Unet-keras-kaggle

March 22, 2022

1 Resultados Parciais PIBIC 2021-2022

1.1 Finding and Measuring Lungs in CT Data

Desafio Kaggle

Código utilizado como base para a U-net com a biblioteca Keras

[1]:
```
import os
for dirname, _, filenames in os.walk('/content/drive/MyDrive/PIBIC-2022/kaggle/
↪2d_images'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

```
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0000_Z_0142.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0001_Z_0146.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0002_Z_0162.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0003_Z_0132.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0004_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0005_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0006_Z_0206.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0007_Z_0211.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0008_Z_0065.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0009_Z_0114.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0010_Z_0259.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0011_Z_0156.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0012_Z_0167.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0013_Z_0047.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0014_Z_0116.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0015_Z_0136.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0016_Z_0208.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0017_Z_0061.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0018_Z_0069.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0019_Z_0088.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0020_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0021_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0022_Z_0131.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0023_Z_0241.tif
```

/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0024_Z_0086.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0025_Z_0112.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0026_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0027_Z_0125.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0028_Z_0125.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0029_Z_0059.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0030_Z_0302.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0031_Z_0232.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0032_Z_0055.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0033_Z_0278.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0034_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0035_Z_0224.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0036_Z_0060.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0037_Z_0150.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0038_Z_0148.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0039_Z_0112.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0040_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0041_Z_0336.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0042_Z_0366.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0043_Z_0097.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0044_Z_0116.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0045_Z_0131.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0046_Z_0110.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0047_Z_0272.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0048_Z_0294.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0049_Z_0105.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0050_Z_0085.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0051_Z_0130.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0052_Z_0108.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0053_Z_0127.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0054_Z_0135.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0055_Z_0122.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0056_Z_0163.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0057_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0058_Z_0150.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0059_Z_0150.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0060_Z_0147.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0061_Z_0064.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0062_Z_0125.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0063_Z_0067.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0064_Z_0069.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0065_Z_0126.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0066_Z_0141.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0067_Z_0238.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0068_Z_0055.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0069_Z_0054.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0070_Z_0120.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0071_Z_0072.tif

/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0072_Z_0119.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0073_Z_0076.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0074_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0075_Z_0061.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0076_Z_0230.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0077_Z_0173.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0078_Z_0058.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0079_Z_0072.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0080_Z_0213.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0081_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0082_Z_0278.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0083_Z_0256.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0084_Z_0218.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0085_Z_0237.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0086_Z_0253.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0087_Z_0237.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0088_Z_0100.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0089_Z_0341.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0090_Z_0119.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0091_Z_0063.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0092_Z_0258.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0093_Z_0123.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0094_Z_0214.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0095_Z_0097.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0096_Z_0216.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0097_Z_0098.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0098_Z_0068.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0099_Z_0069.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0100_Z_0062.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0101_Z_0196.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0102_Z_0238.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0103_Z_0069.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0104_Z_0101.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0105_Z_0240.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0106_Z_0130.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0107_Z_0062.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0108_Z_0259.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0109_Z_0134.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0110_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0111_Z_0078.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0112_Z_0085.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0113_Z_0090.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0114_Z_0078.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0115_Z_0060.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0116_Z_0116.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0117_Z_0235.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0118_Z_0206.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0119_Z_0063.tif

/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0120_Z_0123.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0121_Z_0245.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0122_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0123_Z_0073.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0124_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0125_Z_0119.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0126_Z_0139.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0127_Z_0064.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0128_Z_0130.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0129_Z_0104.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0130_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0131_Z_0097.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0132_Z_0069.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0133_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0134_Z_0137.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0135_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0136_Z_0122.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0137_Z_0155.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0138_Z_0063.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0139_Z_0056.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0140_Z_0230.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0141_Z_0128.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0142_Z_0145.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0143_Z_0124.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0144_Z_0224.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0145_Z_0059.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0146_Z_0122.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0147_Z_0051.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0148_Z_0254.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0149_Z_0269.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0150_Z_0090.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0151_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0152_Z_0133.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0153_Z_0065.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0154_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0155_Z_0130.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0156_Z_0099.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0157_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0158_Z_0164.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0159_Z_0104.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0160_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0161_Z_0075.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0162_Z_0091.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0163_Z_0138.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0164_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0165_Z_0145.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0166_Z_0072.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0167_Z_0128.tif

/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0168_Z_0130.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0169_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0170_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0171_Z_0184.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0172_Z_0098.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0173_Z_0110.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0174_Z_0054.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0175_Z_0165.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0176_Z_0162.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0177_Z_0163.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0178_Z_0127.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0179_Z_0130.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0180_Z_0086.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0181_Z_0122.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0182_Z_0060.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0183_Z_0242.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0184_Z_0089.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0185_Z_0131.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0186_Z_0102.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0187_Z_0145.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0188_Z_0137.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0189_Z_0132.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0190_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0191_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0192_Z_0064.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0193_Z_0060.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0194_Z_0120.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0195_Z_0062.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0196_Z_0259.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0197_Z_0123.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0198_Z_0120.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0199_Z_0119.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0200_Z_0125.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0201_Z_0241.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0202_Z_0098.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0203_Z_0079.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0204_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0205_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0206_Z_0062.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0207_Z_0160.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0208_Z_0063.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0209_Z_0267.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0210_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0211_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0212_Z_0064.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0213_Z_0088.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0214_Z_0120.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0215_Z_0238.tif

/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0216_Z_0057.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0217_Z_0078.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0218_Z_0231.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0219_Z_0222.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0220_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0221_Z_0081.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0222_Z_0122.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0223_Z_0214.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0224_Z_0210.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0225_Z_0069.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0226_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0227_Z_0181.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0228_Z_0097.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0229_Z_0060.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0230_Z_0242.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0231_Z_0140.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0232_Z_0063.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0233_Z_0064.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0234_Z_0096.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0235_Z_0058.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0236_Z_0122.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0237_Z_0061.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0238_Z_0253.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0239_Z_0365.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0240_Z_0066.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0241_Z_0124.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0242_Z_0123.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0243_Z_0056.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0244_Z_0184.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0245_Z_0318.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0246_Z_0228.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0247_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0248_Z_0062.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0249_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0250_Z_0070.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0251_Z_0125.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0252_Z_0064.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0253_Z_0238.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0254_Z_0075.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0255_Z_0061.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0256_Z_0062.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0257_Z_0071.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0258_Z_0072.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0259_Z_0073.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0260_Z_0148.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0261_Z_0238.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0262_Z_0064.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0263_Z_0093.tif

```
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0264_Z_0080.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0265_Z_0063.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0266_Z_0202.tif
```

[2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
import seaborn as sns
%matplotlib inline

np.random.seed(2)

from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
import itertools
```

[3]:
```
!pip install tensorflow==2.4.1
!pip install keras==2.4.3
```

```
Collecting tensorflow==2.4.1
  Downloading tensorflow-2.4.1-cp37-cp37m-manylinux2010_x86_64.whl (394.3 MB)
     |                 | 394.3 MB 12 kB/s
Requirement already satisfied: opt-einsum~=3.3.0 in
/usr/local/lib/python3.7/dist-packages (from tensorflow==2.4.1) (3.3.0)
Requirement already satisfied: keras-preprocessing~=1.1.2 in
/usr/local/lib/python3.7/dist-packages (from tensorflow==2.4.1) (1.1.2)
Collecting wrapt~=1.12.1
  Downloading wrapt-1.12.1.tar.gz (27 kB)
Requirement already satisfied: termcolor~=1.1.0 in
/usr/local/lib/python3.7/dist-packages (from tensorflow==2.4.1) (1.1.0)
Collecting absl-py~=0.10
  Downloading absl_py-0.15.0-py3-none-any.whl (132 kB)
     |                 | 132 kB 58.8 MB/s
Collecting typing-extensions~=3.7.4
  Downloading typing_extensions-3.7.4.3-py3-none-any.whl (22 kB)
Collecting gast==0.3.3
  Downloading gast-0.3.3-py2.py3-none-any.whl (9.7 kB)
Collecting grpcio~=1.32.0
  Downloading grpcio-1.32.0-cp37-cp37m-manylinux2014_x86_64.whl (3.8 MB)
     |                 | 3.8 MB 37.8 MB/s
Collecting tensorboard~=2.4
  Downloading tensorboard-2.8.0-py3-none-any.whl (5.8 MB)
     |                 | 5.8 MB 28.8 MB/s
Requirement already satisfied: six~=1.15.0 in
/usr/local/lib/python3.7/dist-packages (from tensorflow==2.4.1) (1.15.0)
Requirement already satisfied: astunparse~=1.6.3 in
/usr/local/lib/python3.7/dist-packages (from tensorflow==2.4.1) (1.6.3)
```

```
Requirement already satisfied: protobuf>=3.9.2 in /usr/local/lib/python3.7/dist-
packages (from tensorflow==2.4.1) (3.17.3)
Requirement already satisfied: google-pasta~=0.2 in
/usr/local/lib/python3.7/dist-packages (from tensorflow==2.4.1) (0.2.0)
Collecting h5py~=2.10.0
  Downloading h5py-2.10.0-cp37-cp37m-manylinux1_x86_64.whl (2.9 MB)
     |                  | 2.9 MB 19.6 MB/s
Collecting flatbuffers~=1.12.0
  Downloading flatbuffers-1.12-py2.py3-none-any.whl (15 kB)
Collecting numpy~=1.19.2
  Downloading numpy-1.19.5-cp37-cp37m-manylinux2010_x86_64.whl (14.8 MB)
     |                  | 14.8 MB 35.8 MB/s
Requirement already satisfied: wheel~=0.35 in
/usr/local/lib/python3.7/dist-packages (from tensorflow==2.4.1) (0.37.1)
Collecting tensorflow-estimator<2.5.0,>=2.4.0
  Downloading tensorflow_estimator-2.4.0-py2.py3-none-any.whl (462 kB)
     |                  | 462 kB 54.7 MB/s
Requirement already satisfied: requests<3,>=2.21.0 in
/usr/local/lib/python3.7/dist-packages (from
tensorboard~=2.4->tensorflow==2.4.1) (2.23.0)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in
/usr/local/lib/python3.7/dist-packages (from
tensorboard~=2.4->tensorflow==2.4.1) (0.6.1)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in
/usr/local/lib/python3.7/dist-packages (from
tensorboard~=2.4->tensorflow==2.4.1) (1.8.1)
Requirement already satisfied: setuptools>=41.0.0 in
/usr/local/lib/python3.7/dist-packages (from
tensorboard~=2.4->tensorflow==2.4.1) (57.4.0)
Requirement already satisfied: google-auth<3,>=1.6.3 in
/usr/local/lib/python3.7/dist-packages (from
tensorboard~=2.4->tensorflow==2.4.1) (1.35.0)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in
/usr/local/lib/python3.7/dist-packages (from
tensorboard~=2.4->tensorflow==2.4.1) (0.4.6)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.7/dist-
packages (from tensorboard~=2.4->tensorflow==2.4.1) (3.3.6)
Requirement already satisfied: werkzeug>=0.11.15 in
/usr/local/lib/python3.7/dist-packages (from
tensorboard~=2.4->tensorflow==2.4.1) (1.0.1)
Requirement already satisfied: cachetools<5.0,>=2.0.0 in
/usr/local/lib/python3.7/dist-packages (from google-
auth<3,>=1.6.3->tensorboard~=2.4->tensorflow==2.4.1) (4.2.4)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.7/dist-
packages (from google-auth<3,>=1.6.3->tensorboard~=2.4->tensorflow==2.4.1) (4.8)
Requirement already satisfied: pyasn1-modules>=0.2.1 in
/usr/local/lib/python3.7/dist-packages (from google-
auth<3,>=1.6.3->tensorboard~=2.4->tensorflow==2.4.1) (0.2.8)
```

```
Requirement already satisfied: requests-oauthlib>=0.7.0 in
/usr/local/lib/python3.7/dist-packages (from google-auth-
oauthlib<0.5,>=0.4.1->tensorboard~=2.4->tensorflow==2.4.1) (1.3.1)
Requirement already satisfied: importlib-metadata>=4.4 in
/usr/local/lib/python3.7/dist-packages (from
markdown>=2.6.8->tensorboard~=2.4->tensorflow==2.4.1) (4.11.2)
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-
packages (from importlib-
metadata>=4.4->markdown>=2.6.8->tensorboard~=2.4->tensorflow==2.4.1) (3.7.0)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in
/usr/local/lib/python3.7/dist-packages (from pyasn1-modules>=0.2.1->google-
auth<3,>=1.6.3->tensorboard~=2.4->tensorflow==2.4.1) (0.4.8)
Requirement already satisfied: chardet<4,>=3.0.2 in
/usr/local/lib/python3.7/dist-packages (from
requests<3,>=2.21.0->tensorboard~=2.4->tensorflow==2.4.1) (3.0.4)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-
packages (from requests<3,>=2.21.0->tensorboard~=2.4->tensorflow==2.4.1) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.7/dist-packages (from
requests<3,>=2.21.0->tensorboard~=2.4->tensorflow==2.4.1) (2021.10.8)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in
/usr/local/lib/python3.7/dist-packages (from
requests<3,>=2.21.0->tensorboard~=2.4->tensorflow==2.4.1) (1.24.3)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.7/dist-
packages (from requests-oauthlib>=0.7.0->google-auth-
oauthlib<0.5,>=0.4.1->tensorboard~=2.4->tensorflow==2.4.1) (3.2.0)
Building wheels for collected packages: wrapt
  Building wheel for wrapt (setup.py) … done
  Created wheel for wrapt: filename=wrapt-1.12.1-cp37-cp37m-linux_x86_64.whl
size=68719
sha256=6db3a3deb0b031fa2ff6a398b7e94364dd6c38d0b856c2c9368e897f4c37852b
  Stored in directory: /root/.cache/pip/wheels/62/76/4c/aa25851149f3f6d9785f6c86
9387ad82b3fd37582fa8147ac6
Successfully built wrapt
Installing collected packages: typing-extensions, numpy, grpcio, absl-py, wrapt,
tensorflow-estimator, tensorboard, h5py, gast, flatbuffers, tensorflow
  Attempting uninstall: typing-extensions
    Found existing installation: typing-extensions 3.10.0.2
    Uninstalling typing-extensions-3.10.0.2:
      Successfully uninstalled typing-extensions-3.10.0.2
  Attempting uninstall: numpy
    Found existing installation: numpy 1.21.5
    Uninstalling numpy-1.21.5:
      Successfully uninstalled numpy-1.21.5
  Attempting uninstall: grpcio
    Found existing installation: grpcio 1.44.0
    Uninstalling grpcio-1.44.0:
      Successfully uninstalled grpcio-1.44.0
```

```
  Attempting uninstall: absl-py
    Found existing installation: absl-py 1.0.0
    Uninstalling absl-py-1.0.0:
      Successfully uninstalled absl-py-1.0.0
  Attempting uninstall: wrapt
    Found existing installation: wrapt 1.13.3
    Uninstalling wrapt-1.13.3:
      Successfully uninstalled wrapt-1.13.3
  Attempting uninstall: tensorflow-estimator
    Found existing installation: tensorflow-estimator 2.1.0
    Uninstalling tensorflow-estimator-2.1.0:
      Successfully uninstalled tensorflow-estimator-2.1.0
  Attempting uninstall: tensorboard
    Found existing installation: tensorboard 2.1.1
    Uninstalling tensorboard-2.1.1:
      Successfully uninstalled tensorboard-2.1.1
  Attempting uninstall: h5py
    Found existing installation: h5py 3.1.0
    Uninstalling h5py-3.1.0:
      Successfully uninstalled h5py-3.1.0
  Attempting uninstall: gast
    Found existing installation: gast 0.2.2
    Uninstalling gast-0.2.2:
      Successfully uninstalled gast-0.2.2
  Attempting uninstall: flatbuffers
    Found existing installation: flatbuffers 2.0
    Uninstalling flatbuffers-2.0:
      Successfully uninstalled flatbuffers-2.0
  Attempting uninstall: tensorflow
    Found existing installation: tensorflow 2.1.0
    Uninstalling tensorflow-2.1.0:
      Successfully uninstalled tensorflow-2.1.0
ERROR: pip's dependency resolver does not currently take into account all
the packages that are installed. This behaviour is the source of the following
dependency conflicts.
datascience 0.10.6 requires folium==0.2.1, but you have folium 0.8.3 which is
incompatible.
albumentations 0.1.12 requires imgaug<0.2.7,>=0.2.5, but you have imgaug 0.2.9
which is incompatible.
Successfully installed absl-py-0.15.0 flatbuffers-1.12 gast-0.3.3 grpcio-1.32.0
h5py-2.10.0 numpy-1.19.5 tensorboard-2.8.0 tensorflow-2.4.1 tensorflow-
estimator-2.4.0 typing-extensions-3.7.4.3 wrapt-1.12.1

Collecting keras==2.4.3
  Downloading Keras-2.4.3-py2.py3-none-any.whl (36 kB)
```

```
Requirement already satisfied: numpy>=1.9.1 in /usr/local/lib/python3.7/dist-
packages (from keras==2.4.3) (1.19.5)
Requirement already satisfied: pyyaml in /usr/local/lib/python3.7/dist-packages
(from keras==2.4.3) (3.13)
Requirement already satisfied: h5py in /usr/local/lib/python3.7/dist-packages
(from keras==2.4.3) (2.10.0)
Requirement already satisfied: scipy>=0.14 in /usr/local/lib/python3.7/dist-
packages (from keras==2.4.3) (1.4.1)
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages
(from h5py->keras==2.4.3) (1.15.0)
Installing collected packages: keras
  Attempting uninstall: keras
    Found existing installation: Keras 2.3.1
    Uninstalling Keras-2.3.1:
      Successfully uninstalled Keras-2.3.1
Successfully installed keras-2.4.3
```

[4]:
```
from tensorflow.keras.layers import *
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.regularizers import l2
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.callbacks import ReduceLROnPlateau, ModelCheckpoint
from tensorflow.keras.models import Model, load_model, save_model, Sequential
from tensorflow.keras.layers import Dense, Dropout, Flatten, Conv2D,␣
 ↪MaxPooling2D, Conv2DTranspose
from tensorflow.keras.layers import Dense, Activation, Dropout, Input, Masking,␣
 ↪TimeDistributed, LSTM, Conv1D
from tensorflow.keras.layers import GRU, Bidirectional, BatchNormalization,␣
 ↪Reshape
from tensorflow.keras.optimizers import Adam, RMSprop

sns.set(style='white', context='notebook', palette='deep')
```

[5]:
```
from glob import glob
from skimage.util import montage
from skimage.io   import imread
%matplotlib inline
```

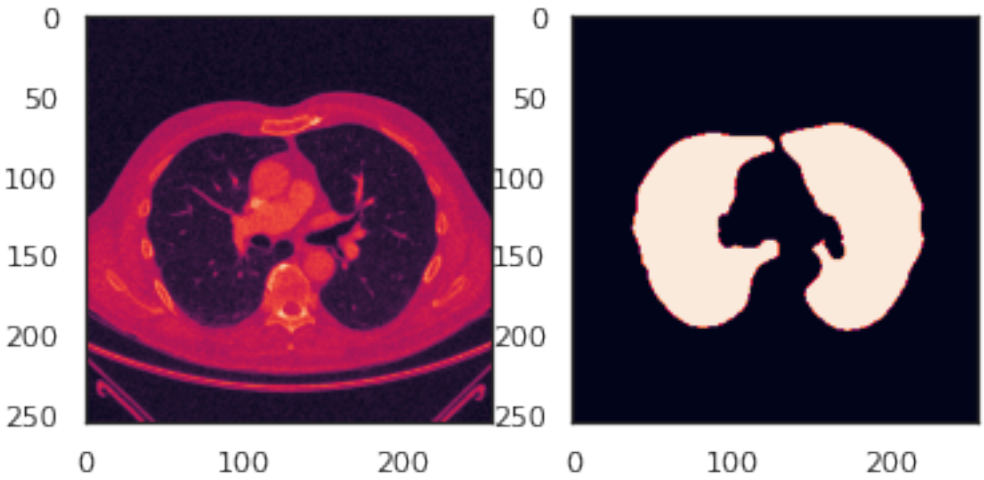
[6]:
```
BASE_IMG_PATH = '/content/drive/MyDrive/PIBIC-2022/kaggle'
DS_FACT = 2
SEED=42

all_image_files = glob(os.path.join(BASE_IMG_PATH,'2d_images','*.tif'))
all_mask_files  = glob(os.path.join(BASE_IMG_PATH,'2d_masks','*.tif'))

print('No. of images:', len(all_image_files))
```

```
print(all_image_files[0])
print(all_mask_files[0])
```

```
No. of images: 267
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_images/ID_0000_Z_0142.tif
/content/drive/MyDrive/PIBIC-2022/kaggle/2d_masks/ID_0000_Z_0142.tif
```

[7]:
```
test_image = np.expand_dims(imread(all_image_files[0])[::2, ::2],0)
test_mask  = np.expand_dims(imread(all_mask_files[0])[::2, ::2],0)/255.0
fig, (ax1 ,ax2) = plt.subplots(1, 2)
ax1.imshow(test_image[0])
ax2.imshow(test_mask[0])
print(test_image.shape)
```

```
(1, 256, 256)
```



[8]:
```
images  = np.stack((np.expand_dims(imread(i)[::DS_FACT, ::DS_FACT], -1) for i␣
 ↪in all_image_files),0)
masks   = np.stack((np.expand_dims(imread(i)[::DS_FACT, ::DS_FACT]/255., -1)␣
 ↪for i in all_mask_files),0)

X_train, X_test, y_train,  y_test = train_test_split(images, masks, test_size=0.
 ↪1)

print('X_train - len/shape:', len(X_train), X_train.shape)
print('Y_train is {}, min is {}, max is {}, mean is {}'.format(y_train.shape,␣
 ↪y_train.min(), y_train.max(), y_train.mean()))
print('X_test  - len/shape:', len(X_test), y_test.shape)
print(images.shape[:])
```

```
/usr/local/lib/python3.7/dist-packages/IPython/core/interactiveshell.py:2822:
FutureWarning: arrays to stack must be passed as a "sequence" type such as list
or tuple. Support for non-sequence iterables such as generators is deprecated as
of NumPy 1.16 and will raise an error in the future.
  if self.run_code(code, result):

X_train - len/shape: 240 (240, 256, 256, 1)
Y_train is (240, 256, 256, 1), min is 0.0, max is 1.0, mean is
0.23402748107910157
X_test  - len/shape: 27 (27, 256, 256, 1)
(267, 256, 256, 1)
```

2 U-net model

[9]:
```
def unet(inputs, n=32):
    bn    = BatchNormalization()(inputs)
    conv1 = Conv2D(n, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(bn)
    conv1 = Conv2D(n, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv1)
    pool1 = MaxPooling2D(pool_size=(2, 2))(conv1)
    pool1 = Dropout(0.1)(pool1)

    conv2 = Conv2D(n*2, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(pool1)
    conv2 = Conv2D(n*2, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv2)
    pool2 = MaxPooling2D(pool_size=(2, 2))(conv2)
    pool2 = Dropout(0.1)(pool2)

    conv3 = Conv2D(n*4, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(pool2)
    conv3 = Conv2D(n*4, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv3)
    pool3 = MaxPooling2D(pool_size=(2, 2))(conv3)
    pool3 = Dropout(0.1)(pool3)

    conv4 = Conv2D(n*8, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(pool3)
    conv4 = Conv2D(n*8, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv4)
    pool4 = MaxPooling2D(pool_size=(2, 2))(conv4)
    pool4 = Dropout(0.1)(pool4)

    convm = Conv2D(n*16, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(pool4)
```

```
    convm = Conv2D(n*16, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(convm)

    up6   = Conv2DTranspose(n*8, (2, 2), strides=(2, 2), padding='same')(convm)
    conv6 = concatenate([up6, conv4])
    conv6 = Dropout(0.1)(conv6)
    conv6 = Conv2D(n*8, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv6)
    conv6 = Conv2D(n*8, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv6)

    up7   = Conv2DTranspose(n*4, (2, 2), strides=(2, 2), padding='same')(conv6)
    conv7 = concatenate([up7, conv3])
    conv7 = Dropout(0.1)(conv7)
    conv7 = Conv2D(n*4, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv7)
    conv7 = Conv2D(n*4, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv7)

    up8   = Conv2DTranspose(n*2, (2, 2), strides=(2, 2), padding='same')(conv7)
    conv8 = concatenate([up8, conv2])
    conv8 = Dropout(0.1)(conv8)
    conv8 = Conv2D(n*2, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv8)
    conv8 = Conv2D(n*2, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv8)

    up9   = Conv2DTranspose(n, (2, 2), strides=(2, 2), padding='same')(conv8)
    conv9 = concatenate([up9, conv1])
    conv9 = Dropout(0.1)(conv9)
    conv9 = Conv2D(n, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv9)
    conv9 = Conv2D(n, (3, 3), activation='relu',␣
↪kernel_initializer='he_normal', padding='same')(conv9)

    output = Conv2D(1, (1, 1), activation='sigmoid')(conv9)

    return Model(inputs=[inputs], outputs=[output])
```

[10]:
```
input_img = Input(X_train.shape[1:], name='img')
n_filters   = 32

model = unet(input_img, n_filters)

model.compile(optimizer=Adam(), loss="binary_crossentropy",␣
↪metrics=["accuracy"])
```

```
print(model.summary())
```

```
Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
img (InputLayer)             [(None, 256, 256, 1)      0
_________________________________________________________________
batch_normalization (BatchNorma (None, 256, 256, 1)  4
_________________________________________________________________
conv2d (Conv2D)              (None, 256, 256, 32)      320
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 256, 256, 32)      9248
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 128, 128, 32)      0
_________________________________________________________________
dropout (Dropout)            (None, 128, 128, 32)      0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 128, 128, 64)      18496
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 128, 128, 64)      36928
_________________________________________________________________
max_pooling2d_1 (MaxPooling2D)  (None, 64, 64, 64)     0
_________________________________________________________________
dropout_1 (Dropout)          (None, 64, 64, 64)        0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 64, 64, 128)       73856
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 64, 64, 128)       147584
_________________________________________________________________
```

```
max_pooling2d_2 (MaxPooling2D)  (None, 32, 32, 128)  0           conv2d_5[0][0]
__________________________________________________________________________________________
__________________
dropout_2 (Dropout)             (None, 32, 32, 128)  0
max_pooling2d_2[0][0]
__________________________________________________________________________________________
__________________
conv2d_6 (Conv2D)               (None, 32, 32, 256)  295168      dropout_2[0][0]
__________________________________________________________________________________________
__________________
conv2d_7 (Conv2D)               (None, 32, 32, 256)  590080      conv2d_6[0][0]
__________________________________________________________________________________________
__________________
max_pooling2d_3 (MaxPooling2D)  (None, 16, 16, 256)  0           conv2d_7[0][0]
__________________________________________________________________________________________
__________________
dropout_3 (Dropout)             (None, 16, 16, 256)  0
max_pooling2d_3[0][0]
__________________________________________________________________________________________
__________________
conv2d_8 (Conv2D)               (None, 16, 16, 512)  1180160     dropout_3[0][0]
__________________________________________________________________________________________
__________________
conv2d_9 (Conv2D)               (None, 16, 16, 512)  2359808     conv2d_8[0][0]
__________________________________________________________________________________________
__________________
conv2d_transpose (Conv2DTranspo (None, 32, 32, 256)  524544      conv2d_9[0][0]
__________________________________________________________________________________________
__________________
concatenate (Concatenate)       (None, 32, 32, 512)  0
conv2d_transpose[0][0]
                                                                  conv2d_7[0][0]
__________________________________________________________________________________________
__________________
dropout_4 (Dropout)             (None, 32, 32, 512)  0
concatenate[0][0]
__________________________________________________________________________________________
__________________
conv2d_10 (Conv2D)              (None, 32, 32, 256)  1179904     dropout_4[0][0]
__________________________________________________________________________________________
__________________
conv2d_11 (Conv2D)              (None, 32, 32, 256)  590080      conv2d_10[0][0]
__________________________________________________________________________________________
__________________
conv2d_transpose_1 (Conv2DTrans (None, 64, 64, 128)  131200      conv2d_11[0][0]
__________________________________________________________________________________________
__________________
concatenate_1 (Concatenate)     (None, 64, 64, 256)  0
```

```
conv2d_transpose_1[0][0]
                                                                    conv2d_5[0][0]
__________________________________________________________________________________________________
dropout_5 (Dropout)             (None, 64, 64, 256)  0
concatenate_1[0][0]
__________________________________________________________________________________________________
conv2d_12 (Conv2D)              (None, 64, 64, 128)  295040      dropout_5[0][0]
__________________________________________________________________________________________________
conv2d_13 (Conv2D)              (None, 64, 64, 128)  147584      conv2d_12[0][0]
__________________________________________________________________________________________________
conv2d_transpose_2 (Conv2DTrans (None, 128, 128, 64) 32832       conv2d_13[0][0]
__________________________________________________________________________________________________
concatenate_2 (Concatenate)     (None, 128, 128, 128 0
conv2d_transpose_2[0][0]
                                                                    conv2d_3[0][0]
__________________________________________________________________________________________________
dropout_6 (Dropout)             (None, 128, 128, 128 0
concatenate_2[0][0]
__________________________________________________________________________________________________
conv2d_14 (Conv2D)              (None, 128, 128, 64) 73792       dropout_6[0][0]
__________________________________________________________________________________________________
conv2d_15 (Conv2D)              (None, 128, 128, 64) 36928       conv2d_14[0][0]
__________________________________________________________________________________________________
conv2d_transpose_3 (Conv2DTrans (None, 256, 256, 32) 8224        conv2d_15[0][0]
__________________________________________________________________________________________________
concatenate_3 (Concatenate)     (None, 256, 256, 64) 0
conv2d_transpose_3[0][0]
                                                                    conv2d_1[0][0]
__________________________________________________________________________________________________
dropout_7 (Dropout)             (None, 256, 256, 64) 0
concatenate_3[0][0]
__________________________________________________________________________________________________
conv2d_16 (Conv2D)              (None, 256, 256, 32) 18464       dropout_7[0][0]
__________________________________________________________________________________________________
conv2d_17 (Conv2D)              (None, 256, 256, 32) 9248        conv2d_16[0][0]
```

```
__________________________________________________________________________________
__________________
conv2d_18 (Conv2D)              (None, 256, 256, 1)  33          conv2d_17[0][0]
==================================================================================
==================
Total params: 7,759,525
Trainable params: 7,759,523
Non-trainable params: 2
__________________________________________________________________________________
__________________
None
```

[11]:
```
from keras.callbacks import EarlyStopping, ModelCheckpoint, ReduceLROnPlateau

callbacks = [
    EarlyStopping(patience=10, verbose=1),
    ReduceLROnPlateau(factor=0.1, patience=3, min_lr=0.00001, verbose=1),
    ModelCheckpoint('model-lung.h5', verbose=1, save_best_only=True,␣
 ↪save_weights_only=True)
]
```

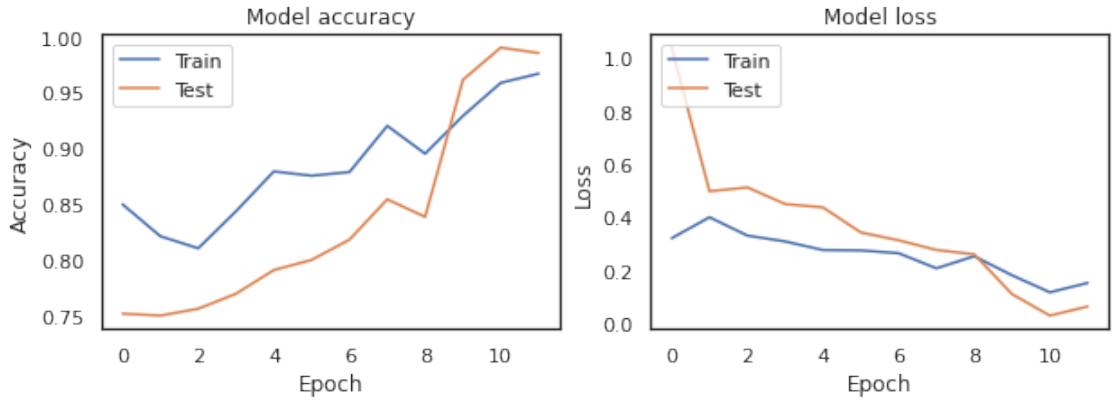
[13]:
```
history = model.fit(X_train, y_train, batch_size=10, epochs=12,␣
 ↪callbacks=callbacks, \
                    validation_data=(X_test, y_test))
```

```
Epoch 1/12
24/24 [==============================] - 506s 21s/step - loss: 0.3212 -
accuracy: 0.8503 - val_loss: 1.0370 - val_accuracy: 0.7527

Epoch 00001: val_loss improved from 1.87091 to 1.03702, saving model to model-
lung.h5
Epoch 2/12
24/24 [==============================] - 494s 21s/step - loss: 0.4001 -
accuracy: 0.8218 - val_loss: 0.4976 - val_accuracy: 0.7510

Epoch 00002: val_loss improved from 1.03702 to 0.49758, saving model to model-
lung.h5
Epoch 3/12
24/24 [==============================] - 496s 21s/step - loss: 0.3312 -
accuracy: 0.8110 - val_loss: 0.5120 - val_accuracy: 0.7571

Epoch 00003: val_loss did not improve from 0.49758
Epoch 4/12
24/24 [==============================] - 493s 21s/step - loss: 0.3091 -
accuracy: 0.8441 - val_loss: 0.4496 - val_accuracy: 0.7705

Epoch 00004: val_loss improved from 0.49758 to 0.44958, saving model to model-
lung.h5
```

```
Epoch 5/12
24/24 [==============================] - 497s 21s/step - loss: 0.2768 -
accuracy: 0.8796 - val_loss: 0.4371 - val_accuracy: 0.7916

Epoch 00005: val_loss improved from 0.44958 to 0.43710, saving model to model-
lung.h5
Epoch 6/12
24/24 [==============================] - 495s 21s/step - loss: 0.2755 -
accuracy: 0.8758 - val_loss: 0.3430 - val_accuracy: 0.8007

Epoch 00006: val_loss improved from 0.43710 to 0.34297, saving model to model-
lung.h5
Epoch 7/12
24/24 [==============================] - 493s 21s/step - loss: 0.2650 -
accuracy: 0.8791 - val_loss: 0.3135 - val_accuracy: 0.8187

Epoch 00007: val_loss improved from 0.34297 to 0.31347, saving model to model-
lung.h5
Epoch 8/12
24/24 [==============================] - 490s 20s/step - loss: 0.2083 -
accuracy: 0.9203 - val_loss: 0.2772 - val_accuracy: 0.8547

Epoch 00008: val_loss improved from 0.31347 to 0.27723, saving model to model-
lung.h5
Epoch 9/12
24/24 [==============================] - 490s 20s/step - loss: 0.2536 -
accuracy: 0.8955 - val_loss: 0.2609 - val_accuracy: 0.8391

Epoch 00009: val_loss improved from 0.27723 to 0.26091, saving model to model-
lung.h5
Epoch 10/12
24/24 [==============================] - 494s 21s/step - loss: 0.1821 -
accuracy: 0.9292 - val_loss: 0.1112 - val_accuracy: 0.9614

Epoch 00010: val_loss improved from 0.26091 to 0.11121, saving model to model-
lung.h5
Epoch 11/12
24/24 [==============================] - 493s 21s/step - loss: 0.1182 -
accuracy: 0.9587 - val_loss: 0.0308 - val_accuracy: 0.9901

Epoch 00011: val_loss improved from 0.11121 to 0.03079, saving model to model-
lung.h5
Epoch 12/12
24/24 [==============================] - 494s 21s/step - loss: 0.1535 -
accuracy: 0.9669 - val_loss: 0.0650 - val_accuracy: 0.9853

Epoch 00012: val_loss did not improve from 0.03079
```

[14]:
```
def plot_history(history, title):
    plt.figure(figsize=(10,3))
    # Plot training & validation accuracy values
    plt.subplot(121)
    plt.plot(history.history['accuracy'])
    plt.plot(history.history['val_accuracy'])
    plt.title('Model accuracy')
    plt.ylabel('Accuracy')
    plt.xlabel('Epoch')
    plt.legend(['Train', 'Test'], loc='upper left')

    # Plot training & validation loss values
    plt.subplot(122)
    plt.plot(history.history['loss'])
    plt.plot(history.history['val_loss'])
    plt.title('Model loss')
    plt.ylabel('Loss')
    plt.xlabel('Epoch')
    plt.legend(['Train', 'Test'], loc='upper left')
    plt.show()
```

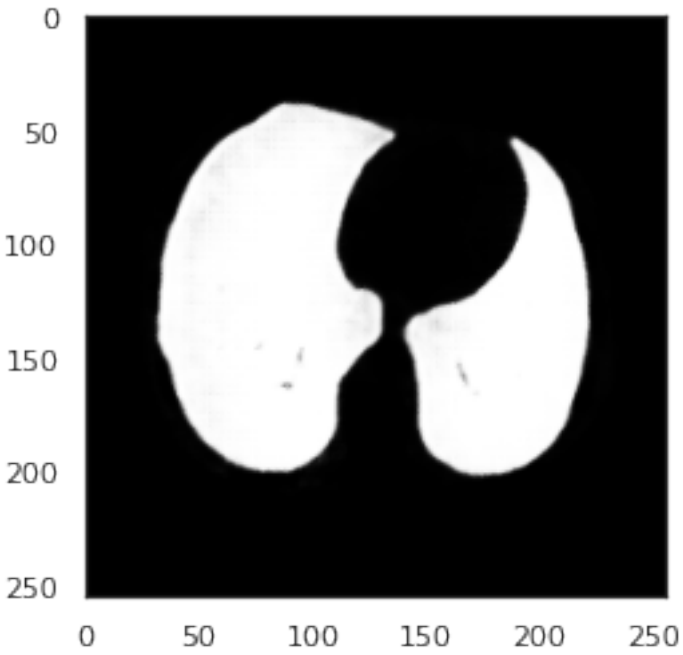
[15]:
```
plot_history(history, 'UNet Loss/Accuracy')
```



[16]:
```
model.load_weights('model-lung.h5')
```

[17]:
```
plt.imshow(
    model.predict(X_train[0].reshape(1,256, 256, 1))[0,:,:,0],
    cmap='gray')
```

[17]:
```
<matplotlib.image.AxesImage at 0x7efbc1aa8e90>
```



[18]:
```
y_predict = model.predict(X_test)

for i in range(X_test.shape[0]):
    fig, ax = plt.subplots(1,3,figsize=(12,6))
    ax[0].set_title('Original')
    ax[1].set_title('Result')
    ax[2].set_title('Predicted Result')
    ax[0].imshow(X_test[i,:,:,0], cmap='gray')
    ax[1].imshow(y_test[i,:,:,0])
    ax[2].imshow(y_predict[i,:,:,0])
```

```
Output hidden; open in https://colab.research.google.com to view.
```

[ ]:
```
!wget -nc https://raw.githubusercontent.com/brpy/colab-pdf/master/colab_pdf.py
from colab_pdf import colab_pdf
colab_pdf('Unet-keras-kaggle.ipynb')
```

```
File ‘colab_pdf.py’ already there; not retrieving.


WARNING: apt does not have a stable CLI interface. Use with caution in scripts.


WARNING: apt does not have a stable CLI interface. Use with caution in scripts.
```