

# AutoML Modeling Report

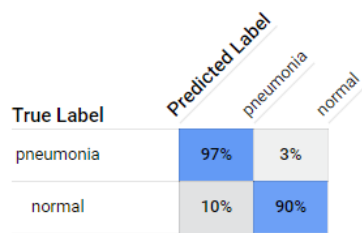


<Clifton Zhuo>

## Binary Classifier with Clean/Balanced Data

<b>Train/Test Split</b> How much data was used for training? How much data was used for testing?	180 images for training. 20 for testing.											
<b>Confusion Matrix</b> What do each of the cells in the confusion matrix describe? What values did you observe (include a screenshot)? What is the true positive rate for the “pneumonia” class? What is the false positive rate for the “normal” class?	<div><table><tr><th rowspan="2">True Label</th><th colspan="2">Predicted Label</th></tr><tr><th>normal</th><th>pneumonia</th></tr><tr><th>normal</th><td>100%</td><td>-</td></tr><tr><th>pneumonia</th><td>-</td><td>100%</td></tr></table></div> <p>Top left = True Negative Top right = False positive Bottom left = False Negative Bottom right = True Positive</p> <p>The True positive rate for Pneumonia is 100% The False positive rate for normal class is 0%</p>	True Label	Predicted Label		normal	pneumonia	normal	100%	-	pneumonia	-	100%
True Label	Predicted Label											
	normal	pneumonia										
normal	100%	-										
pneumonia	-	100%										
<b>Precision and Recall</b> What does precision measure? What does recall measure? What precision and recall did the model achieve (report the values for a score threshold of 0.5)?	<p>Precision measures how many positive predictions are made are correct (True positives / True positives + false positives). Recall measure how many positive cases is correctly predicted (True positive / True positives + False negatives).</p> <p>both precision and recall reached 100% at 0.5 threshold</p>											
<b>Score Threshold</b> When you increase the threshold what happens to precision? What happens to recall? Why?	<p>Increasing the threshold also increase the precision % but decreases the recall %. Since the precision is already 100% at 0.5 threshold, it remains at 100%. The reason is that by increasing the threshold, we put more weight on one class.</p>											

## Binary Classifier with Clean/Unbalanced Data

<b>Train/Test Split</b> How much data was used for training? How much data was used for testing?	360 for training 40 for testing.											
<b>Confusion Matrix</b> How has the confusion matrix been affected by the unbalanced data? Include a screenshot of the new confusion matrix.	<div><table><tr><th rowspan="2">True Label</th><th colspan="2">Predicted Label</th></tr><tr><th>pneumonia</th><th>normal</th></tr><tr><th>pneumonia</th><td>97%</td><td>3%</td></tr><tr><th>normal</th><td>10%</td><td>90%</td></tr></table></div> <p>The model predicts better at pneumonia (97%) than normal cases (90%). This makes sense because it gotten more pneumonia data to work with compare to normal case data.</p>	True Label	Predicted Label		pneumonia	normal	pneumonia	97%	3%	normal	10%	90%
True Label	Predicted Label											
	pneumonia	normal										
pneumonia	97%	3%										
normal	10%	90%										
<b>Precision and Recall</b> How have the model's precision and recall been affected by the unbalanced data (report the values for a score threshold of 0.5)?	Both precision and recall are 95% at 0.5 threshold.											
<b>Unbalanced Classes</b> From what you have observed, how do unbalanced classed affect a machine learning model?	Based on observation, it seems if the data is unbalanced, the most effective threshold is also no longer 0.5. Thus, a more effective way to adapt is to put more weight on one class if priority balance is the goal.											

## Binary Classifier with Dirty/Balanced Data

### Confusion Matrix

How has the confusion matrix been affected by the dirty data? Include a screenshot of the new confusion matrix.

True Label	Predicted Label	
	normal	pneumonia
normal	90%	10%
pneumonia	40%	60%

The prediction accuracy got dramatically lower compare to the other first two models.

### Precision and Recall

How have the model's precision and recall been affected by the dirty data (report the values for a score threshold of 0.5)? Of the binary classifiers, which has the highest precision? Which has the highest recall?

At 0.5 threshold, both precision and recall are at 75%. The binary classifier of the clean balanced data got the highest precision and recall.

### Dirty Data

From what you have observed, how does dirty data affect a machine learning model?

It significantly drops the performance for both precision and recall. It especially reduces its performance on predicting pneumonia cases.

## 3-Class Model

### Confusion Matrix

Summarize the 3-class confusion matrix. Which classes is the model most likely to confuse? Which class(es) is the model most likely to get right? Why might you do to try to remedy the model's "confusion"? Include a screenshot of the new confusion matrix.

True Label	Predicted Label		
	bacteria	normal	virus
bacteria	90%	-	10%
normal	-	100%	-
virus	10%	-	90%

True Label	Predicted Label		
	bacteria	normal	virus
bacteria	9	-	1
normal	-	10	-
virus	1	-	9

The model is confused between bacteria and virus mostly. The normal class got a perfect score. I would add more data so that it learns to distinguished between virus and bacteria cases more. However, I will also keep in mind that the total data preserve balance between the classes.

### Precision and Recall

What are the model's precision and recall? How are these values

Precision measures how many positive predictions are made are correct (True positives / True positives + false positives). Recall measure how many positive cases is

calculated (report the values for a score threshold of 0.5)?	<p>correctly predicted (True positive / True positives + False negatives).</p> <p>both precision and recall reached 93.33 % at 0.5 threshold</p>
<b>F1 Score</b> What is this model's F1 score?	<p>Precision bacteria = <math>9/10 = 0.9</math>  Precision normal = 1  Precision virus = <math>9/10 = 0.9</math>  Overall Precision = 93.33%</p> <p>Recall bacteria = <math>9/10</math>  Recall normal = 1  Recall virus = <math>9/10</math>  Overall Recall = 93.33%</p> <p><b>F1 = <math>2 \cdot 0.93 \cdot 0.93 / 0.93 + 0.93 = 0.93</math></b></p>