

Reading 5 : AI ML Challenges

Name: Pushpak Vijay Katkhede

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1. What is the difference (conceptually, not in terms of equations) between label shift and covariate shift (two kinds of domain shift)?

Ans: Label shift occurs when the distribution in the source data does not change however, the target distribution may change. Conceptually, the example of medical diagnosis for a disease can be hold as an example to explain. Label shift will occur when we train over a sample space and predict the outcome on test data where only few let's say for an instance 2% have the disease. In real time during the pandemic situation the actual number of people having disease may be 20% or say more. So here the distribution of classes in the target set i.e. real world is changed drastically. However, in label shift the input feature does not change with period and they remain constant.

In case of covariate shift, the target distribution is same however, in contrast to the label shift here, the input features change over time. To understand let's assume that the percentage of different variants patients was equal. So, variant 1 had some different set of symptoms than variant two but the output number was still in same distribution with that of 1st training. So mostly, the algorithms which are actually trained to map input data to output data, on retraining may not recognize this new inputs on different distribution. So, because of reason that the distribution of input variables has shifted, the model may misclassify data in a live/real environment.

I have gathered this information mostly from the below paper and article :

i) <http://proceedings.mlr.press/v130/zhao21b/zhao21b.pdf>

ii) <https://www.seldon.io/what-is-covariate-shift>

2. (a) What property of a confusion matrix would cause it to be uninvertible? (Do not just share the definition of "uninvertible/singular matrix"; describe what this means for a confusion matrix.)

Ans: Consider the following standard confusion matrix for an instance,

This is mostly dependent on the correlation of the classes. When the rows and columns are not linearly independent then we have confusion matrix which is uninvertible. Which may occur due to having either TP, FP, FN, or TN having a zero. In such cases we cannot calculate the inverse of this confusion matrix.

		Actual Values	
		Positive (1)	Negative (0)
Predicted Values	Positive (1)	TP	FP
	Negative (0)	FN	TN

For an example confusion matrix if one of the classes is not predicted at all, then the corresponding row in the confusion matrix will be all zeros. So, due to this we will not be able identify accuracy over each class separately. Also, this may happen if same set of inputs give the different output classes in test set. Hence, it is important to deal with class imbalance before feeding the dataset to the classifier.

2. (b) Show an example of a 3x3 confusion matrix with this property.

Ans : Please find the example below:-

		Actual values		
Predicted Values		1	2	3
	1	40	20	0
	2	20	30	10
	3	0	20	30

3. What is one **question** you have after finishing the reading? (What wasn't clear? What needs more investigation?)

Ans: I would like to know more about how actually we do average the classifier response. I assume this is just about averaging the accuracy or other metric like we did in K fold cross validations but I would like to see it in actual example.

4. **Reflect on your work for the course over the past week.** What did you do that was effective and increased your knowledge? What could you do or change to increase what you gain from this course? Is there anything about this course you are anxious / worried about? (There are no wrong answers here; this is your chance to maximize what you get out of the course and to let me know about any concerns.)

Ans: I went through many articles that were about identifying different types of bias, identifying correlations, and about dealing with the different challenges which I eventually needed for the Initial Findings document. I was also exposed to different types of methodologies that we haven't yet discussed in the class. For this week I am planning and reading more about Prof Hutchinson's IBCV concept as I recently received some pointers from her and I hope to implement it as a part of our project. I am not anxious about anything moreover I have been really enjoying working in the content of this class. Thank you for the useful insights on the assignments.