Lung Cancer detection with U-Net/Faster R-CNN nodule/region of interest proposal

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1 Introduction and Problem Statement

The problem with segmentation and structure identification within the field of biomedical imaging has become a well developed and very active field in the past years. In 2016 and 2015, the LUng Nodule Annotation (LUNA) challenge and SPIE Lungx challege, asked researchers to develop models to identify pulmonary nodules in lung CT slices. In the 2016 LUNA Challange, researchers gained access to annotated CT slices that identified abnormal nodules but did not release data about the malignancy of the nodles. In the 2015 SPIE less than 80 CT annotated images of malignant nodules were released to the public.

However, with the 2017 Kaggle Data Science Bowl, a largeish dataset of 1000+ lung CT images in DICOM format was finally released with cancer/no cancer labels. Preliminary investigations by Kaggle members using 3D-convolutional neural nets have already begun. There is one caveat to this dataset; location of malignant nodules are not labeled.

Inspired by recent work in biomedical image segmentation, region proposal networks and multiple instance learnign for whole mammogram classification, We seek to present a novel pipeline for cancer detection by combining region proposal and multiple instance learning (MIL).

2 Method/Algorithm/Pipeline

We will enhance multiple instance learning (MIL) by combining MIL with region proposal. We plan to leverage state of the art region proposal networks to propose regions and implicitly weight instances consumed by a downstream MIL classifier.

We will first train a region proposal network on the LUNA dataset to propose abnormal regions in CT slices. Then feed these regions along with original DICOM images to an MIL framework that leverages on AlexNet and is similar to that developed by Zhu et. al.

Region Proposal Networks

We

Multiple Instance Learning

3 Goals

The main challenge that we face in lung cancer detection

Goals:?

Tuning Faster/fast RNN or YOLO to detect nodules

Using Alex-net or other 2GPU methods to train cancer classifier

Find ways to reduce false positive/false negatives

4 Datasets

The number of lung CT scans available to us is very low. The total number of examples available are many orders of magnitudes smaller than the size of datasets for modern, state of the art classficiation challenges such as ImageNet or MSCOCO.

Listed below are the datsets we will leverage to train our classification/nodule extraction model.

Dataset	# CT scans	Label Type
Kaggle	1000+	Cancer/No-cancer binary
LIDC-IDRI	888?	Nodule annotation
NLST	?	?
SPIE	80	Nodule annotation

Kaggle Data Science Bowl - (Kaggle)

Lung Image Database Consortium image collection - (LIDC-IDRI)

National Lung Screening Trial - (NLST)

SPIE Lungx Challenge - (SPIE)

5 How we will evaluate our results

Visualizations of 3D convolutions?
Comparison between plain CNN vs. nodule extraction -> CNN?
Comparison between U-NET vs tuned FASTER R-CNN?

1) Nodule extraction with u-net, r-cnn roi proposal, or another pre-trained model. TODO: what will be the extracted features be?!
2) leverage 2 GPU with alex-net like architechture to classify cancer instances, we really dont have more data so we might have to train on the kaggle dataset.

6 About us

buncha kiddos who have no idea about anything

7 Related Work

8 Questions and challenges

1. What will the output of node-extraction be like?
2. What kind of novelty will we bring to the table?
3. How will we deal with the small dataset(s)?