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1. Assume you have an Ensemble ML model of 6 base-learners that each outputs the following values for a test sample: 0.2, 0.3, 0.7, 0.2, 0.9, and 0.4.

a)  If you assign the following weights to the 6 base-learners, respectively, 0.12, 0.18, 0.21, 0.18, 0.17, and 0.14, what is the fused output of the ensemble using a weighted average?

Fusion = 0.2 \* 0.12 + 0.3 \* 0.18 + 0.7 \* 0.21 + 0.2 \* 0.18 + 0.9 \* 0.17 + 0.4 \* 0.14 = 0.47

b)  What is the fused output using a median?

0.2, 0.2, 0.3, 0.4, 0.7. 0.9

Median = 0.3, 0.4

Fusion = (0.3 + 0.4) / 2 = 0.35

2. Suppose you have 4 classes, A, B, C, and D. List the pairs of classes the base-learner, binary-classification models will be trained with, if you use the Method 2 of Pairwise Coupling.

Base learner: (d1, d2, d3, d4, d5, d6)

Binary-classification:

d1: A and B d2: A and C d3: A and D

d4: B and C d5: B and D d6: C and D

3. Using the Method 2 of Pairwise Coupling:

* Assume for a test sample, the outputs

for the base-learners (d1, d2, and d3) are (assume the left class is assigned to 1 and the right class to 0):

* d1: A and B=0.6 p1(A) = 0.6 p1(B) = 0.4
* d2: A and C=0.7 p2(A) = 0.7 p2(C) = 0.3
* d3: B and C=0.5. p3(B) = 0.5 p3(C) = 0.5
  1. What is p(A), p(B), and p(C)?

P(A) = p1(A) \* p2(A) = 0.6 \* 0.7 = **0.42**

P(B) = p1(B) \* p3(B) = 0.4 \* 0.5 = 0.2

P(C )= p2(C ) \* p3(C )= 0.3 \* 0.5 = 0.15

* 1. Which class will the ensemble classify the test sample as?

Class A, because P(A) is highest among 3

4. Assume you are using four Neural Networks as the base-learners for a Bagging Ensemble and that the training set (X) contains 10 samples labeled 1-10. If N is 5, create a subset of training samples for each the base-learners. Make sure at least one of the subsets demonstrates “with replacement”.

Sample1: 1, **2, 3,** 4, 5

Sample2: **2, 3,** 4, 6, 9

Sample3: 1, 6, 7, 8, 9

Samlpe4: 2, 3, 5, 7, 8

5. Using the original Boosting algorithm, assume:

• X1 = {a, b, c, d, e}  
• X2 = {f, g, h, i, j}  
• X3 = {k, l, m, n, o}

• In Iteration1, that d1 misclassified{i, j} of X2

Give a data set for training d2 in Iteration 2.

d2 = {i, j, g, h}