Learning Analytics Tools

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Lecture 3.4

Performance Metrics

Welcome back in this video we will talk about Performance Metrics in machine learning algorithms.

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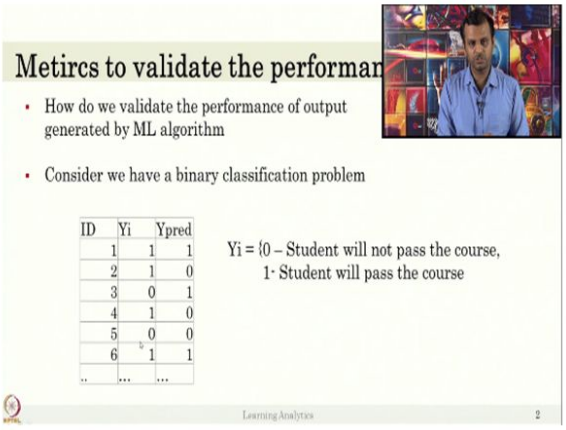

Consider, we have a binary classification problem, not the linear regression this is a binary classification problem and you have ID say there are a lot of values. For time being let us consider only 6 data points for this example and you have y_i that is the real value you already have in your test dataset and your prediction value ($y_{predicted}$) from the output of the ML model.

So the y_i is 0 for students will not pass the course, 1 the students will pass the course. So, the binary classification problem is to classify the student in whether he will pass the course or he

will not pass the course. Our intention is to identify whether the student will pass the course or not so it is about 1 and 0.

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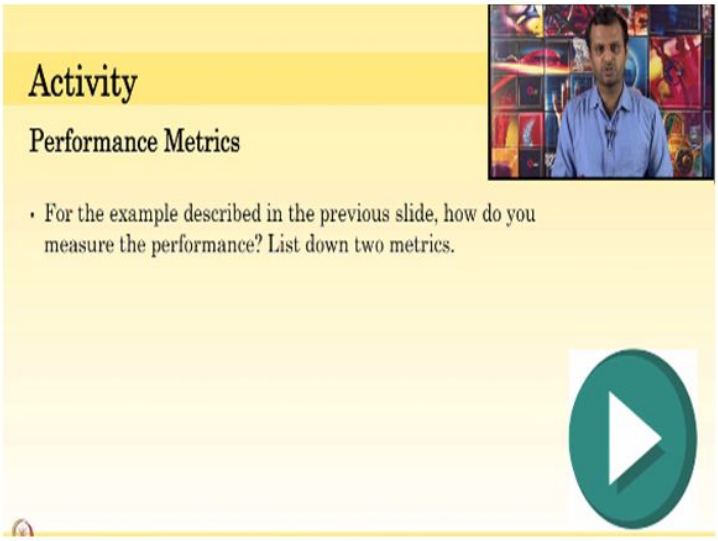

For example, described in the previous slide that is a binary classification problem of predicting students whether he will pass the course. For example, describe how do you measure the performance of the algorithm? Say you used from classification algorithm. If you think about it and list down at least two metrics if you have more metric please list down everything we will discuss them in the class.

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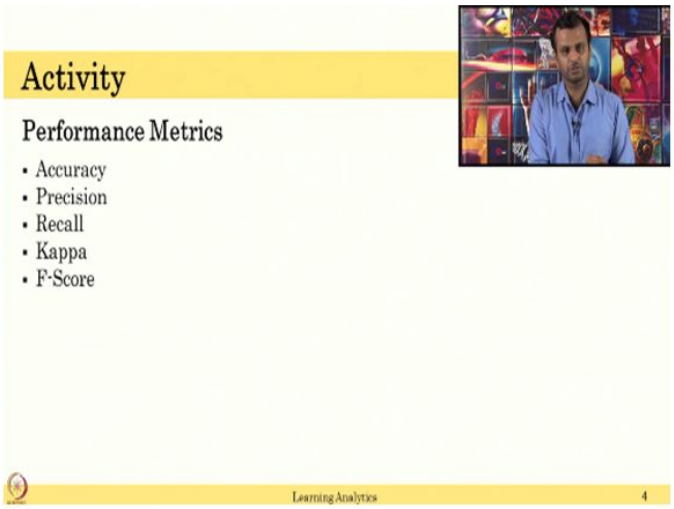

So, some of the metrics can be accuracy most people will think about that because accuracy tells exactly complete accuracy, how much accurately the classifier can classify the data and also precision, recall and also you would have heard about kappa and F- score or more like ROC AUC we will talk about that in this class.

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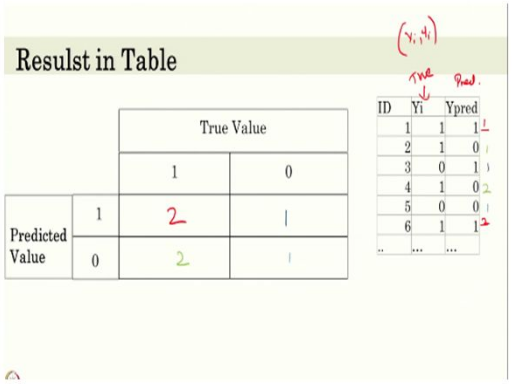

So, if I have the results in this kind of a table if I want to convert this into a table format, for example, I have y_i this is true value. You give only x_i to the machine learning algorithm to get a $y_{prediction}$ the y_i is with you so that is a true value and uses a predicted value. So, let us say this is the predicted value, this is a true value.

The predicted value is 1 and 0 and this is 1 and 0 this is called confusion matrix or in some other domain it is also called contingency table, but this is called confusion matrix. So how much true

value one has been classified as a predicted value 1? So if the true value is this how many of 1 in true value will be as exactly classified as the predicted value also 1, so this is 1, this 1, and this 1. So this is 1, this is 2.

So how many of a true value is 0 has been classified as 1? This is 1 and 0 classified as 1 it is only 1. So now how many of the values, true value 1 is misclassified as 0? So true value is 1 misclassified as 0 and true value is 1 this is misclassified as 2 this is so there are 2 values here and so the rest is 0 to 0 that is true value is also 0 and predictable is 0 so rest will be only 1.

So, now you have this data, so the data is here it is exactly what we did like a 2 and 2 so you know how to compute this confusion matrix from the given table. It is easy to compute using the excel sheet or manually computing is also good. In the excel sheet you can just write some matter or use the filters to compute these values it depends on how many data. If you have too many data I recommend you writing a small script in python. It is a good exercise for you to start writing the python scripts to create such a table.

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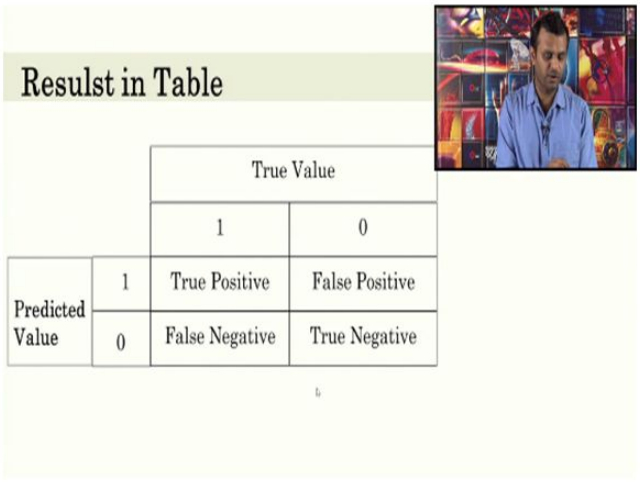

So now what all we saw in a previous slide it is called true positive, false positive, false negative and true negative this is what I am saying. If the value is 1 and it is correctly classified as 1 in our prediction model it is called true positive. If the value is 0, but we wrongly classified it is a false positive because the student will not pass the exam, but you said you will pass the exam.

So when the student will definitely pass the exam, but you classified as not positive, it is a false negative. The student will not pass the exam and you are also predicted they will not pass the exam it is a true negative. So true positive, true negative, false positive and false negative.

If you know what is type 1 and type 2 error you might now understand what is this error is matching to type 1 and type 2 error. We will talk about that later, but this is the table you have to understand. For predicted value, true value and this is a table.

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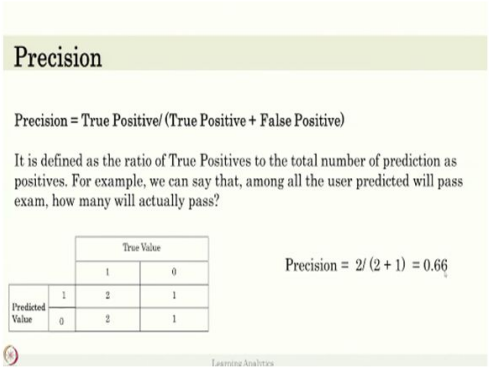

So using that table we can compute the precision, recall and accuracy. So, precision is true positive data by true positive plus false positive that is for example we can say that among all user predicted will pass the exam, how many will actually pass. Let us see that in the example we have. We have an example true positive and false positive. So among the users, you said everybody will pass, how many will actually pass?

So you said that there are 3 students will pass the exam, but actually only 2 will pass the exam so that is precision. So how do you compute it? You compute it by adding these two values that is true positive and false positive like then divided by 2. So 2 divided by, true positive plus false-positive it is 0.66 the precision score is 0.66.

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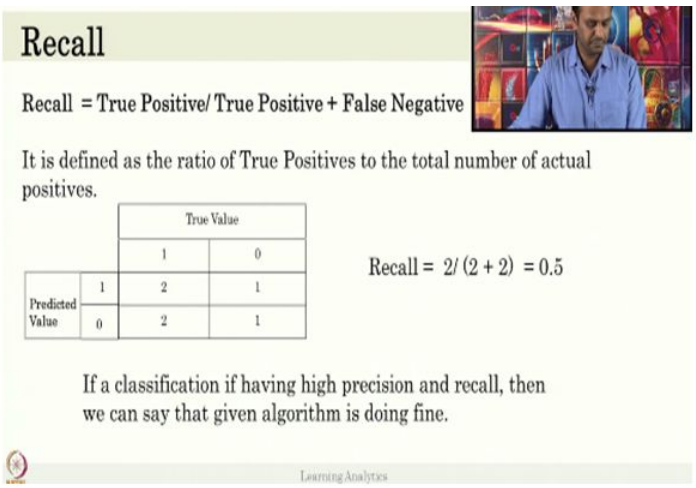

The recall value is defined as the ratio of true positive to the total number of actual positives that is the true positive is 2 and true positive plus false positive is 2 + 2 is 4. So you will see that it is 0.5 so it is a recall value. So, if we have better recall and better precision you can call that algorithm successful, but in this case, it is only 0.66 and 0.5 it is not so great.

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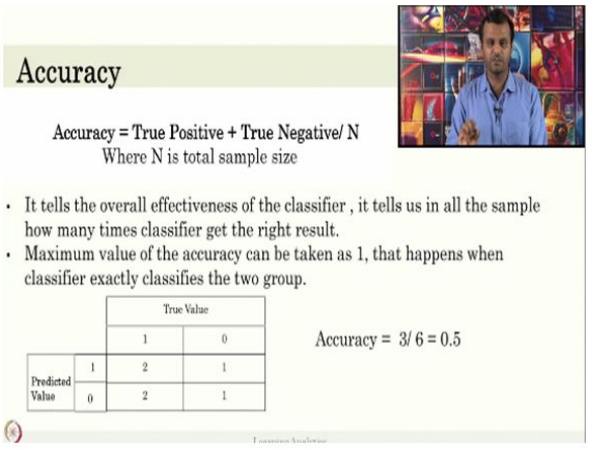

What is the accuracy? So accuracy is collectively classified as true positive and true negative divided by all the samples you have. The number of samples we have in this example is 6. So it tells the overall effectiveness of the classifier and it tells us in all the sample how many times the classifier get the correct results. So the maximum value for accuracy is of course 1 because everything classified as correctly a so N by N will be 1 if that happens the classifier is perfect.

Most of research we do will not have an accuracy equal to 1. So if we get accuracy equal to 1 and we get accuracy 1 on multiple examples, multiple observations, multiple things that kind of algorithm will be moved to commercialize that further without doing any mistakes. Most of the research will not report accuracy more than say 0.8 or 0.9 because we are trying to improve that and when we get the perfect that particular product will be commercialized.

So the product you see in a commercialized machine learning algorithm are perfected accuracy at least that should be happening. So in our example if you want to compute the accuracy the true positive and true negative is 2 plus 1, 3 the total number of samples is 6 so 3 by 6 the accuracy will be 0.5.

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In the next class, we will talk about what is kappa score and what is F-score and what is other metrics we have in the machine learning. Thank you.