Questionnaire for Segmentation Evaluation
Part 3 : Cavitary

Introduction

This 4 part questionnaire was devised in order to evaluate the region based fast marching method and for the preservation of diagnostic information. It is destined for the radiologists from Tianjin Chest Hospital to get their subjective evaluation on how accurate the segmentation is when applied to a representative subset of lung nodules from the LIDC dataset.

The following document contains an explanation on how the segmentation evaluation rating works followed by some examples. Below each image there will be three fields to fill out with a score, subjectively evaluating each segmentation instance.

Data

This is a short explanation of how the data was obtained and presented. Firstly a subset of nodules from the LIDC dataset was organized in 4 categories: Round, Irregular, Cavitary, Semi-transparent. For each category there will be a separate questionnaire. The input data from CT scans was processed to make the data more manageable, mostly by removing the lung wall and rescaling so as to have all scans at the same spacing of $0.5mm^2$ per pixel. The lung nodules were segmented with 2 different methods (the one subject of evaluation and another method for comparison), and the instances shown in this questionnaire have been randomly shuffled to make it impossible to know beforehand which method was used. The results will be displayed using 3 images:

- Input: it is the original image obtained from CT

- Boundary: the boundary of the segmented nodules is highlighted in red on the processed image

- Mask: the binary mask of the segmentation

Rating

The segmentation quality will be rated on a 1-5 scale, where 1 is the worst possible score and 5 the highest. For each segmentation instance there will be 3 different scores to evaluate how well it describes the nodule.

- Area preservation: this score indicates how close the area of the segmented nodule is compared to the ground truth.

- Shape preservation:this score indicates how similar the shape of the boundary of the segmented nodule is compared to the ground truth.

- Overall diagnostic quality: this score rates the general quality of the segmentation, taking all the properties of the nodule into account this score should quantify how well the segmentation captures all the properties.

Following are some examples of how different segmentation instances can be rated.

- **Example 1** :
  In this case all scores are excellent and the segmentation is considered perfect.

Area preservation	Shape preservation	Overall diagnostic quality
5	5	5
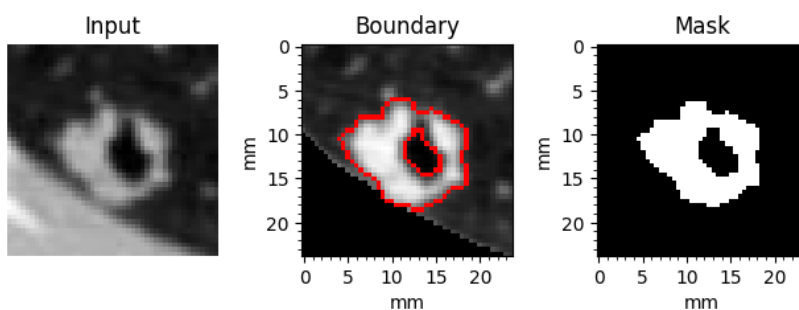
- **Example 2** :
  There are small segmentation errors along the border, area of the nodule is very close to the ground truth, the segmentation looks fairly accurate except for finer detailed features
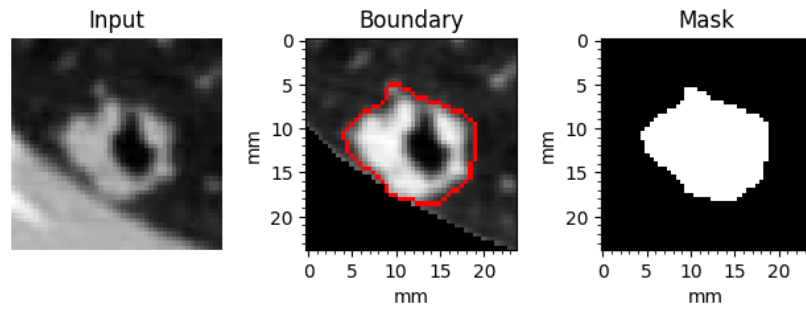
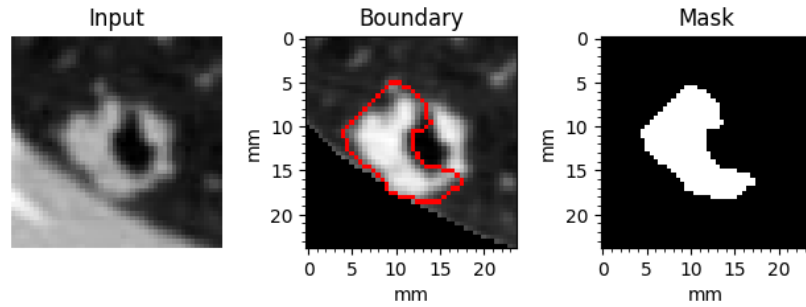| Area preservation	Shape preservation	Overall diagnostic quality
4	4	4
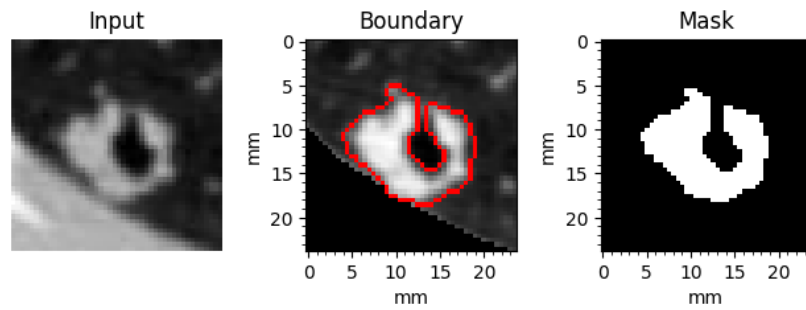
- **Example 3** :
  Segmentation errors are more noticeable but shape and overall size are still close to reality. The result can be considered acceptable.

Area preservation	Shape preservation	Overall diagnostic quality
4	3	3

3

- **Example 4** : Shape of the segmented nodule is distorted, the area covered by the segmented nodule is still comparable to the input, overall quality is poor.

Area preservation	Shape preservation	Overall diagnostic quality
3	2	2

- **Example 5** : The result looks nothing like the lung nodule inspected, based on the segmentation it would be impossible to recognize the nodule.

Area preservation	Shape preservation	Overall diagnostic quality
1	1	1
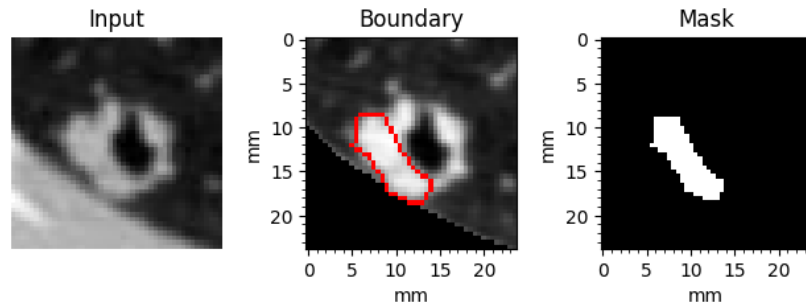
Evaluation

The following images are the segmented lung nodules, for each nodule the 3 scores need to be submitted in the respective fields, the acceptable range for the score is 1-5. The scores can be saved by simply choosing to save the pdf at the end of the evaluation.

Nodule 1
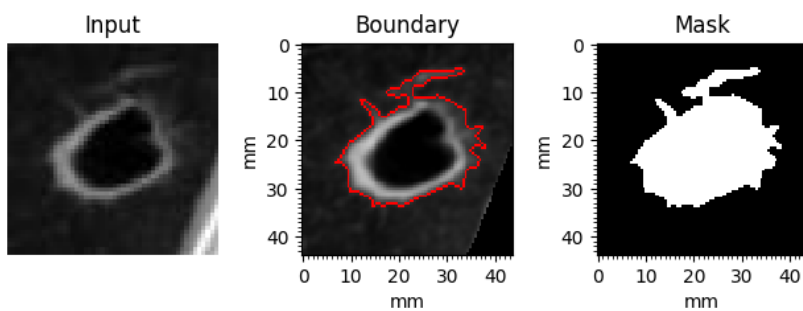
Area preservation:

Shape preservation:

Overall diagnostic quality:
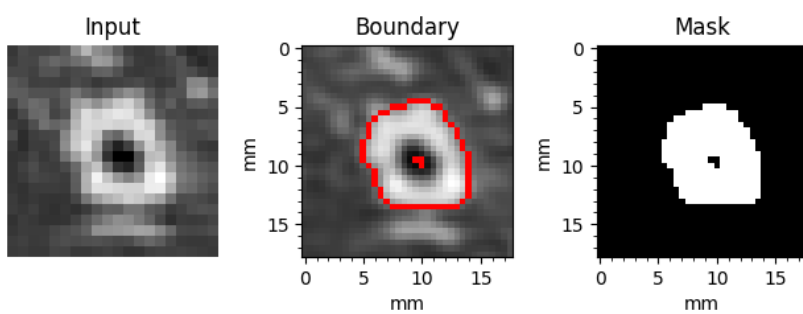
Nodule 2

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 3
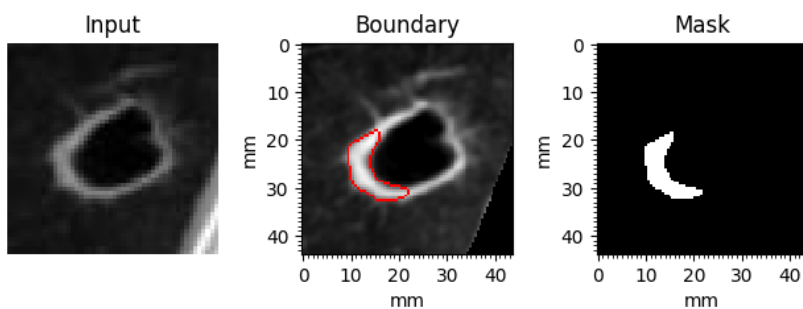
Area preservation:

Shape preservation:
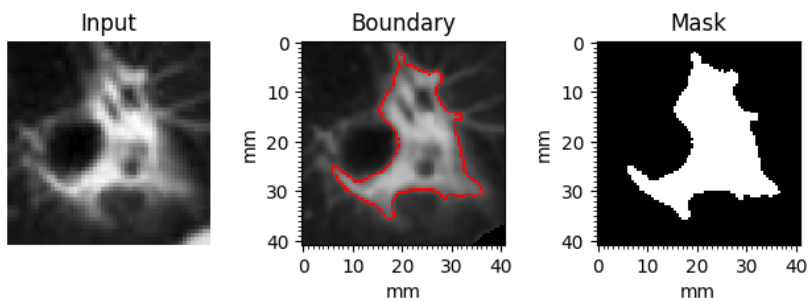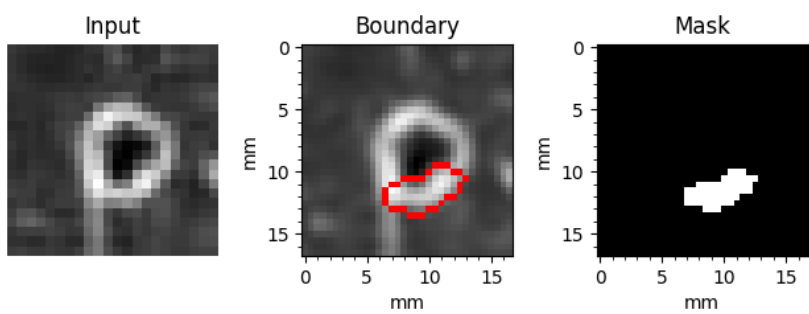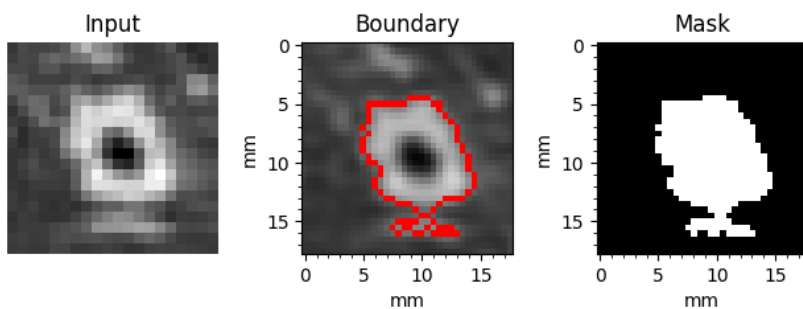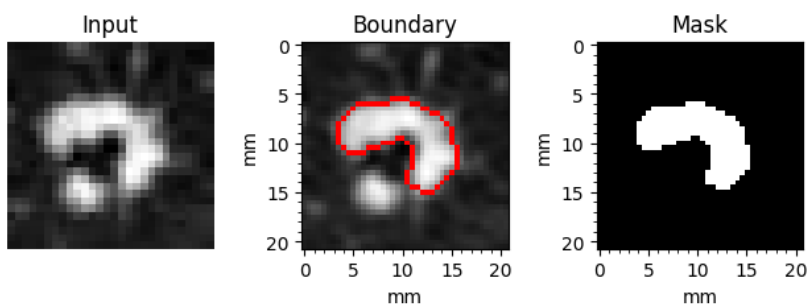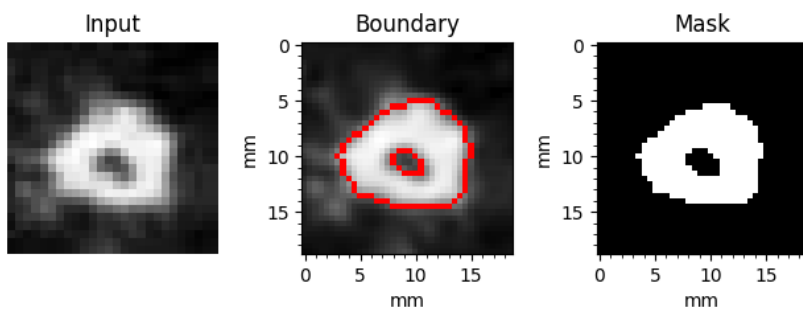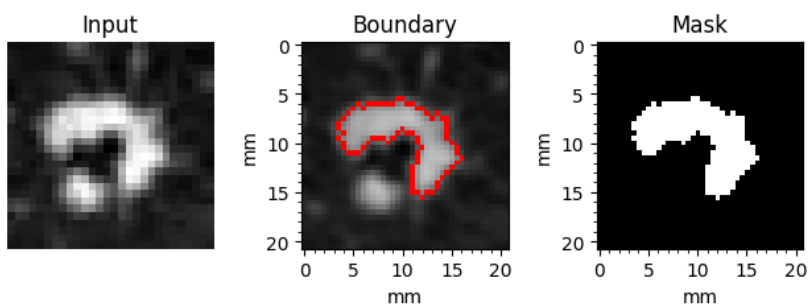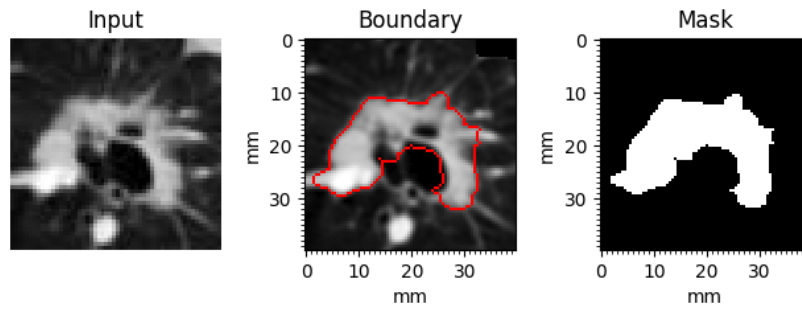
Overall diagnostic quality:

Nodule 4
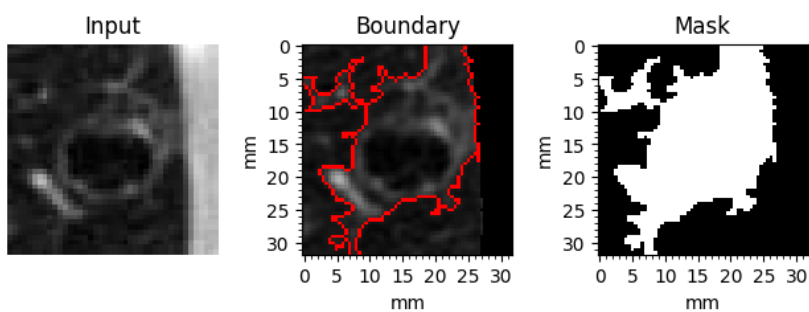
Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 5

Area preservation:

Shape preservation:

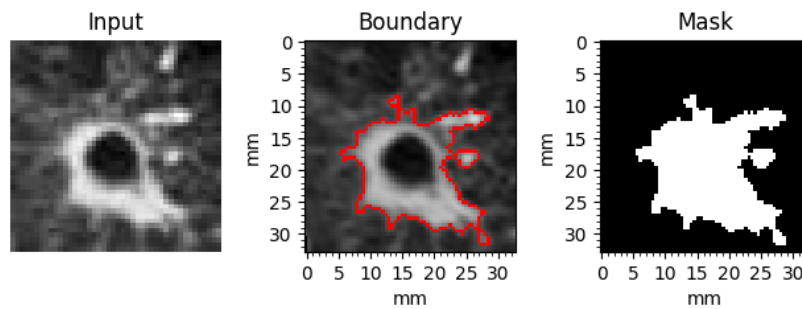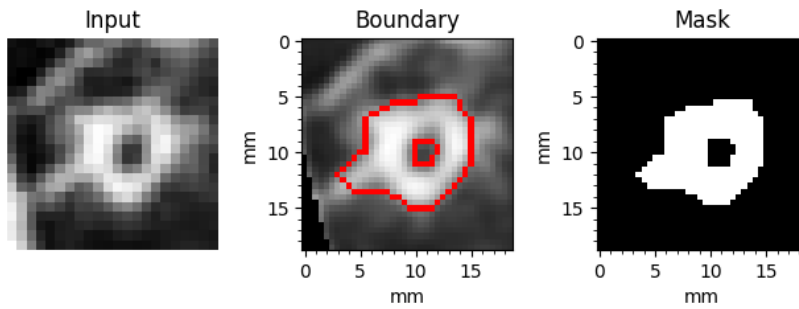Overall diagnostic quality:

Nodule 6

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 7

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 8

Area preservation:

Shape preservation:

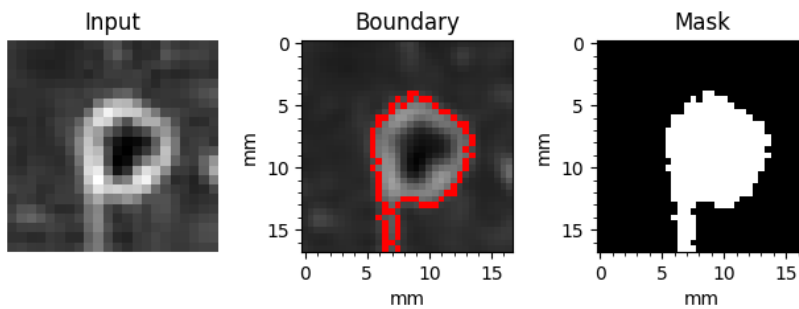Overall diagnostic quality:

Nodule 9

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 10

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 11

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 12

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 13

Area preservation:

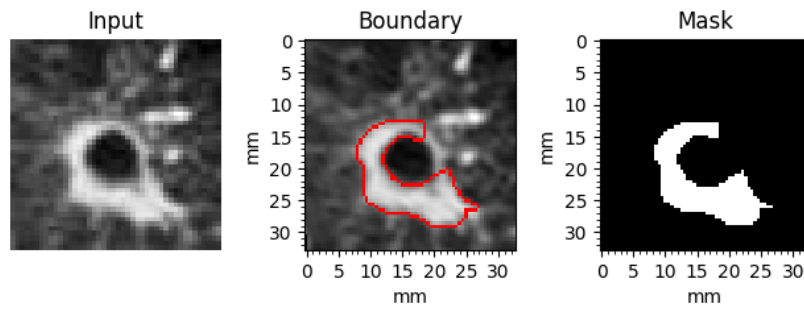Shape preservation:

Overall diagnostic quality:

Nodule 14

Area preservation:

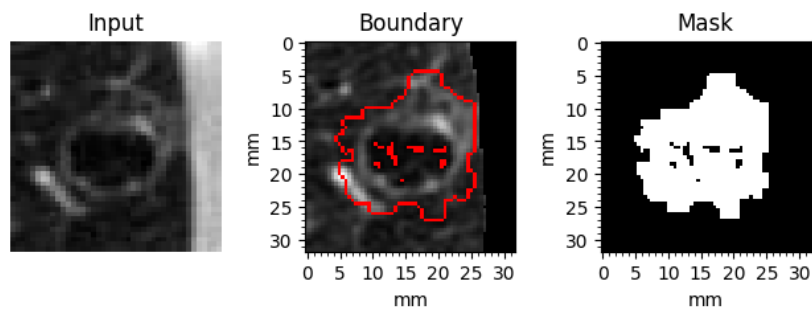Shape preservation:

Overall diagnostic quality:

Nodule 15

Area preservation:

Shape preservation:

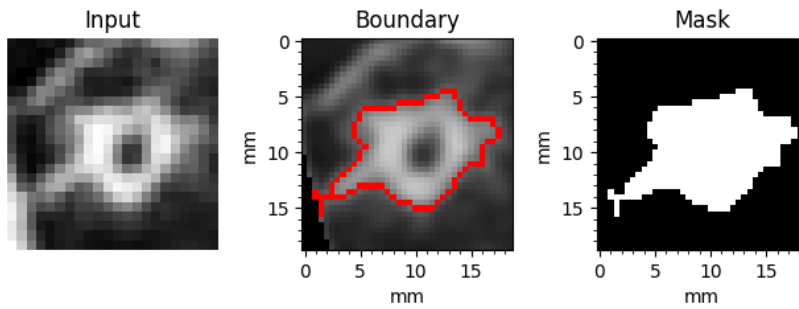Overall diagnostic quality:

Nodule 16

Area preservation:

Shape preservation:

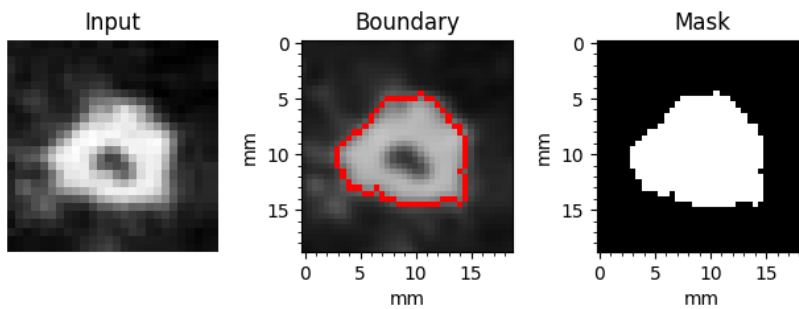Overall diagnostic quality:

Nodule 17

Area preservation:

Shape preservation:
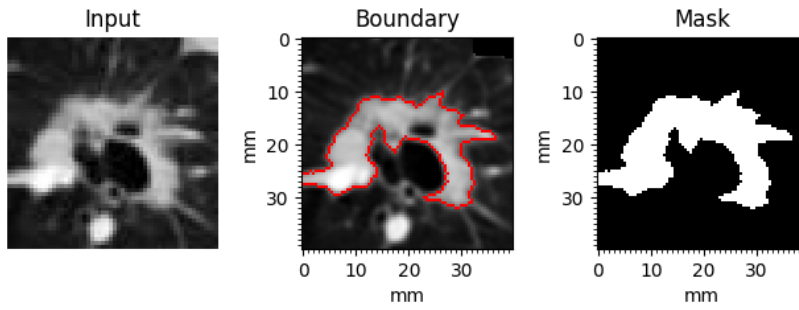
Overall diagnostic quality:

Nodule 18

Area preservation:

Shape preservation:

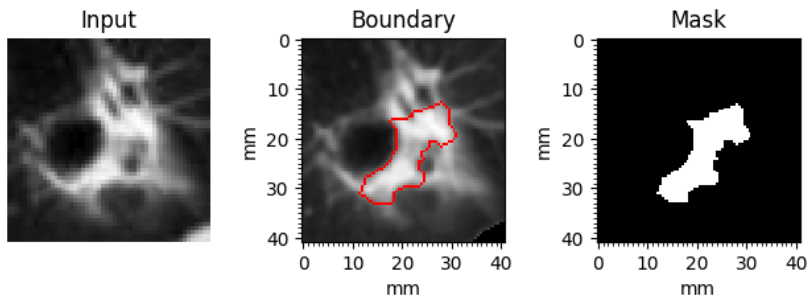Overall diagnostic quality:

Nodule 19

Area preservation:

Shape preservation:

Overall diagnostic quality:

Nodule 20

Area preservation:

Shape preservation:

Overall diagnostic quality: