

# A Sigh of Relief

Deep Learning to Aid the Diagnosis of Pneumonia

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# Complexity

- Many different factors influence care.
- Many of our choices as clinicians are probabilistic, in nature.
- With the advent of EMRs  
Drowning in data  
Starving for insight



<https://pixabay.com/en/photos/medical/>

## Role of Data Science?

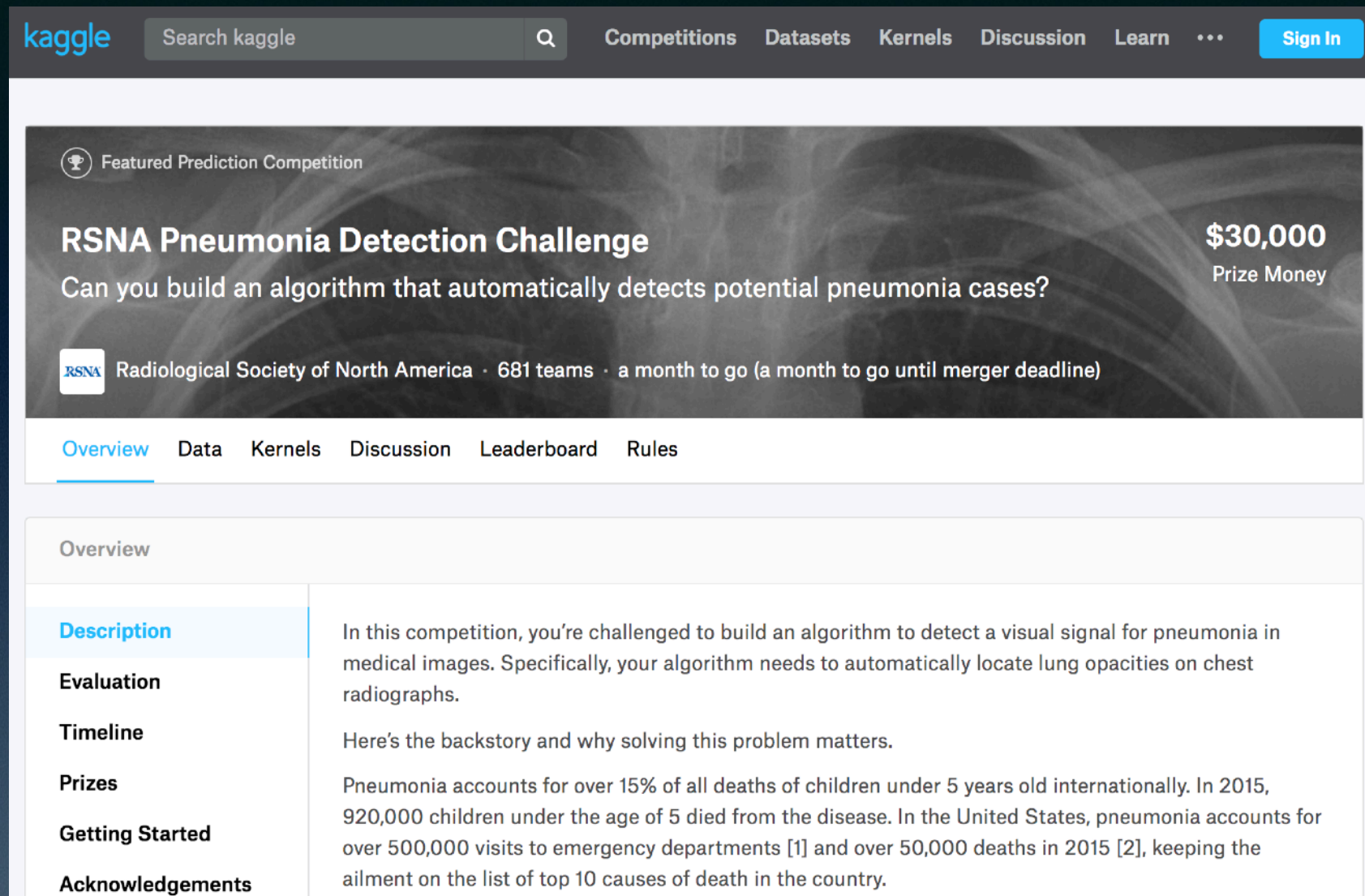


# Project Goal

- To build a screening tool for clinicians, using a Convolutional Neural Net model to detect opacity on X-rays.
- Aid clinicians at the first point of care:  
Primary Care, Urgent Care, Emergency Room
- Wet reads guide treatment, awaiting radiologist's final report
- Early & accurate detection can hasten treatment & save lives!
- Aid Radiologists: Triage large volume of images



# Pneumonia: A leading cause of morbidity and mortality



The screenshot shows the Kaggle website interface for the RSNNA Pneumonia Detection Challenge. The top navigation bar includes the Kaggle logo, a search bar, and links to Competitions, Datasets, Kernels, Discussion, Learn, and a Sign In button. The main banner features a chest X-ray background with the text 'Featured Prediction Competition', 'RSNA Pneumonia Detection Challenge', 'Can you build an algorithm that automatically detects potential pneumonia cases?', '\$30,000 Prize Money', and 'Radiological Society of North America · 681 teams · a month to go (a month to go until merger deadline)'. Below the banner is a tabbed interface with 'Overview' selected. The Overview section contains a table with the following content:

Overview	
Description	In this competition, you're challenged to build an algorithm to detect a visual signal for pneumonia in medical images. Specifically, your algorithm needs to automatically locate lung opacities on chest radiographs.
Evaluation	
Timeline	Here's the backstory and why solving this problem matters.
Prizes	Pneumonia accounts for over 15% of all deaths of children under 5 years old internationally. In 2015, 920,000 children under the age of 5 died from the disease. In the United States, pneumonia accounts for over 500,000 visits to emergency departments [1] and over 50,000 deaths in 2015 [2], keeping the ailment on the list of top 10 causes of death in the country.
Getting Started	
Acknowledgements	

# Kaggle Competition

Sponsored by the Radiological Society of North America



# Pneumonia



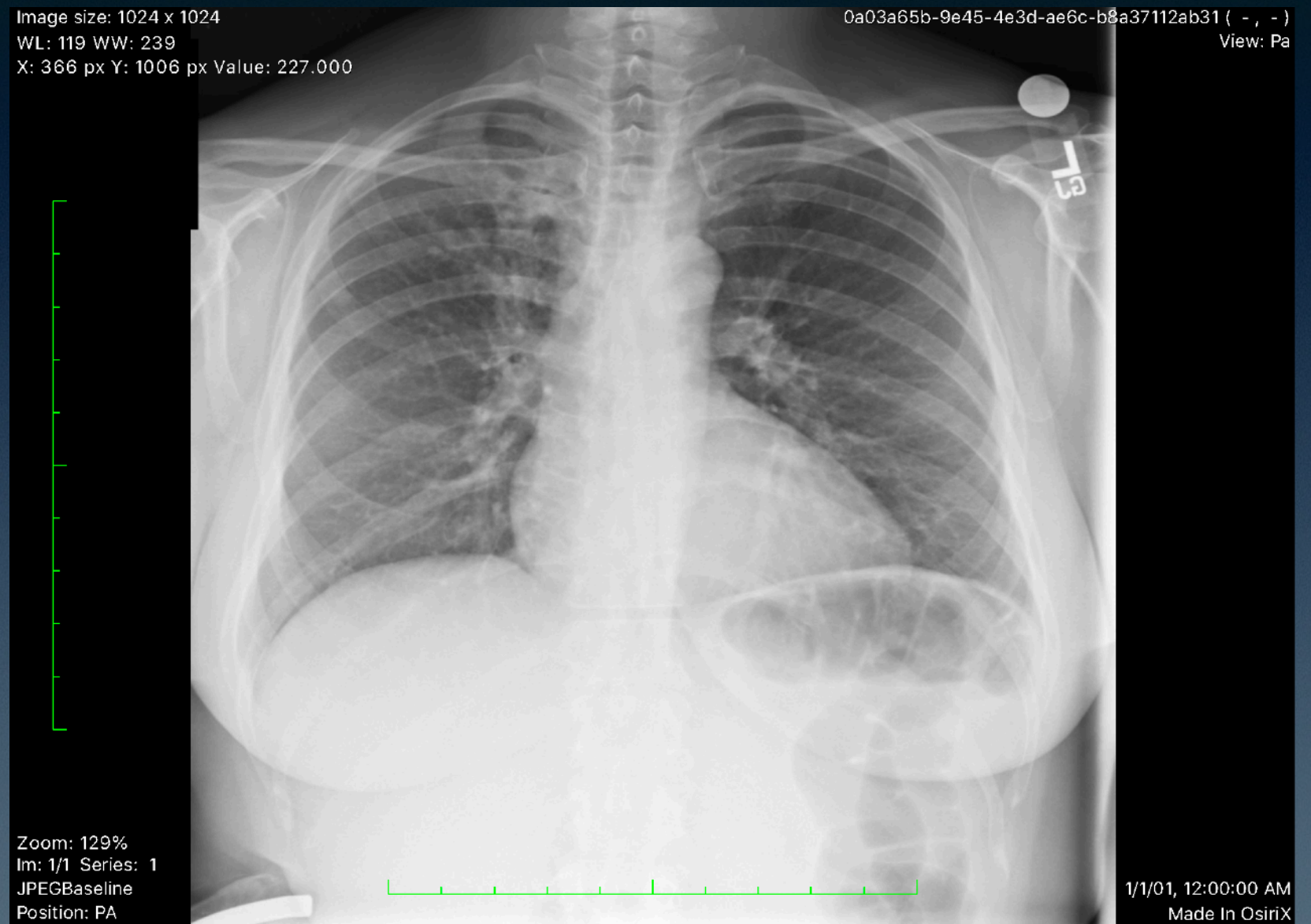
<https://www.123rf.com/stock-photo/pneumonia.html>

What does it look like on a Chest X-ray?



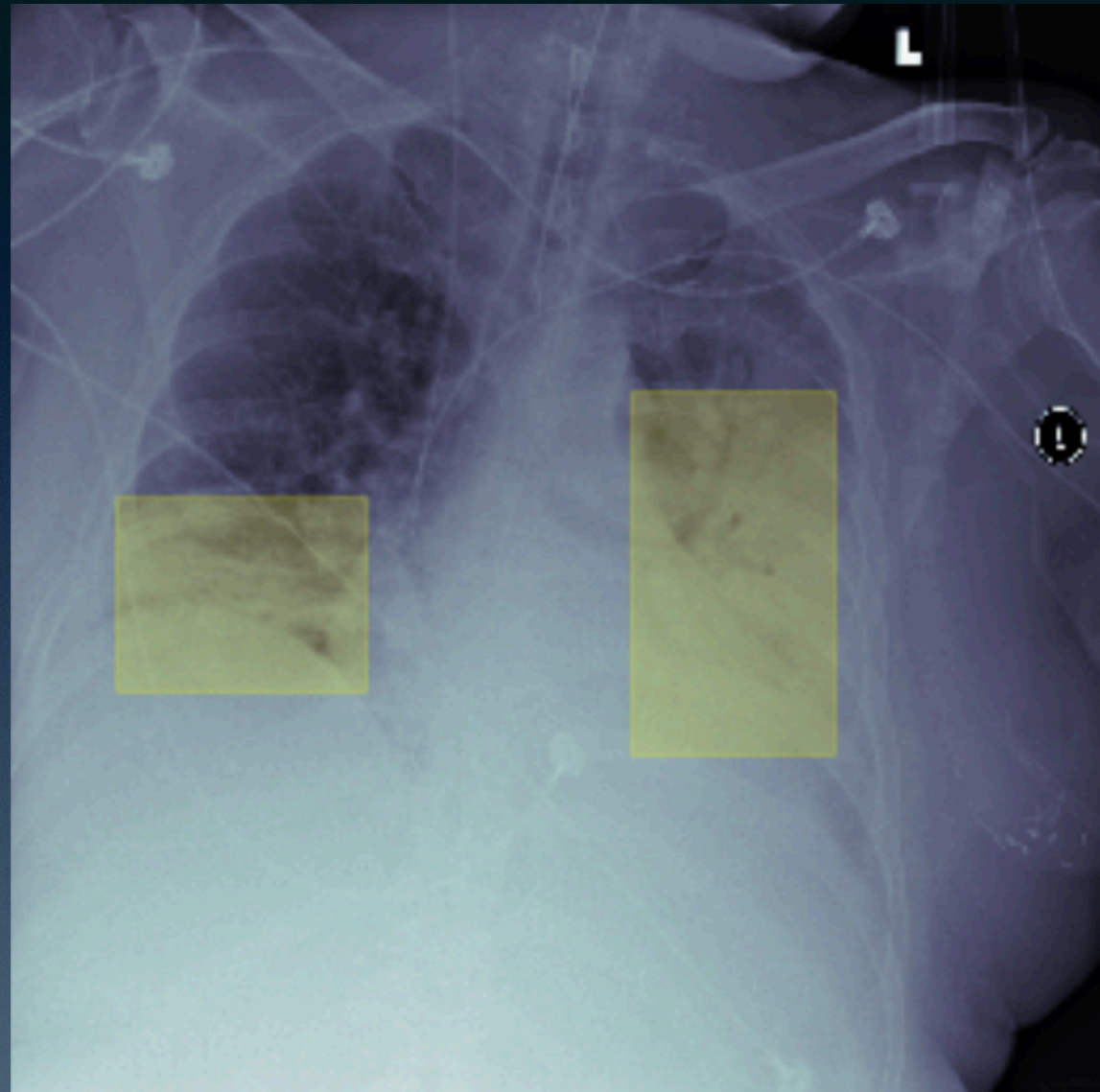
# Medical Images

- Dicom Files (.dcm)
- Grayscale
- Embedded XML
  - eXtensible Markup Language
  - Real patients, De-identified
- Labels: Normal, Opacity, Not Normal / No Opacity
- Coordinates of Opacity





# Segments

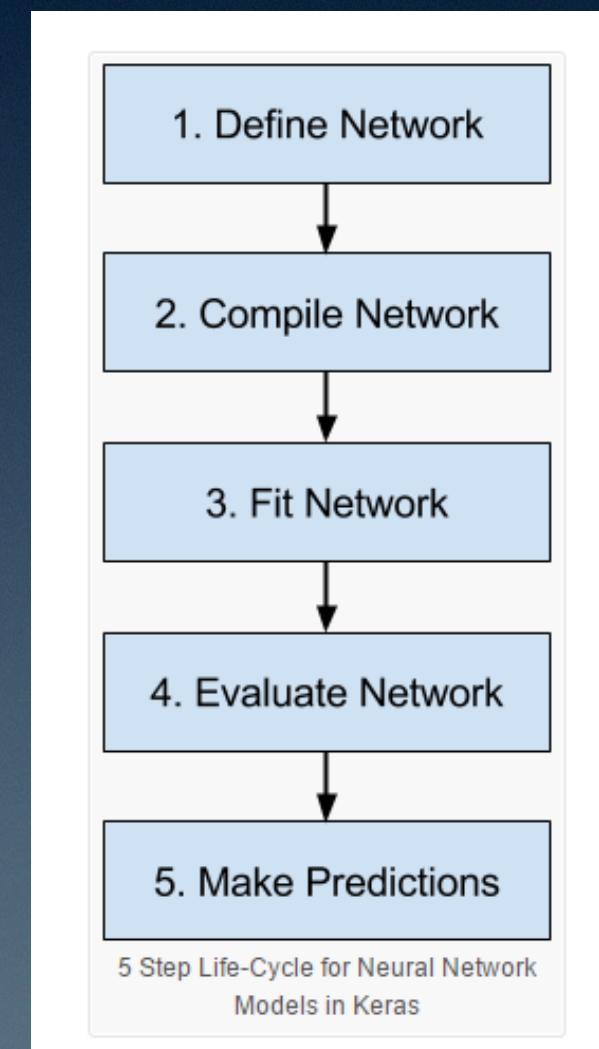
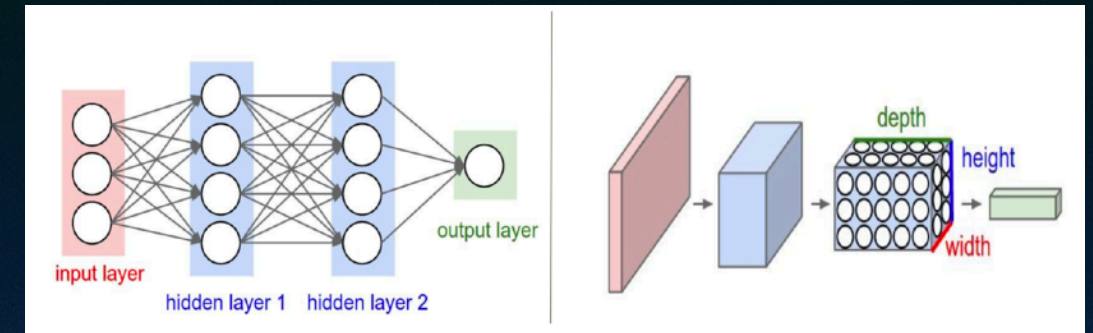


- Regions of Interest



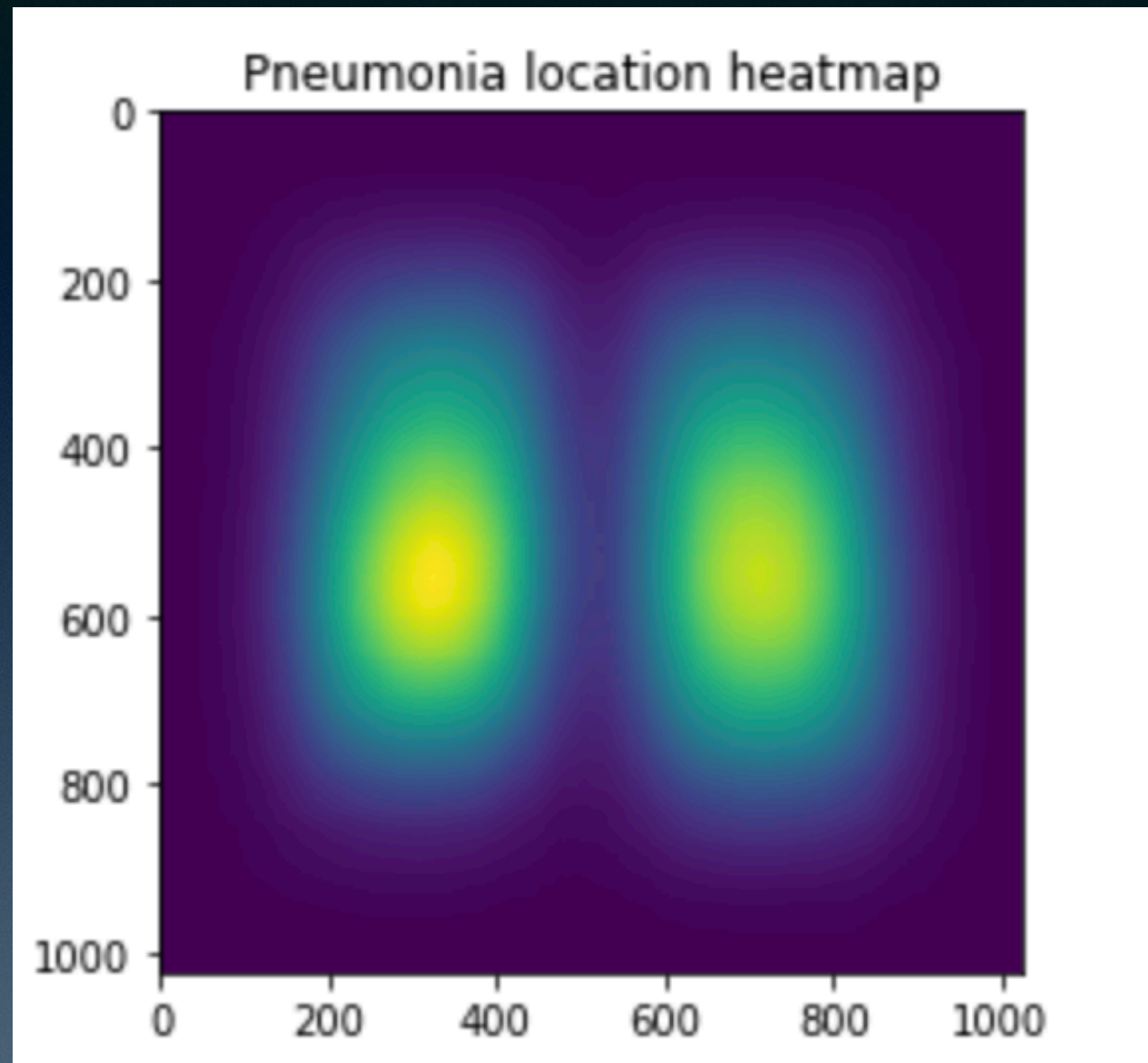
# Convolutional Neural Net

- Set up AML type EC2 instance on AWS: Deep Learning - Image Analysis
- XML data extraction with pyDicom
- Image pre-processing and visualization with pyDicom
- Convolutional Neural Net [CNN] model: Cases exist where CNNs outperform human vision- feature identification, image classification
- Transfer learning with VGG16 to train levels of CNN
- Improve model: augmentation
- Balance classes, Freeze, Unfreeze layers





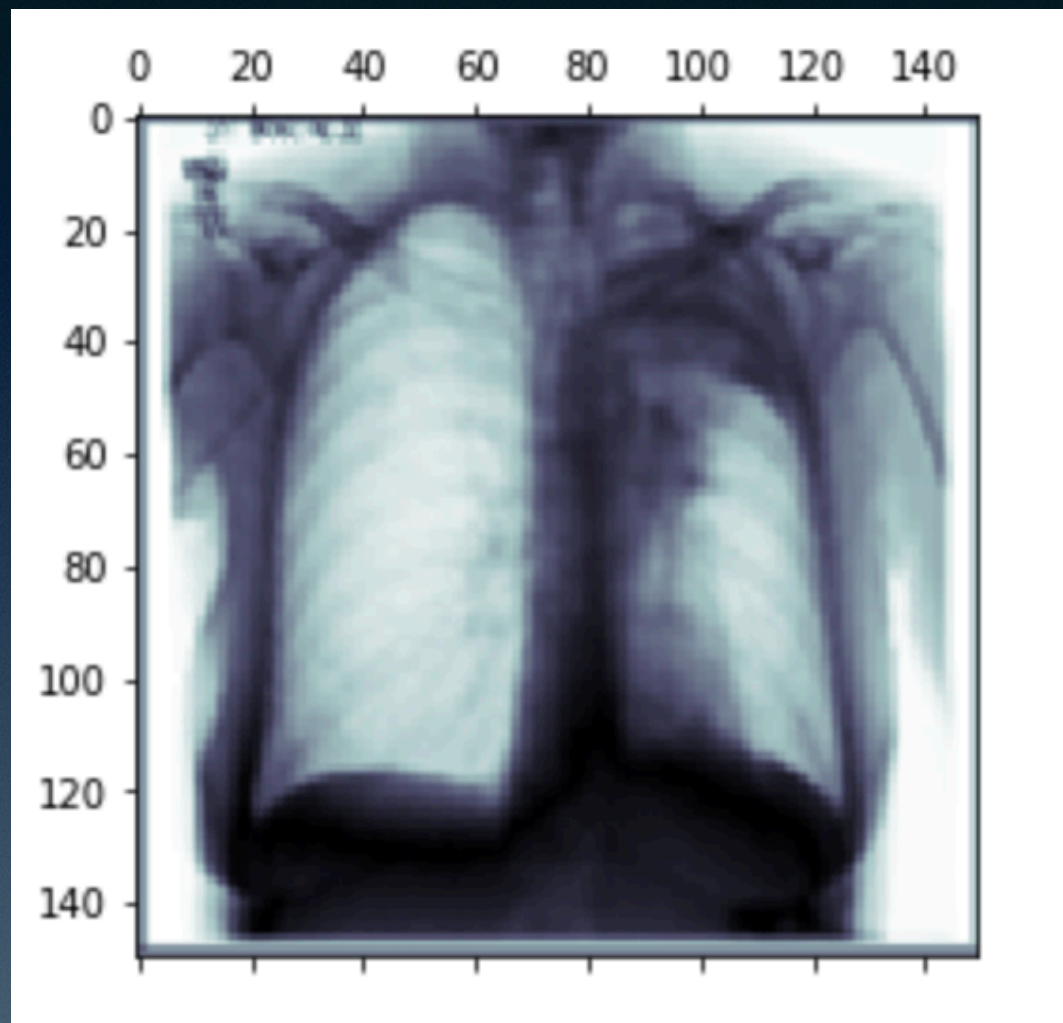
# Concentration



- Opacity across dataset



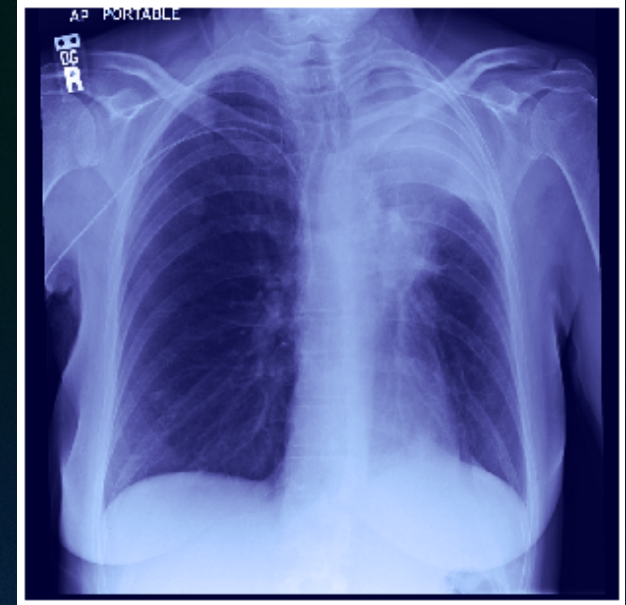
# CNN Filter



- What the model “sees”



# Results



- Binary Classification
- Two classes: Opacity, No Opacity
- %77 accuracy validation set
- Cut point for “opacity” classification can be reset so that providers can rule out pneumonia with high sensitivity.



# Conclusions

- Data Science can successfully augment providers' clinical judgement to aid diagnosis
- Convolutional Neural Nets: proven and continue to be a useful tool - images
- Pneumonia-specific diagnosis algorithm feasible, with additional clinical information



# Contact

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# References

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- <https://www.kaggle.com/c/rsna-pneumonia-detection-challenge>
- <https://www.osirix-viewer.com/osirix/osirix-md/download-osirix-lite/>