Theory Homework - Week 5

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1 Multiclass versus Multilabel Problems

I would use categorical cross entropy:

$$H_p(q) = -\frac{1}{N}\sum_{i=1}^{N} y_i \cdot log(p(y_i)) + (1 - y_i) \cdot log(1 - p(y_i))$$

Essentially if the sample's true label is indeed this class, $log(p(y_i))$ is your loss since we want the output to be 1. Otherwise, it is $log(1-p(y_i))$, where we want it to be 0 as a predicted probability for this class.

2 A loss design problem

2.1 Question 1

First considering the case where z_i where i is even numbered, and must be larger than the number after it, we end with the following loss:

$$\sum_{i=0}^{k-1}[I(i\%2 == 0) \times max(z_{i+1} - z_i, 0)]$$

Then we consider K is an even number, so we recall that it is not affected directly by the equation above since it ends at k-1. As a result, the loss can also include the following:

$$max(5 - z_k, 0)$$

Where we check if z_k is lesser than five, enacting an additional loss if required. This is also in addition to whatever kind of loss we want to enact on the inaccuracy of the statements.

So one example loss function is as follows:

$$\sum_{i=0}^{k-1}[|z_i - z_i^{actual}|] + max(5 - z_k, 0) + \sum_{i=0}^{k-1}[I(i\%2 == 0) \times max(z_{i+1} - z_i, 0)]$$

2.2 Question 2

We attempt a grid search with different weighting on the customised proposed losses above, and the loss we enact based off difference between predicted values and actual values.

2.3 Question 3

Transform the z_k output by a value of $min(5 - z_k, 0)$, instantly fulfilling the condition for z_k. For every even numbered output, multiply it by the output of z_{i+1} where i is the index of the output. This will also ensure that the other condition is fulfilled.

2.4 Number of ways for a to be fulfilled

We can manually transform z_i a few ways:

1. Manually adding the absolute value of z_{i+1} and a constant (either set or random) to z_k, ensuring z_k is always larger than it
2. Manually multiply z_i and z_{i+1}, before taking it's absolute value. This will ensure z_i is always larger.
3. Manually setting z_i to z_{i+1}'s value, but with a minor constant added.
4. Manually reducing the value of z_{i+1} to a value smaller than z_i, for example, by subtracting the value of $z_{i+1} - z_i + 1$ so that the value is always smaller than z_i.