

## Confusion Matrix

```
# Display the confusion matrix
from sklearn.metrics import confusion_matrix

confusion_matrix(y_test, y_pred)

array([[110,  11],
       [ 14, 113]], dtype=int64)
```

	Predicted Fail	Predicted Pass
Actual Fail	110 (True Negative)	11 (False Positive)
Actual Pass	14 (False Negative)	113 (True Positive)

- The True Positives (TP) are the correct predictions of the "Pass" class - In this case, we have 113 true positives.
- The False Positives (FP) are the incorrect predictions of the "Pass" class - In this case, we have 11 false positives.
- The True Negatives (TN) are the correct predictions of the "Fail" class - In this case, we have 110 true negatives.
- The False Negatives (FN) are the incorrect predictions of the "Fail" class - In this case, we have 14 false negatives.

In summary, this confusion matrix indicates that the model correctly predicted 223 instances (110 true negatives + 113 true positives) and made 25 errors (11 false positives + 14 false negatives) in total. Additionally, the model appears to perform well overall since it has a high number of true positives and true negatives and a relatively low number of false positives and false negatives.

```
# Print the imbalanced classification report

from imblearn.metrics import classification_report_imbalanced

print(classification_report_imbalanced(y_test, y_pred))
```

	pre	rec	spe	f1	geo	iba	sup
0	0.89	0.91	0.89	0.90	0.90	0.81	121
1	0.91	0.89	0.91	0.90	0.90	0.81	127
avg / total	0.90	0.90	0.90	0.90	0.90	0.81	248

	precision	recall	specificity	f1	geometric mean	Index balanced accuracy (IBA)	# of samples
Fail	0.89	0.91	0.89	0.90	0.90	0.81	121
Pass	0.91	0.89	0.91	0.90	0.90	0.81	127
avg/ total	0.90	0.90	0.90	0.90	0.90	0.81	248

The classification report shows the precision, recall, specificity, F1-score, geometric mean, and index balanced accuracy (IBA) for each class as well as the average values across all classes.

- The precision for Fail is 0.89, which means that out of all the predicted negatives, 89% of them are truly negative (true negatives / (true negatives + false negatives)).
- The recall for Fail is 0.91, which means that out of all the true negatives, 91% of them are correctly identified as negative (true negatives / (true negatives + false positives)).
- The specificity for Fail is 0.89, which means that out of all the actual negatives, 89% of them are correctly identified as negative (true negatives / (true negatives + false positives)).
- The F1-score for Fail is 0.90, which is the harmonic mean of precision and recall, and is a measure of the classifier's overall accuracy for this class.
- The geometric mean for Fail is 0.90, which is a measure of the classifier's overall ability to balance both recall and specificity.
- The IBA for Fail is 0.81, which is a measure of the classifier's overall performance for this class.

The same set of metrics is reported for Pass, and in this case, the precision, recall, specificity, F1-score, geometric mean, and IBA are 0.91, 0.89, 0.91, 0.90, 0.90, and 0.81, respectively.

Finally, the average values across both classes are also reported in the report. In this case, the average precision, recall, specificity, F1-score, geometric mean, and IBA are 0.90, 0.90, 0.90, 0.90, 0.90, and 0.81, respectively.

Overall, based on this report, the model appears to perform well for both classes with high precision, recall, and F1-score, indicating that it is able to accurately classify instances from both classes.