In [1]:

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# This Python 3 environment comes with many helpful analytics libraries installed
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list all files under the input directory

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) that gets preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be saved outside of the current session
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/kaggle/input/preprocesseddata/prepared_data/train/masks/134.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/259.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/25.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/54.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/111.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/62.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/205.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/0.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/141.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/19.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/110.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/26.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/79.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/257.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/42.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/175.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/226.png
/kaggle/input/preprocesseddata/prepared_data/train/masks/217.png
```

In [2]:

```
import cv2
import matplotlib.pyplot as plt
import os
from PIL import Image
import numpy as np
import pandas as pd
from glob import glob

import os
import random
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
plt.style.use("ggplot")
%matplotlib inline

from tqdm import tqdm_notebook, tnrange
from itertools import chain
from skimage.io import imread, imshow, concatenate_images
from skimage.transform import resize
```

```
from skimage.morphology import label
from sklearn.model_selection import train_test_split

import tensorflow as tf

from keras.models import Model, load_model
from keras.layers import Input, BatchNormalization, Activation, Dense, Dropout
from keras.layers.core import Lambda, RepeatVector, Reshape
from keras.layers.convolutional import Conv2D, Conv2DTranspose
from keras.layers.pooling import MaxPooling2D, GlobalMaxPool2D
from keras.layers.merge import concatenate, add
from keras.callbacks import EarlyStopping, ModelCheckpoint, ReduceLROnPlateau
from tensorflow.keras.optimizers import Adam
from keras.preprocessing.image import ImageDataGenerator, array_to_img, img_to_array, loa
d_img
```

In [3]:

```
train_images  = glob('../input/preprocesseddata/prepared_data/train/images/*.png')
train_masks = glob('../input/preprocesseddata/prepared_data/train/masks/*.png')
```

In [4]:

```
img = []
for filename in train_images:
    img.append(filename)
img.sort()
```

In [5]:

```
mask = []
for filename in train_masks:
    mask.append(filename)
mask.sort()
```

In [6]:

```
# Set some parameters
im_width = 512
im_height = 512
border = 5
ids = next(os.walk("../input/preprocesseddata/prepared_data/train/images"))[2] # list of
names all images in the given path
print("No. of images = ", len(ids))
```

```
No. of images =  268
```

In [7]:

```
X = np.zeros((len(ids), im_height, im_width, 1), dtype=np.float32)
y = np.zeros((len(ids), im_height, im_width, 1), dtype=np.float32)
```

In [8]:

```
# tqdm is used to display the progress bar
for n, id_ in tqdm_notebook(enumerate(ids), total=len(ids)):
    # Load images
    img = load_img("../input/preprocesseddata/prepared_data/train/images/"+id_, grayscale
=True)
    x_img = img_to_array(img)
    x_img = resize(x_img, (512, 512, 1), mode = 'constant', preserve_range = True)
    # Load masks
    mask = img_to_array(load_img("../input/preprocesseddata/prepared_data/train/masks/"+i
d_, grayscale=True))
    mask = resize(mask, (512, 512, 1), mode = 'constant', preserve_range = True)
    # Save images
    X[n] = x_img/255.0
    y[n] = mask/255.0
```

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:2: TqdmDeprecationWarning: T
his function will be removed in tqdm==5.0.0
```

```
Please use `tqdm.notebook.tqdm` instead of `tqdm.tqdm_notebook`
```

```
/opt/conda/lib/python3.7/site-packages/keras_preprocessing/image/utils.py:107: UserWarnin
g: grayscale is deprecated. Please use color_mode = "grayscale"
  warnings.warn('grayscale is deprecated. Please use '
```

In [9]:

```
# Split train and valid
X_train, X_valid, y_train, y_valid = train_test_split(X, y, test_size=0.1, random_state=
42)
```

In [10]:

```
# Visualize any randome image along with the mask
ix = random.randint(0, len(X_train))
has_mask = y_train[ix].max() > 0

fig, (ax1, ax2) = plt.subplots(1, 2, figsize = (20, 15))

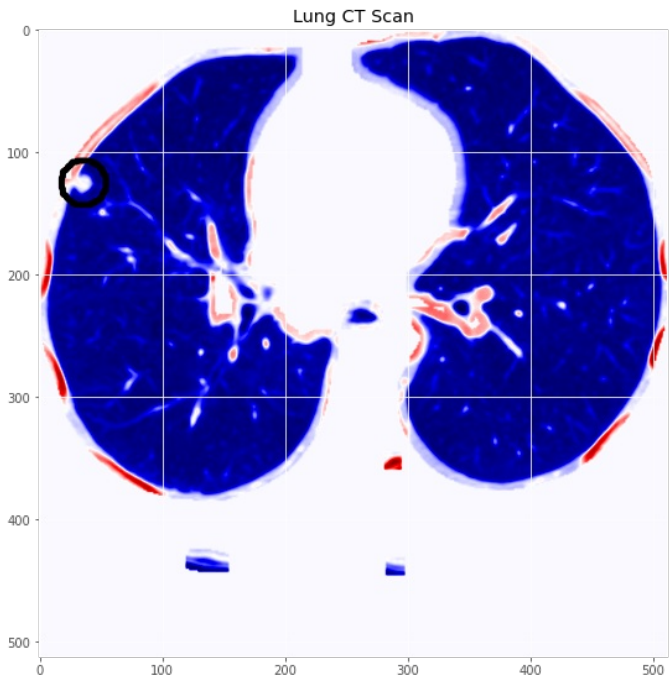
ax1.imshow(X_train[ix, ..., 0], cmap = 'seismic', interpolation = 'bilinear')
if has_mask:
    # draw a boundary(contour) in the original image
    ax1.contour(y_train[ix].squeeze(), colors = 'k', linewidths = 5, levels = [0.5])
ax1.set_title('Lung CT Scan')

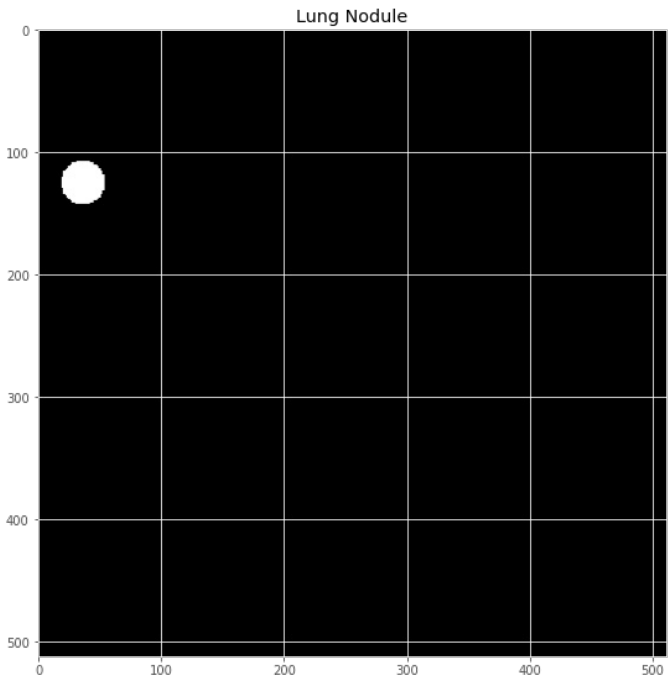
ax2.imshow(y_train[ix].squeeze(), cmap = 'gray', interpolation = 'bilinear')
ax2.set_title('Lung Nodule')
```

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:10: UserWarning: No contour
levels were found within the data range.
  # Remove the CWD from sys.path while we load stuff.
```

Out[10]:

```
Text(0.5, 1.0, 'Lung Nodule')
```





In [11]:

```
def conv2d_block(input_tensor, n_filters, kernel_size = 3, batchnorm = True):
    """Function to add 2 convolutional layers with the parameters passed to it"""
    # first layer
    x = Conv2D(filters = n_filters, kernel_size = (kernel_size, kernel_size),\
               kernel_initializer = 'he_normal', padding = 'same')(input_tensor)
    if batchnorm:
        x = BatchNormalization()(x)
    x = Activation('relu')(x)
```

```
    # second layer
    x = Conv2D(filters = n_filters, kernel_size = (kernel_size, kernel_size),\
               kernel_initializer = 'he_normal', padding = 'same')(input_tensor)
    if batchnorm:
        x = BatchNormalization()(x)
    x = Activation('relu')(x)

    return x
```

In [12]:

```
def get_unet(input_img, n_filters = 16, dropout = 0.1, batchnorm = True):
    """Function to define the UNET Model"""
    # Contracting Path
    c1 = conv2d_block(input_img, n_filters * 1, kernel_size = 3, batchnorm = batchnorm)
    p1 = MaxPooling2D((2, 2), padding='same')(c1)
    p1 = Dropout(dropout)(p1)

    c2 = conv2d_block(p1, n_filters * 2, kernel_size = 3, batchnorm = batchnorm)
    p2 = MaxPooling2D((2, 2),padding='same')(c2)
    p2 = Dropout(dropout)(p2)

    c3 = conv2d_block(p2, n_filters * 4, kernel_size = 3, batchnorm = batchnorm)
    p3 = MaxPooling2D((2, 2),padding='same')(c3)
    p3 = Dropout(dropout)(p3)

    c4 = conv2d_block(p3, n_filters * 8, kernel_size = 3, batchnorm = batchnorm)
    p4 = MaxPooling2D((2, 2),padding='same')(c4)
    p4 = Dropout(dropout)(p4)

    c5 = conv2d_block(p4, n_filters = n_filters * 16, kernel_size = 3, batchnorm = batch
norm)

    # Expansive Path
    u6 = Conv2DTranspose(n_filters * 8, (3, 3), strides = (2, 2), padding = 'same')(c5)
    u6 = concatenate([u6, c4])
    u6 = Dropout(dropout)(u6)
    c6 = conv2d_block(u6, n_filters * 8, kernel_size = 3, batchnorm = batchnorm)

    u7 = Conv2DTranspose(n_filters * 4, (3, 3), strides = (2, 2), padding = 'same')(c6)
    u7 = concatenate([u7, c3])
    u7 = Dropout(dropout)(u7)
    c7 = conv2d_block(u7, n_filters * 4, kernel_size = 3, batchnorm = batchnorm)

    u8 = Conv2DTranspose(n_filters * 2, (3, 3), strides = (2, 2), padding = 'same')(c7)
    u8 = concatenate([u8, c2])
    u8 = Dropout(dropout)(u8)
    c8 = conv2d_block(u8, n_filters * 2, kernel_size = 3, batchnorm = batchnorm)

    u9 = Conv2DTranspose(n_filters * 1, (3, 3), strides = (2, 2), padding = 'same')(c8)
    u9 = concatenate([u9, c1])
    u9 = Dropout(dropout)(u9)
    c9 = conv2d_block(u9, n_filters * 1, kernel_size = 3, batchnorm = batchnorm)

    outputs = Conv2D(1, (1, 1), activation='sigmoid')(c9)
    model = Model(inputs=[input_img], outputs=[outputs])
    return model
```

In [13]:

```
input_img = Input((im_height, im_width, 1), name='img')
model = get_unet(input_img, n_filters=16, dropout=0.05, batchnorm=True)
model.compile(optimizer=Adam(), loss="binary_crossentropy", metrics=["accuracy"])
```

```
2022-05-07 16:24:53.781264: I tensorflow/core/common_runtime/process_util.cc:146] Creatin
g new thread pool with default inter op setting: 2. Tune using inter_op_parallelism_threa
ds for best performance.
```

In [14]:

```
model.summary()
```

```
model.summary()
```

```
Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
img (InputLayer)             [(None, 512, 512, 1)      0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 512, 512, 16)      160
_________________________________________________________________
batch_normalization_1 (BatchNor (None, 512, 512, 16)      64
_________________________________________________________________
activation_1 (Activation)    (None, 512, 512, 16)      0
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 256, 256, 16)      0
_________________________________________________________________
dropout (Dropout)            (None, 256, 256, 16)      0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 256, 256, 32)      4640
_________________________________________________________________
batch_normalization_3 (BatchNor (None, 256, 256, 32)      128
_________________________________________________________________
activation_3 (Activation)    (None, 256, 256, 32)      0
_________________________________________________________________
max_pooling2d_1 (MaxPooling2D)  (None, 128, 128, 32)      0
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 128, 32)      0
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 128, 128, 64)      18496
_________________________________________________________________
batch_normalization_5 (BatchNor (None, 128, 128, 64)      256
_________________________________________________________________
activation_5 (Activation)    (None, 128, 128, 64)      0
_________________________________________________________________
max_pooling2d_2 (MaxPooling2D)  (None, 64, 64, 64)    0
_________________________________________________________________
dropout_2 (Dropout)          (None, 64, 64, 64)    0
_________________________________________________________________
```

conv2d_7 (Conv2D)	(None, 64, 64, 128)	73856	dropout_2[0][0]
batch_normalization_7 (BatchNor	(None, 64, 64, 128)	512	conv2d_7[0][0]
activation_7 (Activation) [0]	(None, 64, 64, 128)	0	batch_normalization_7[0]
max_pooling2d_3 (MaxPooling2D)	(None, 32, 32, 128)	0	activation_7[0][0]
dropout_3 (Dropout)	(None, 32, 32, 128)	0	max_pooling2d_3[0][0]
conv2d_9 (Conv2D)	(None, 32, 32, 256)	295168	dropout_3[0][0]
batch_normalization_9 (BatchNor	(None, 32, 32, 256)	1024	conv2d_9[0][0]
activation_9 (Activation) [0]	(None, 32, 32, 256)	0	batch_normalization_9[0]
conv2d_transpose (Conv2DTranspo	(None, 64, 64, 128)	295040	activation_9[0][0]
concatenate (Concatenate)	(None, 64, 64, 256)	0	conv2d_transpose[0][0] activation_7[0][0]
dropout_4 (Dropout)	(None, 64, 64, 256)	0	concatenate[0][0]
conv2d_11 (Conv2D)	(None, 64, 64, 128)	295040	dropout_4[0][0]
batch_normalization_11 (BatchNo	(None, 64, 64, 128)	512	conv2d_11[0][0]
activation_11 (Activation)][0]	(None, 64, 64, 128)	0	batch_normalization_11[0
conv2d_transpose_1 (Conv2DTrans	(None, 128, 128, 64)	73792	activation_11[0][0]
concatenate_1 (Concatenate)	(None, 128, 128, 128	0	conv2d_transpose_1[0][0] activation_5[0][0]
dropout_5 (Dropout)	(None, 128, 128, 128	0	concatenate_1[0][0]

```
__________
conv2d_13 (Conv2D)              (None, 128, 128, 64) 73792       dropout_5[0][0]

____________________________________________________________________________________________
__________
batch_normalization_13 (BatchNo (None, 128, 128, 64) 256         conv2d_13[0][0]

____________________________________________________________________________________________
__________
activation_13 (Activation)      (None, 128, 128, 64) 0           batch_normalization_13[0
][0]
____________________________________________________________________________________________
__________
conv2d_transpose_2 (Conv2DTrans (None, 256, 256, 32) 18464       activation_13[0][0]

____________________________________________________________________________________________
__________
concatenate_2 (Concatenate)     (None, 256, 256, 64) 0           conv2d_transpose_2[0][0]
                                                                 activation_3[0][0]

____________________________________________________________________________________________
__________
dropout_6 (Dropout)             (None, 256, 256, 64) 0           concatenate_2[0][0]

____________________________________________________________________________________________
__________
conv2d_15 (Conv2D)              (None, 256, 256, 32) 18464       dropout_6[0][0]

____________________________________________________________________________________________
__________
batch_normalization_15 (BatchNo (None, 256, 256, 32) 128         conv2d_15[0][0]

____________________________________________________________________________________________
__________
activation_15 (Activation)      (None, 256, 256, 32) 0           batch_normalization_15[0
][0]
____________________________________________________________________________________________
__________
conv2d_transpose_3 (Conv2DTrans (None, 512, 512, 16) 4624        activation_15[0][0]

____________________________________________________________________________________________
__________
concatenate_3 (Concatenate)     (None, 512, 512, 32) 0           conv2d_transpose_3[0][0]
                                                                 activation_1[0][0]

____________________________________________________________________________________________
__________
dropout_7 (Dropout)             (None, 512, 512, 32) 0           concatenate_3[0][0]

____________________________________________________________________________________________
__________
conv2d_17 (Conv2D)              (None, 512, 512, 16) 4624        dropout_7[0][0]

____________________________________________________________________________________________
__________
batch_normalization_17 (BatchNo (None, 512, 512, 16) 64          conv2d_17[0][0]

____________________________________________________________________________________________
__________
activation_17 (Activation)      (None, 512, 512, 16) 0           batch_normalization_17[0
][0]
____________________________________________________________________________________________
__________
conv2d_18 (Conv2D)              (None, 512, 512, 1)  17          activation_17[0][0]

============================================================================================
=========
Total params: 1,179,121
Trainable params: 1,177,649
Non-trainable params: 1,472
```

In [15]:

```
callbacks = [
    EarlyStopping(patience=10, verbose=1),
    ReduceLROnPlateau(factor=0.1, patience=5, min_lr=0.00001, verbose=1),
    ModelCheckpoint('./lung_nodules_model.h5', verbose=1, save_best_only=True, save_weig
hts_only=True)
]
```

In [16]:

```
results = model.fit(X_train, y_train, batch_size=32, epochs=10, callbacks=callbacks,\
                    validation_data=(X_valid, y_valid))
```

```
2022-05-07 16:24:55.175948: I tensorflow/compiler/mlir/mlir_graph_optimization_pass.cc:18
5] None of the MLIR Optimization Passes are enabled (registered 2)
Epoch 1/10
8/8 [==============================] - 175s 21s/step - loss: 0.7473 - accuracy: 0.5841 -
val_loss: 13.7697 - val_accuracy: 0.1505

Epoch 00001: val_loss improved from inf to 13.76968, saving model to ./lung_nodules_model
.h5
Epoch 2/10
8/8 [==============================] - 168s 21s/step - loss: 0.5487 - accuracy: 0.9413 -
val_loss: 54.9287 - val_accuracy: 0.0020

Epoch 00002: val_loss did not improve from 13.76968
Epoch 3/10
8/8 [==============================] - 167s 21s/step - loss: 0.4664 - accuracy: 0.9753 -
val_loss: 16.9327 - val_accuracy: 0.0074

Epoch 00003: val_loss did not improve from 13.76968
Epoch 4/10
8/8 [==============================] - 168s 21s/step - loss: 0.4234 - accuracy: 0.9859 -
val_loss: 8.1438 - val_accuracy: 0.0309

Epoch 00004: val_loss improved from 13.76968 to 8.14383, saving model to ./lung_nodules_m
odel.h5
Epoch 5/10
8/8 [==============================] - 166s 21s/step - loss: 0.3941 - accuracy: 0.9899 -
val_loss: 0.7280 - val_accuracy: 0.7962

Epoch 00005: val_loss improved from 8.14383 to 0.72802, saving model to ./lung_nodules_mo
del.h5
Epoch 6/10
8/8 [==============================] - 168s 21s/step - loss: 0.3663 - accuracy: 0.9930 -
val_loss: 0.5230 - val_accuracy: 0.9361

Epoch 00006: val_loss improved from 0.72802 to 0.52298, saving model to ./lung_nodules_mo
del.h5
Epoch 7/10
8/8 [==============================] - 167s 21s/step - loss: 0.3449 - accuracy: 0.9936 -
val_loss: 0.5837 - val_accuracy: 0.8423

Epoch 00007: val_loss did not improve from 0.52298
Epoch 8/10
8/8 [==============================] - 168s 21s/step - loss: 0.3247 - accuracy: 0.9944 -
val_loss: 0.4533 - val_accuracy: 0.9945

Epoch 00008: val_loss improved from 0.52298 to 0.45335, saving model to ./lung_nodules_mo
del.h5
Epoch 9/10
8/8 [==============================] - 167s 21s/step - loss: 0.3061 - accuracy: 0.9950 -
val_loss: 0.4272 - val_accuracy: 0.9958

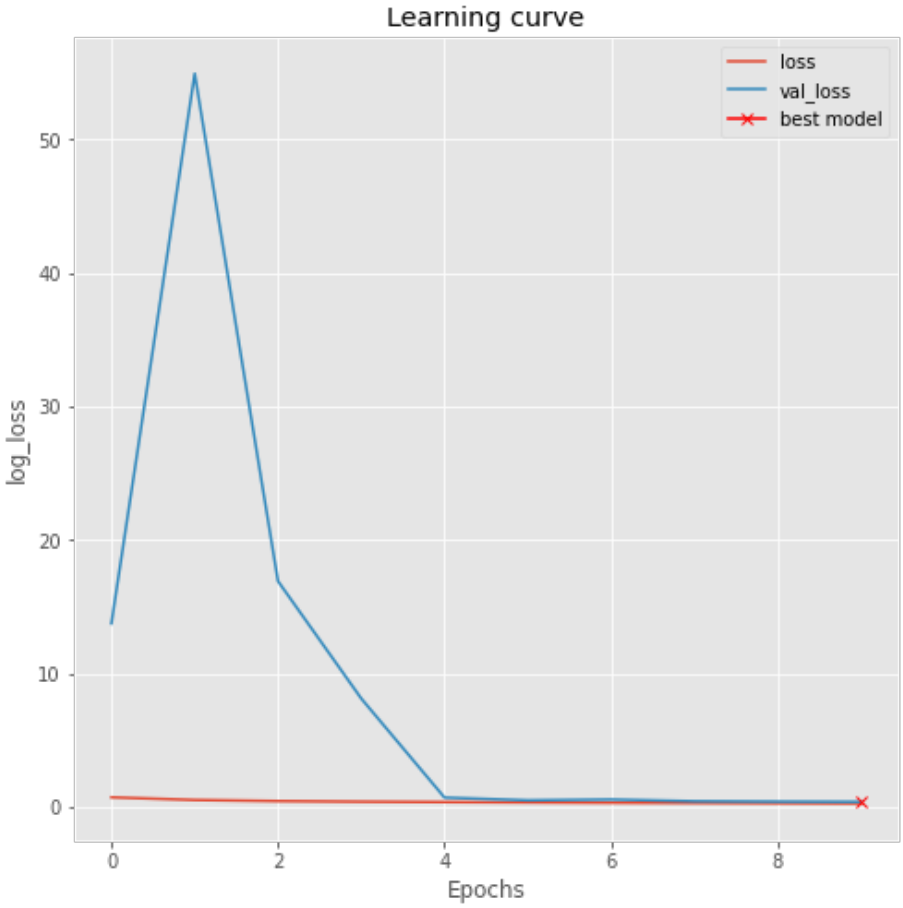
Epoch 00009: val_loss improved from 0.45335 to 0.42715, saving model to ./lung_nodules_mo
del.h5
Epoch 10/10
8/8 [==============================] - 168s 21s/step - loss: 0.2901 - accuracy: 0.9953 -
```

```
val_loss: 0.4100 - val_accuracy: 0.9958

Epoch 00010: val_loss improved from 0.42715 to 0.40997, saving model to ./lung_nodules_mo
del.h5
```

In [17]:

```
plt.figure(figsize=(8, 8))
plt.title("Learning curve")
plt.plot(results.history["loss"], label="loss")
plt.plot(results.history["val_loss"], label="val_loss")
plt.plot( np.argmin(results.history["val_loss"]), np.min(results.history["val_loss"]), m
arker="x", color="r", label="best model")
plt.xlabel("Epochs")
plt.ylabel("log_loss")
plt.legend();
```



In [18]:

```
# load the best model
model.load_weights('./lung_nodules_model.h5')
```

In [19]:

```
model.save('./unet_model.h5')
```

In [20]:

```
from keras.models import model_from_json
model_json = model.to_json()

with open("./unet_model_weights.json", "w") as json_file:
    json_file.write(model_json)
model.save_weights("./unet_model_weights.h5")
print("Saved model to disk")
```

```
Saved model to disk
```

In [21]:

```
# Evaluate on validation set (this must be equals to the best log_loss)
model.evaluate(X_valid, y_valid, verbose=1)
```

```
1/1 [==============================] - 4s 4s/step - loss: 0.4100 - accuracy: 0.9958
```

Out[21]:

```
[0.409972220659256, 0.9957706332206726]
```

In [22]:

```
# Predict on train, val and test
preds_train = model.predict(X_train, verbose=1)
preds_val = model.predict(X_valid, verbose=1)
```

```
8/8 [==============================] - 33s 4s/step
1/1 [==============================] - 4s 4s/step
```

In [23]:

```
# Threshold predictions
preds_train_t = (preds_train > 0.5).astype(np.uint8)
preds_val_t = (preds_val > 0.5).astype(np.uint8)
```

In [24]:

```
def plot_sample(X, y, preds, binary_preds, ix=None):
    """Function to plot the results"""
    if ix is None:
        ix = random.randint(0, len(X))

    has_mask = y[ix].max() > 0

    fig, ax = plt.subplots(1, 4, figsize=(20, 10))
    ax[0].imshow(X[ix, ..., 0], cmap='seismic')
    if has_mask:
        ax[0].contour(y[ix].squeeze(), colors='k', levels=[0.5])
    ax[0].set_title('Lung CT Scan ')

    ax[1].imshow(y[ix].squeeze())
    ax[1].set_title('Ground Truth')

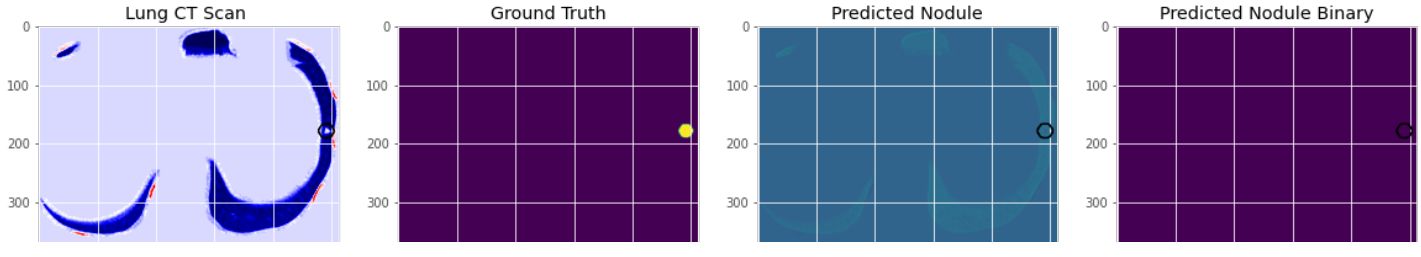
    ax[2].imshow(preds[ix].squeeze(), vmin=0, vmax=1)
    if has_mask:
        ax[2].contour(y[ix].squeeze(), colors='k', levels=[0.5])
    ax[2].set_title('Predicted Nodule')

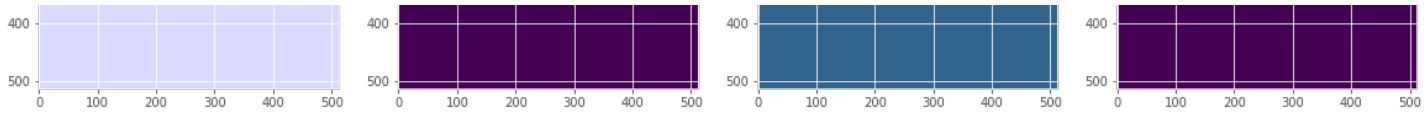
    ax[3].imshow(binary_preds[ix].squeeze(), vmin=0, vmax=1)
    if has_mask:
        ax[3].contour(y[ix].squeeze(), colors='k', levels=[0.5])
    ax[3].set_title('Predicted Nodule Binary')
```

In [25]:

```
# Check if training data looks all right
plot_sample(X_train, y_train, preds_train, preds_train_t, ix=14)
```

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:11: UserWarning: No contour
levels were found within the data range.
  # This is added back by InteractiveShellApp.init_path()
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:19: UserWarning: No contour
levels were found within the data range.
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:24: UserWarning: No contour
levels were found within the data range.
```

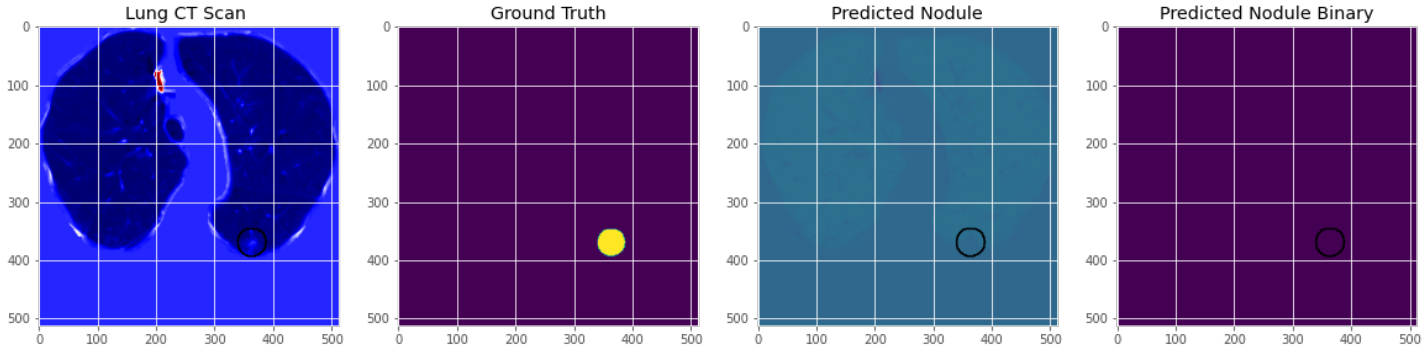




In [26]:

```
plot_sample(X_train, y_train, preds_train, preds_train_t)
```

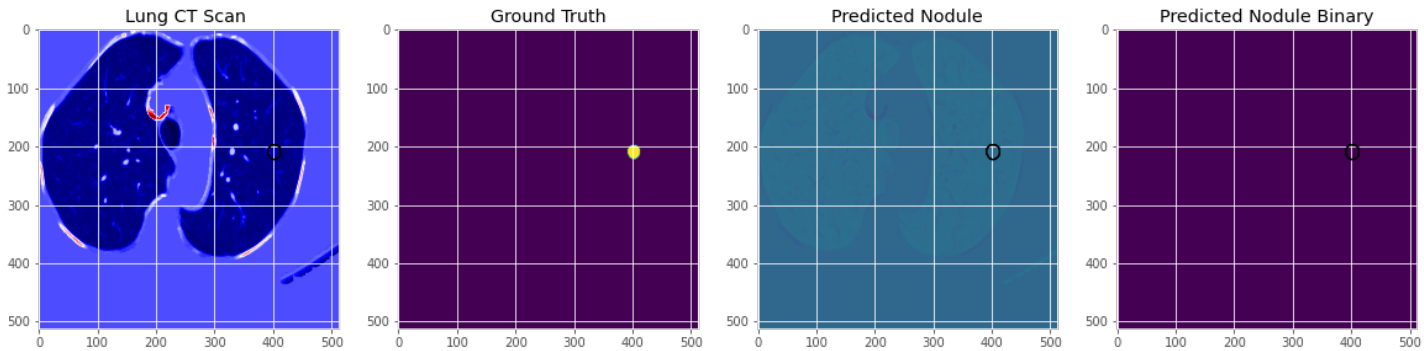
```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:11: UserWarning: No contour
levels were found within the data range.
  # This is added back by InteractiveShellApp.init_path()
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:19: UserWarning: No contour
levels were found within the data range.
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:24: UserWarning: No contour
levels were found within the data range.
```



In [27]:

```
# Check if valid data looks all right
plot_sample(X_valid, y_valid, preds_val, preds_val_t, ix=19)
```

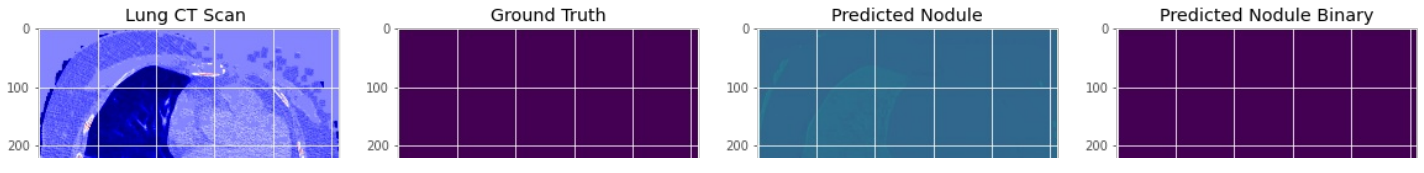
```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:11: UserWarning: No contour
levels were found within the data range.
  # This is added back by InteractiveShellApp.init_path()
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:19: UserWarning: No contour
levels were found within the data range.
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:24: UserWarning: No contour
levels were found within the data range.
```

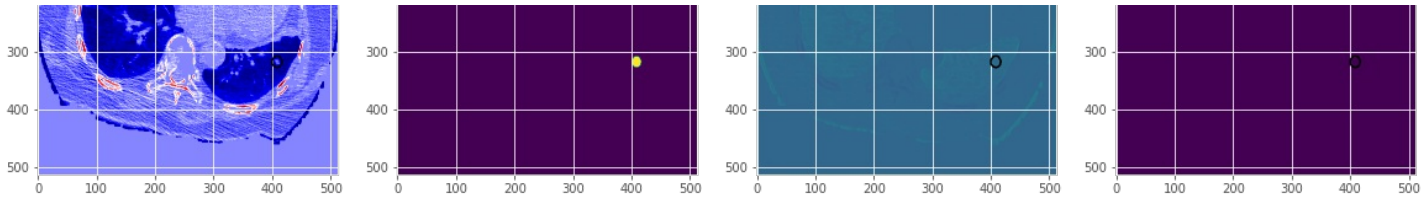


In [28]:

```
# Check if valid data looks all right
plot_sample(X_valid, y_valid, preds_val, preds_val_t)
```

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:11: UserWarning: No contour
levels were found within the data range.
  # This is added back by InteractiveShellApp.init_path()
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:19: UserWarning: No contour
levels were found within the data range.
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:24: UserWarning: No contour
levels were found within the data range.
```





In [29]:

```
# LOAD MODEL
from keras.models import load_model
model = load_model('./unet_model.h5')
```

In [30]:

```
test_images  = glob('../input/preprocesseddata/prepared_data/test/images/*.png')
test_masks = glob('../input/preprocesseddata/prepared_data/test/masks/*.png')
```

In [31]:

```
img = []
for filename in test_images:
    img.append(filename)
img.sort()
mask = []
for filename in test_masks:
    mask.append(filename)
mask.sort()
```

In [32]:

```
# Set some parameters
im_width = 512
im_height = 512
border = 5
ids = next(os.walk("../input/preprocesseddata/prepared_data/test/images"))[2] # list of n
ames all images in the given path
print("No. of images = ", len(ids))
```

```
No. of images =  67
```

In [33]:

```
X = np.zeros((1, im_height, im_width, 1), dtype=np.float32)
y = np.zeros((1, im_height, im_width, 1), dtype=np.float32)
```

In [34]:

```
# tqdm is used to display the progress bar
from tqdm import tqdm
images_path = "../input/preprocesseddata/prepared_data/test/images/"
masks_path = "../input/preprocesseddata/prepared_data/test/masks/"
img = load_img(images_path+'1.png', grayscale=True)
x_img = img_to_array(img)
x_img = resize(x_img, (512, 512, 1), mode = 'constant', preserve_range = True)
# Load masks
mask = img_to_array(load_img(masks_path+'1.png', grayscale=True))
mask = resize(mask, (512, 512, 1), mode = 'constant', preserve_range = True)
    # Save images
X[0] = x_img/255.0
y[0] = mask/255.0
```

In [35]:

```
preds_val = model.predict(X, verbose=1)
```

```
1/1 [==============================] - 1s 507ms/step
```

In [36]:

```
preds_val_t = (preds_val > 0.5).astype(np.uint8)
```

```
preds_val_t = (preds_val > 0.5).astype(np.uint8)
```

In [37]:

```
# Check if valid data looks all right
plot_sample(X, y, preds_val, preds_val_t)
```

```
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:11: UserWarning: No contour
levels were found within the data range.
  # This is added back by InteractiveShellApp.init_path()
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:19: UserWarning: No contour
levels were found within the data range.
/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:24: UserWarning: No contour
levels were found within the data range.
```