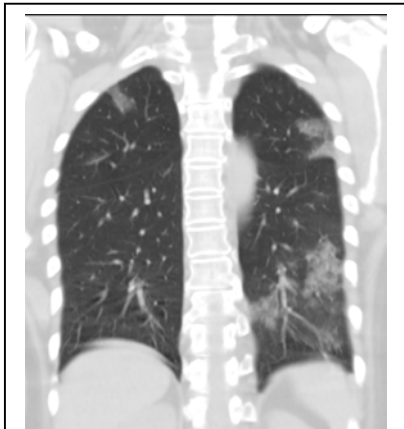Given the context of covid19 pandemic, CT imaging has been used to diagnose and visualize the effect of this particular coronavirus on the lung with some reports calling CT images a reliable an early marker than tests based on PCR.

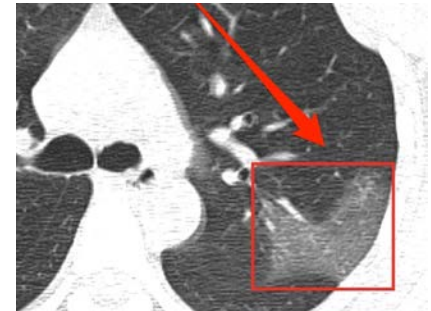https://www.itnonline.com/content/ct-provides-best-diagnosis-novel-coronavirus-covid-19

Normal lung CT

https://healthcare-in-europe.com/en/news/ct-outperforms-lab-diagnosis-for-coronavirus-infection.html

Covid19 lung CT

https://radiopaedia.org/articles/covid-19-3?lang=us

Ground Glass CT feature

https://www.businessinsider.com/china-coronavirus-diagnosis-ct-scans-lungs-2020-2

This virus can, in some cases, damage the lungs quite severely and leave scar tissue that appears as diffuse pattern resembling "ground glass" on CT images. Hence the name "ground glass opacity" for the scarry tissue.

Needed is a metric to measure the area of the ground glass opacity vis-à-vis the area of the lung in a given image to quantify the severity of the disease. As image processing engineers who have taken a course on image processing, this is a task being entrusted to you as your course project.

Tasks:

1) Segment the lung tissue that appears dark regions in CT images (choose the frontal view images like shown above in the normal lung CT image). Crop the images to retain only a tight field of view around the lung)
2) Segment the diffuse white patches, the ground glass opacity, in the given CT images
3) Create a metric that measures the severity of the ground glass opacity, i.e. what percentage of the lung is affected by this particular CT-imaging feature.
   a. Determine which patient is healthy or is suspected to have COVID-19
   b. Determine the severity of infection (if infected)
   c. For all patients, show segmented COVID-19 results, compared to original input image
4) Show this calculation and examples for the test set provided with this project. You are free to use any of Matlab's inbuilt functions or any codes available anywhere (with proper attribution). This is a real-life test of your ability to generate a practical tool that solves a current relevant problem.
5) Please not share your codes with anyone. Reference any code sourced from a third-party. Follow appropriate code copying guidelines set for this course.

Deliverables:

A. A detailed presentation showing the original images, and their segmentations for the lung and the covid19-related ground-glass opacity as seen on CT images for the test set provided.
   a. For each patient, identify if COVID-19 exists and its severity (i.e. your % calculation).
B. All MATLAB script used to create the final solutions. Your main script should access all files within the directory provided. Do not rename the test set directory. Insert this directory as a sub-folder and access files within.

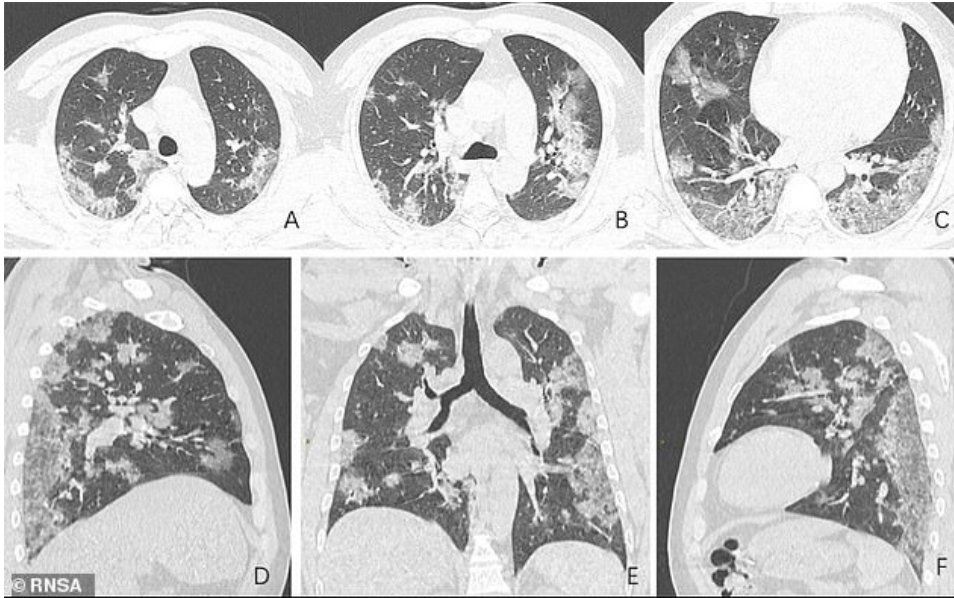## Report
Section 1: Exploration

1. Sequentially discuss all solution(s) attempted to solve the problem. This section should be written like a journal as you try different methods / solutions for segmentation. Show results, whether they are good and bad.
2. Discuss your original logic in these sections and why you think it works/did not work/issue
   - Date: April…
   - Method Explanation: <high level logic here>
   - Results: <a couple image examples>
   - Briefly explain what you learned from results

Section 2: Proposed Solution

1. A detailed writeup describing the main methods you used in your codes. For example, if you used a method called Otsu's segmentation, or active contours, then describe the concepts and ideas underlying this method in a few paragraphs.
2. A well-documented set of codes, as per the design principles we have been following in the course, along with the bank of images you have used so that while grading, a call to a top level function will generate all the figures you have used in your presentation.
3. Present all test images, COVID-19 segmentations, identification (i.e. healthy or infected), and progress of infection (i.e. metric calculation)
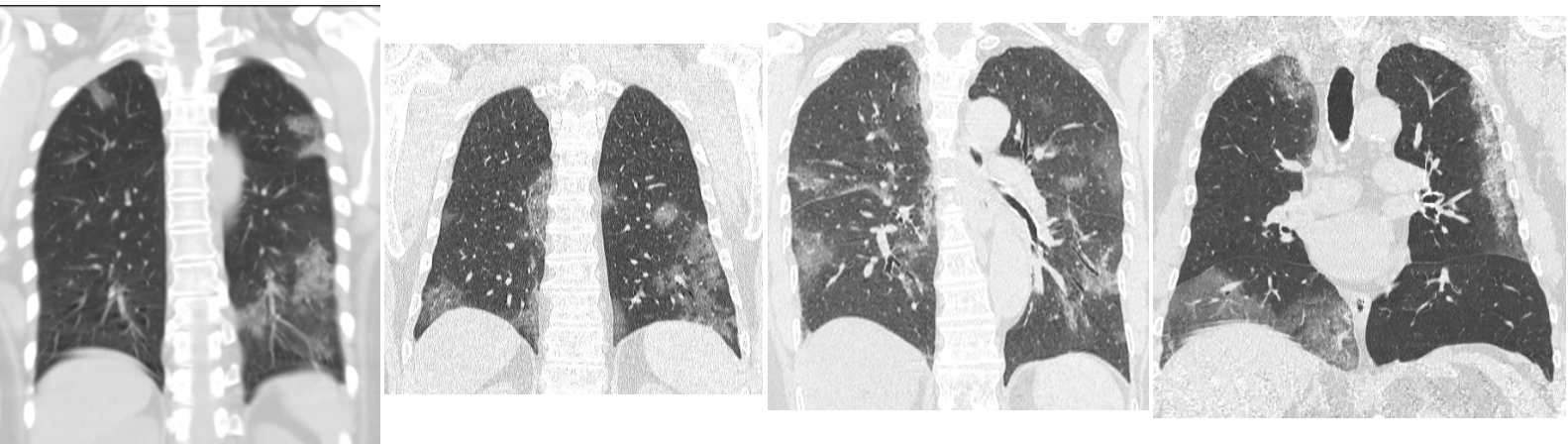
APPENDIX: COVID-19 CT Examples

https://www.dailymail.co.uk/news/article-8101383/Shocking-X-ray-images-coronavirus-does-victims-lungs.html
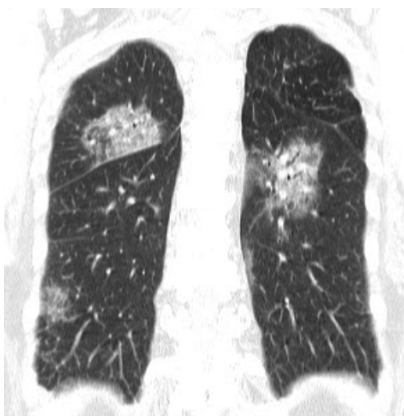

The shocking chest X-rays (pictured) of one coronavirus victim, a 44-year-old man who worked at the Wuhan seafood market thought to be the origin of the outbreak, clearly show the ground glass opacity abnormality
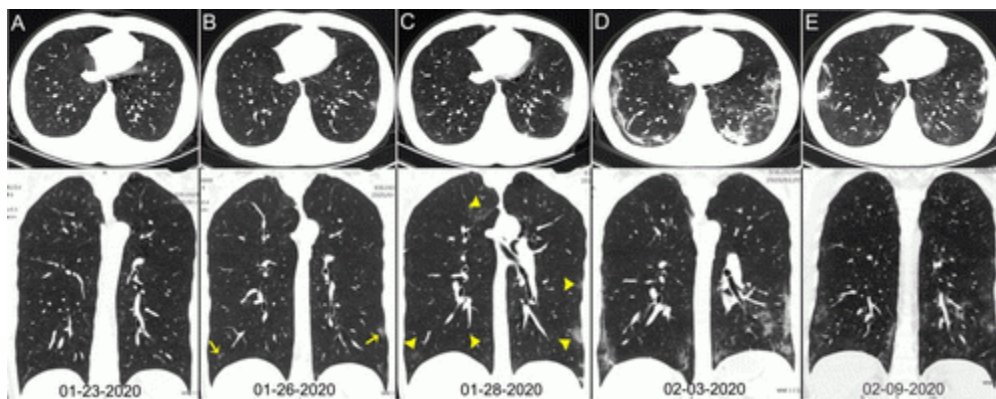
https://radiopaedia.org/articles/covid-19-3?lang=us

https://www.ajronline.org/doi/full/10.2214/AJR.20.22969

https://www.itnonline.com/content/ct-provides-best-diagnosis-novel-coronavirus-covid-19

http://www.koreabiomed.com/news/articleView.html?idxno=7361