```
22/22 [==============================] - 59s 3s/step - loss: 1.8738 - accuracy: 0.1968 - val_loss: 1.7327 - val_accuracy: 0.3646
Epoch 3/50
22/22 [==============================] - 60s 3s/step - loss: 1.7208 - accuracy: 0.3122 - val_loss: 1.6286 - val_accuracy: 0.4062
Epoch 4/50
22/22 [==============================] - 59s 3s/step - loss: 1.6729 - accuracy: 0.3505 - val_loss: 1.5680 - val_accuracy: 0.4167
Epoch 5/50
22/22 [==============================] - 59s 3s/step - loss: 1.5920 - accuracy: 0.3612 - val_loss: 1.5103 - val_accuracy: 0.4375
Epoch 6/50
22/22 [==============================] - 59s 3s/step - loss: 1.5115 - accuracy: 0.3969 - val_loss: 1.4767 - val_accuracy: 0.4375
Epoch 7/50
22/22 [==============================] - 59s 3s/step - loss: 1.5406 - accuracy: 0.3747 - val_loss: 1.4153 - val_accuracy: 0.4375
Epoch 8/50
22/22 [==============================] - 59s 3s/step - loss: 1.4546 - accuracy: 0.4070 - val_loss: 1.3994 - val_accuracy: 0.4375
Epoch 9/50
22/22 [==============================] - 59s 3s/step - loss: 1.4271 - accuracy: 0.4277 - val_loss: 1.3701 - val_accuracy: 0.4479
Epoch 10/50
22/22 [==============================] - 59s 3s/step - loss: 1.4071 - accuracy: 0.4592 - val_loss: 1.3598 - val_accuracy: 0.4375
Epoch 11/50
22/22 [==============================] - 59s 3s/step - loss: 1.3337 - accuracy: 0.4800 - val_loss: 1.3478 - val_accuracy: 0.4792
Epoch 12/50
22/22 [==============================] - 59s 3s/step - loss: 1.3038 - accuracy: 0.4993 - val_loss: 1.3181 - val_accuracy: 0.4896
Epoch 13/50
22/22 [==============================] - 59s 3s/step - loss: 1.3817 - accuracy: 0.4594 - val_loss: 1.2905 - val_accuracy: 0.4896
Epoch 14/50
22/22 [==============================] - 59s 3s/step - loss: 1.2661 - accuracy: 0.5028 - val_loss: 1.2873 - val_accuracy: 0.5104
Epoch 15/50
22/22 [==============================] - 59s 3s/step - loss: 1.2309 - accuracy: 0.5302 - val_loss: 1.2650 - val_accuracy: 0.5208
Epoch 16/50
22/22 [==============================] - 59s 3s/step - loss: 1.3263 - accuracy: 0.4500 - val_loss: 1.2635 - val_accuracy: 0.4792
Epoch 17/50
22/22 [==============================] - 59s 3s/step - loss: 1.2323 - accuracy: 0.4943 - val_loss: 1.2617 - val_accuracy: 0.4688
Epoch 18/50
22/22 [==============================] - 60s 3s/step - loss: 1.1807 - accuracy: 0.5120 - val_loss: 1.2310 - val_accuracy: 0.5312
Epoch 19/50
22/22 [==============================] - 60s 3s/step - loss: 1.2107 - accuracy: 0.5274 - val_loss: 1.2186 - val_accuracy: 0.5000
Epoch 20/50
22/22 [==============================] - 59s 3s/step - loss: 1.1447 - accuracy: 0.5386 - val_loss: 1.2250 - val_accuracy: 0.5104
Epoch 21/50
22/22 [==============================] - 59s 3s/step - loss: 1.1655 - accuracy: 0.5500 - val_loss: 1.2074 - val_accuracy: 0.4896
Epoch 22/50
22/22 [==============================] - 59s 3s/step - loss: 1.1121 - accuracy: 0.5600 - val_loss: 1.2162 - val_accuracy: 0.4896
Epoch 23/50
22/22 [==============================] - 59s 3s/step - loss: 1.0493 - accuracy: 0.5993 - val_loss: 1.2011 - val_accuracy: 0.5104
Epoch 24/50
22/22 [==============================] - 59s 3s/step - loss: 1.0995 - accuracy: 0.5556 - val_loss: 1.1798 - val_accuracy: 0.5000
Epoch 25/50
22/22 [==============================] - 59s 3s/step - loss: 1.0702 - accuracy: 0.5923 - val_loss: 1.1714 - val_accuracy: 0.5208
Epoch 26/50
22/22 [==============================] - 62s 3s/step - loss: 1.0671 - accuracy: 0.6151 - val_loss: 1.1848 - val_accuracy: 0.5208
Epoch 27/50
22/22 [==============================] - 61s 3s/step - loss: 1.0723 - accuracy: 0.5756 - val_loss: 1.1857 - val_accuracy: 0.5104
Epoch 28/50
22/22 [==============================] - 60s 3s/step - loss: 1.0173 - accuracy: 0.5680 - val_loss: 1.1904 - val_accuracy: 0.4896
Epoch 29/50
22/22 [==============================] - 59s 3s/step - loss: 0.9938 - accuracy: 0.5930 - val_loss: 1.1520 - val_accuracy: 0.5000
Epoch 30/50
22/22 [==============================] - 60s 3s/step - loss: 1.0458 - accuracy: 0.5990 - val_loss: 1.1813 - val_accuracy: 0.5000
Epoch 31/50
22/22 [==============================] - 60s 3s/step - loss: 0.9964 - accuracy: 0.6338 - val_loss: 1.1858 - val_accuracy: 0.5208
Epoch 32/50
22/22 [==============================] - 61s 3s/step - loss: 0.9603 - accuracy: 0.6494 - val_loss: 1.1785 - val_accuracy: 0.5104
Epoch 33/50
22/22 [==============================] - 61s 3s/step - loss: 0.9469 - accuracy: 0.6650 - val_loss: 1.1639 - val_accuracy: 0.4896
Epoch 34/50
22/22 [==============================] - 64s 3s/step - loss: 0.9461 - accuracy: 0.6608 - val_loss: 1.1321 - val_accuracy: 0.5000
Epoch 35/50
22/22 [==============================] - 63s 3s/step - loss: 0.9037 - accuracy: 0.6673 - val_loss: 1.1616 - val_accuracy: 0.5208
Epoch 36/50
22/22 [==============================] - 62s 3s/step - loss: 0.9013 - accuracy: 0.6530 - val_loss: 1.1433 - val_accuracy: 0.5104
Epoch 37/50
22/22 [==============================] - 59s 3s/step - loss: 0.8838 - accuracy: 0.6296 - val_loss: 1.1330 - val_accuracy: 0.5521
Epoch 38/50
22/22 [==============================] - 60s 3s/step - loss: 0.8770 - accuracy: 0.6491 - val_loss: 1.1515 - val_accuracy: 0.5208
Epoch 39/50
22/22 [==============================] - 60s 3s/step - loss: 0.8015 - accuracy: 0.6982 - val_loss: 1.1596 - val_accuracy: 0.5521
Epoch 40/50
22/22 [==============================] - 59s 3s/step - loss: 0.7981 - accuracy: 0.7163 - val_loss: 1.1702 - val_accuracy: 0.5312
Epoch 41/50
22/22 [==============================] - 60s 3s/step - loss: 0.8196 - accuracy: 0.7001 - val_loss: 1.1612 - val_accuracy: 0.5312
Epoch 42/50
22/22 [==============================] - 59s 3s/step - loss: 0.8021 - accuracy: 0.7219 - val_loss: 1.1595 - val_accuracy: 0.5104
Epoch 43/50
22/22 [==============================] - 59s 3s/step - loss: 0.7502 - accuracy: 0.7155 - val_loss: 1.1803 - val_accuracy: 0.5208
Epoch 44/50
22/22 [==============================] - 59s 3s/step - loss: 0.8040 - accuracy: 0.7058 - val_loss: 1.1613 - val_accuracy: 0.4896
Epoch 45/50
22/22 [==============================] - 59s 3s/step - loss: 0.7917 - accuracy: 0.6940 - val_loss: 1.1234 - val_accuracy: 0.5625
Epoch 46/50
22/22 [==============================] - 60s 3s/step - loss: 0.7433 - accuracy: 0.7285 - val_loss: 1.1765 - val_accuracy: 0.5833
Epoch 47/50
22/22 [==============================] - 60s 3s/step - loss: 0.7371 - accuracy: 0.7531 - val_loss: 1.1870 - val_accuracy: 0.4896
Epoch 48/50
22/22 [==============================] - 59s 3s/step - loss: 0.7385 - accuracy: 0.7429 - val_loss: 1.1788 - val_accuracy: 0.5625
Epoch 49/50
22/22 [==============================] - 60s 3s/step - loss: 0.7162 - accuracy: 0.7273 - val_loss: 1.1971 - val_accuracy: 0.5417
Epoch 50/50
22/22 [==============================] - 62s 3s/step - loss: 0.6815 - accuracy: 0.7270 - val_loss: 1.1944 - val_accuracy: 0.5417
```

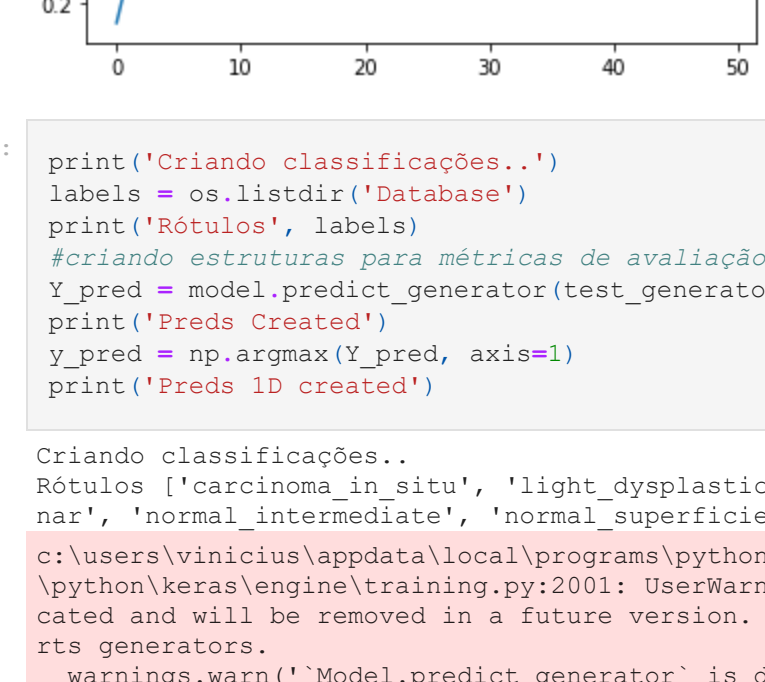
In [13]:

```python
#Avaliando o modelo
loss_train, train_acc = model.evaluate_generator(train_generator, steps=step_size_tra
loss_test, test_acc = model.evaluate_generator(test_generator, steps=step_size_test)
print('Train: %.3f, Test: %.3f' % (train_acc, test_acc))
```

```
Train: 0.906, Test: 0.542
```

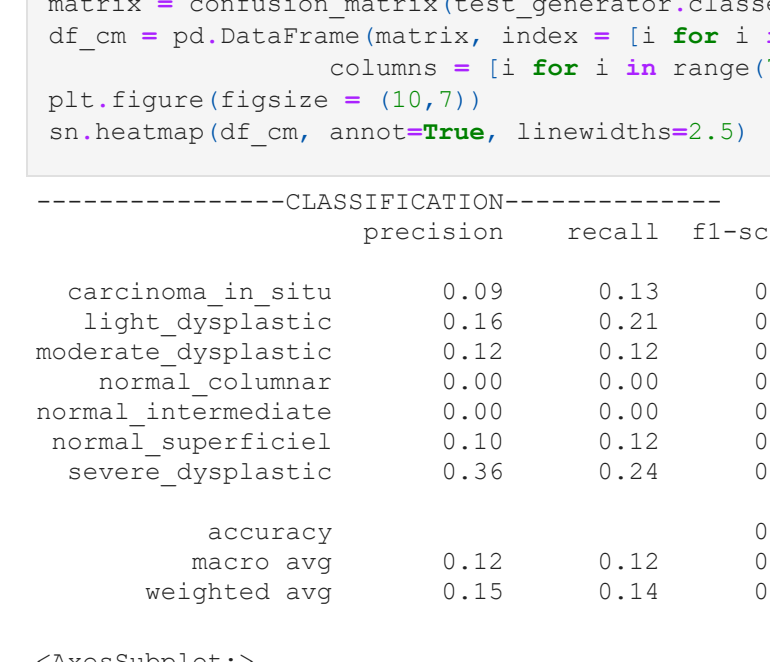
In [14]:

```python
#Apresentando resultados em graficos
plt.title('Loss')
plt.plot(history.history['loss'], label='train')
plt.plot(history.history['val_loss'], label='test')
plt.legend()
plt.show()
```



In [15]:

```python
# Criando graficos para visualização dos resultados
print()
print()
plt.title('Accuracy')
plt.plot(history.history['accuracy'], label='train')
plt.plot(history.history['val_accuracy'], label='test')
plt.legend()
plt.show()
```



In [16]:

```python
print('Criando classificações..')
labels = os.listdir('Database')
print('Rótulos', labels)
#criando estruturas para métricas de avaliação, processo um pouco mais demorado
Y_pred = model.predict_generator(test_generator)
print('Preds Created')
y_pred = np.argmax(Y_pred, axis=1)
print('Preds 1D created')
```

```
Criando classificações..
Rótulos ['carcinoma_in_situ', 'light_dysplastic', 'moderate_dysplastic', 'normal_colum
nar', 'normal_intermediate', 'normal_superficiel', 'severe_dysplastic']
c:\users\vinicius\appdata\local\programs\python\python39\lib\site-packages\tensorflow
\python\keras\engine\training.py:2001: UserWarning: `Model.predict_generator` is depre
cated and will be removed in a future version. Please use `Model.predict`, which suppo
rts generators.
  warnings.warn('`Model.predict_generator` is deprecated and '
Preds Created
Preds 1D created
```

In [18]:

```python
classification = classification_report(test_generator.classes, y_pred, target_names=la
print('----------------CLASSIFICATION--------------')
print(classification)
matrix = confusion_matrix(test_generator.classes, y_pred)
df_cm = pd.DataFrame(matrix, index = [i for i in range(7)],
                  columns = [i for i in range(7)])
plt.figure(figsize = (10,7))
sn.heatmap(df_cm, annot=True, linewidths=2.5)
```

```
----------------CLASSIFICATION--------------
                     precision    recall  f1-score   support

  carcinoma_in_situ       0.09      0.13      0.11        15
   light_dysplastic       0.16      0.21      0.18        19
moderate_dysplastic       0.12      0.12      0.12        16
    normal_columnar       0.00      0.00      0.00        11
normal_intermediate       0.00      0.00      0.00         7
 normal_superficiel       0.10      0.12      0.11         8
  severe_dysplastic       0.36      0.24      0.29        21

           accuracy                           0.14        97
          macro avg       0.12      0.12      0.12        97
       weighted avg       0.15      0.14      0.14        97
```

Out[18]: <AxesSubplot:>

In [ ]: