11 (Preference learning, ranking)

(1) (1.0 pt.) Select all correct statements:

(a) When in rankSVM $y_{ij}\mathbf{w}^\top \Delta x_{ij} < 0$, then the pair (x_i, x_j) is correctly classified **False, a pair is consistently predicted if it has non-negative margin (see slide 23 of lecture)**

(b) RankSVM corresponds to traditional SVM problem with $\phi((x_i, x_j)) = x_i - x_j$ **True**

(c) Given a set $\{x_i\}_{i=1}^n$ of objects for rankSVM, there can be $\mathcal{O}(n^2)$ dual variables in the dual formulation **True**

(2) (1.0 pt.) Alice and Bob wish to have a literature circle during the Covid, and consider

- Alice's adventures in Wonderland (AAW)
- Diskworld series (DW)
- Dune
- Foundation series
- Pride and Prejudice (PP).

Alice prefers the order $AAW \succ DW \succ PP \succ Dune \succ Foundation$ while Bob prefers the order $PP \succ Dune \succ AAW \succ DW \succ Foundation$. To resolve the conflict they decide that they should read the books in order σ that has a small value $d_{max}(\sigma) = \max d_K(\sigma_{Alice}, \sigma), d_K(\sigma_{Bob}, \sigma)$ where d_K is the Kendall's distance, meaning that σ is close to both Alice's and Bob's preferred order.

Which of the following orders would be the best for Alice and Bob:

(a) $PP \succ DW \succ Dune \succ AAW \succ Foundation$

(b) $AAW \succ PP \succ DW \succ Dune \succ Foundation$

(c) $PP \succ AAW \succ DW \succ Dune \succ Foundation$ **Correct answer**

Solution

The pairs:

$$(AAW, DW)$$
$$(AAW, Foundation)$$
$$(AAW, Dune)$$
$$(AAW, PP)$$
$$(DW, Foundation)$$
$$(DW, Dune)$$
$$(DW, PP)$$
$$(Foundation, Dune)$$
$$(Foundation, PP)$$
$$(Dune, PP)$$

In the following sums the pairs are gone through in this order.

(a)

$$d_K(PP \succ DW \succ Dune \succ AAW \succ Foundation,$$
$$AAW \succ DW \succ PP \succ Dune \succ Foundation) = 1+0+1+1+0+0+1+0+0+0 = 4$$

$$d_K(PP \succ DW \succ Dune \succ AAW \succ Foundation,$$
$$PP \succ Dune \succ AAW \succ DW \succ Foundation) = 1+0+0+0+0+1+0+0+0+0 = 2$$

$$\Rightarrow d_{max}(PP \succ DW \succ Dune \succ AAW \succ Foundation) = 4$$

(b) $d_{max}(AAW \succ PP \succ DW \succ Dune \succ Foundation) = 3$

(c) $d_{max}(PP \succ AAW \succ DW \succ Dune \succ Foundation) = 2$