



# **Lung cancer Computer Aided Diagnosis system (CADx) with 3D deep convolutional neural networks**



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# Lung Cancer Key Numbers



**1,800,000** 

Deaths from lung cancer in 2020

**2,210,000** 

New lung cancer cases reported in 2020

**33 %** 

Of deaths from cancer are due to tobacco use, high body mass index, alcohol use, low fruit and vegetable intake, and lack of physical activity.

# Lung Cancer Facts



## Early detection

Early detection can increase the survival chance of the patients significantly. If lung cancer is diagnosed at an earlier stage, and before it has spread, it is more likely to be successfully treated.



## Symptoms

Usually, symptoms of lung cancer do not appear until the disease is already at an advanced stage. Even when lung cancer does cause symptoms, many people may mistake them for other problems, such as an infection or long-term effects from smoking.



## Smoking

Current and former smokers are at a higher risk of getting lung cancer.



# Lung Nodule CADx Challenges

01.

## Nodule Detection

The challenge of detecting a nodule in a CT scan. Several state-of-the-art 2D and 3D Convolutional neural networks (CNN) have been introduced by the authors with the 2D approaches being more accurate and computationally efficient, but losing a lot of the 3D contextual information that a CT scan has. 3D approaches use this 3D information from the scan, and therefore have the ability to extract more volumetric features about the overall appearance of a nodule.

02.

## Nodule Segmentation

The challenge of predicting a 2D or 3D segmentation mask of a nodule. A nodule segmentation network is trained on ground truth segmentation masks that were produced by the doctors. Commonly used architectures for segmenting of pulmonary lung nodules are U-net, Residual networks and custom Convolutional neural networks (CNN)

03.

## Nodule Classification

The challenge of classifying a nodule. Most of the studies usually classify the malignancy level of nodules as benign or malignant. Several state-of-the-art 2D and 3D Convolutional neural networks (CNN) have been proposed by the authors and a lot of them are taking leverage of Transfer Learning to speed up their training process.



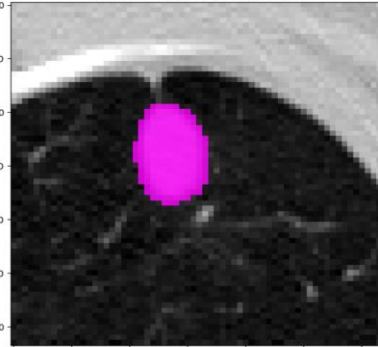
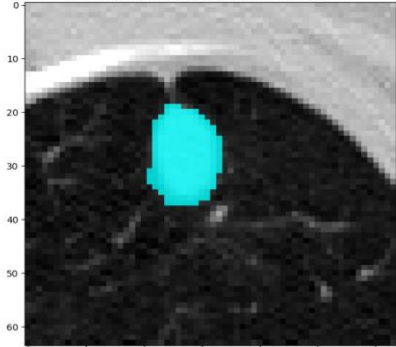
# Nodule Segmentation Predictions

**Ground Truth**

**Prediction**

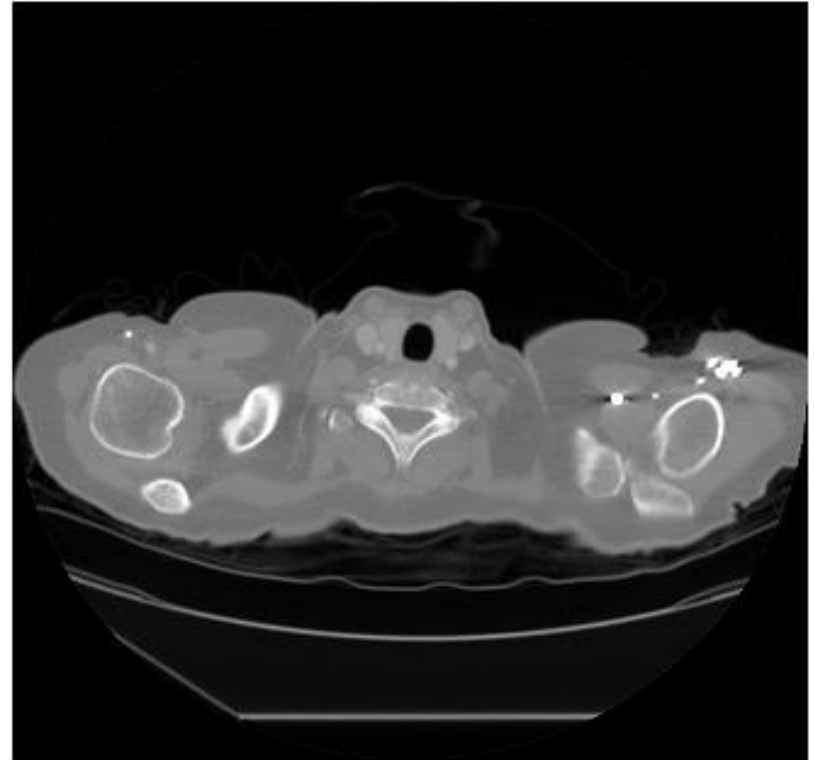
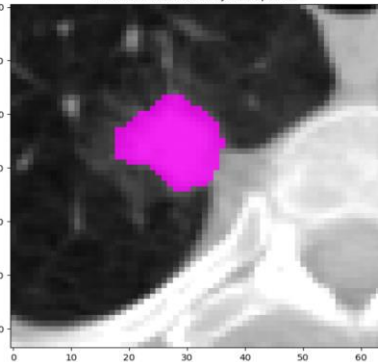
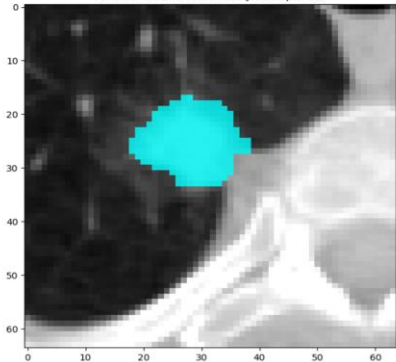
Ground Truth Mask Overlay at Depth 20

Predicted Mask Overlay at Depth 20



Ground Truth Mask Overlay at Depth 32

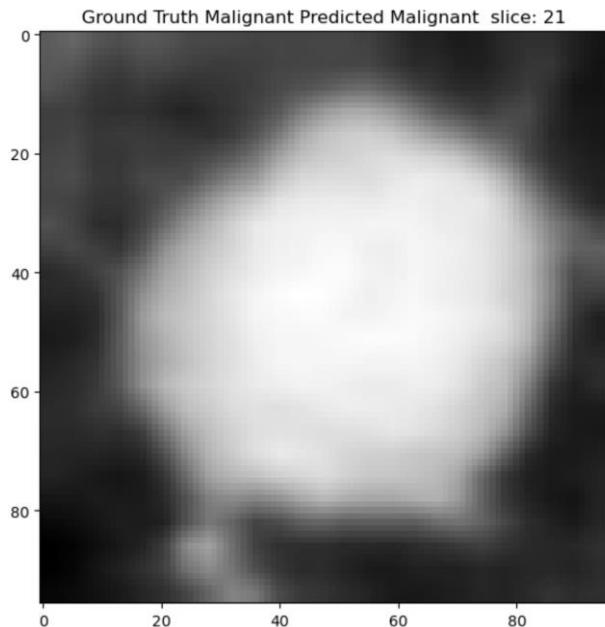
Predicted Mask Overlay at Depth 32





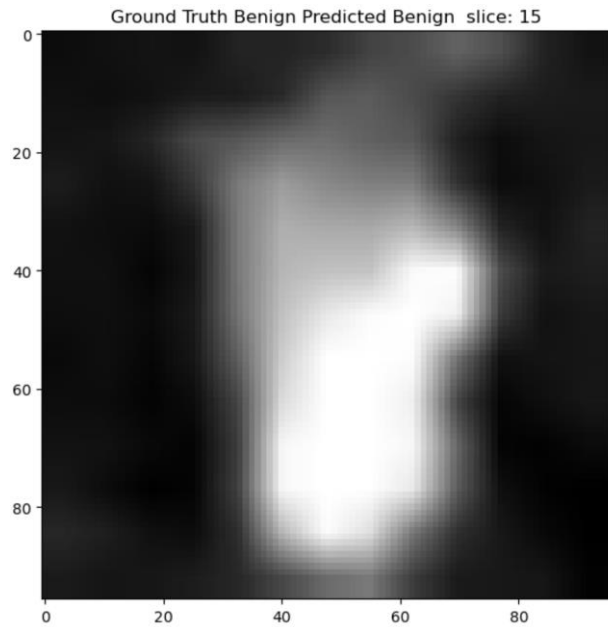
# Nodule Classification Predictions

Ground Truth: **Malignant**



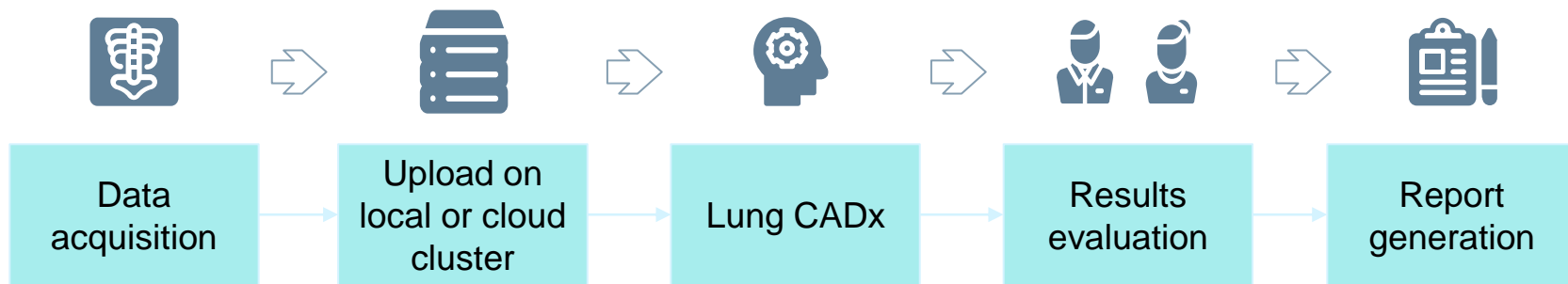
Prediction: **Malignant**

Ground Truth: **Benign**



Prediction: **Benign**

# Analysis pipeline



# THANK YOU!

