The Application of Convolutional Neural Networks to Improve the Efficiency of Lung Cancer Detection

Griffen Bengard

Introduction

Key Terms

- CNN: Convolutional Neural Networks
- CT Scans: Computed Tomography Scans
- AI: Artificial Intelligence
- FP: False Positives
- Sensitivity

Lung Cancer

- Over 900 million smokers → increases risk of lung cancer
- Low 5 year survival rate (18.2%)
- Early Detection is a necessity

Figure 1. Visual representation of lung cancer

Computed Tomography Scans

- Method of diagnosing cancer
- Creates a 3D diagram of the lung

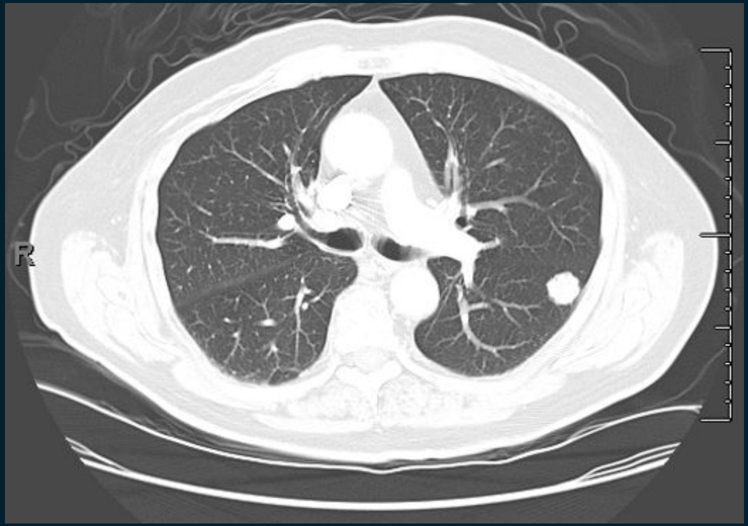

Figure 2. An image of a standard CT scan

Convolutional Neural Networks

- Form of artificial intelligence
  - Used to detect lung cancer through using online databases

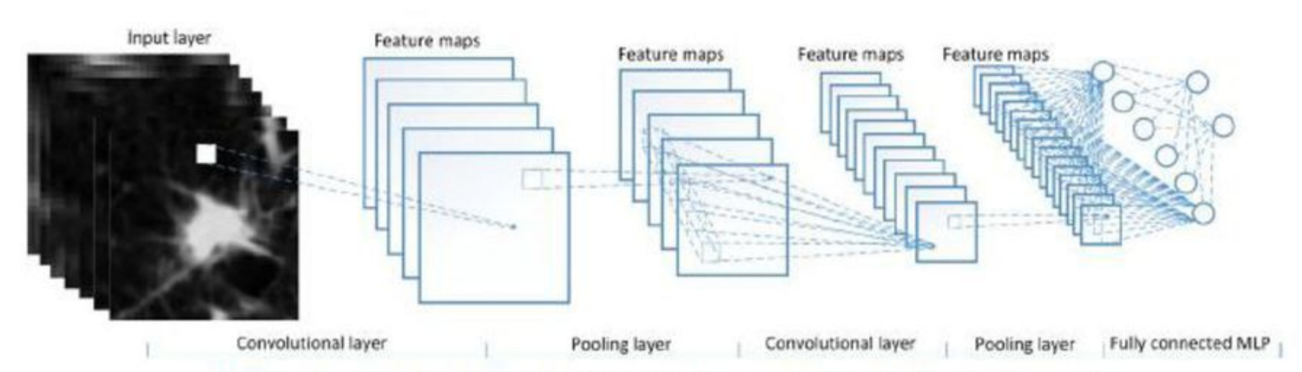

Figure 3. A visual representation of a CNN

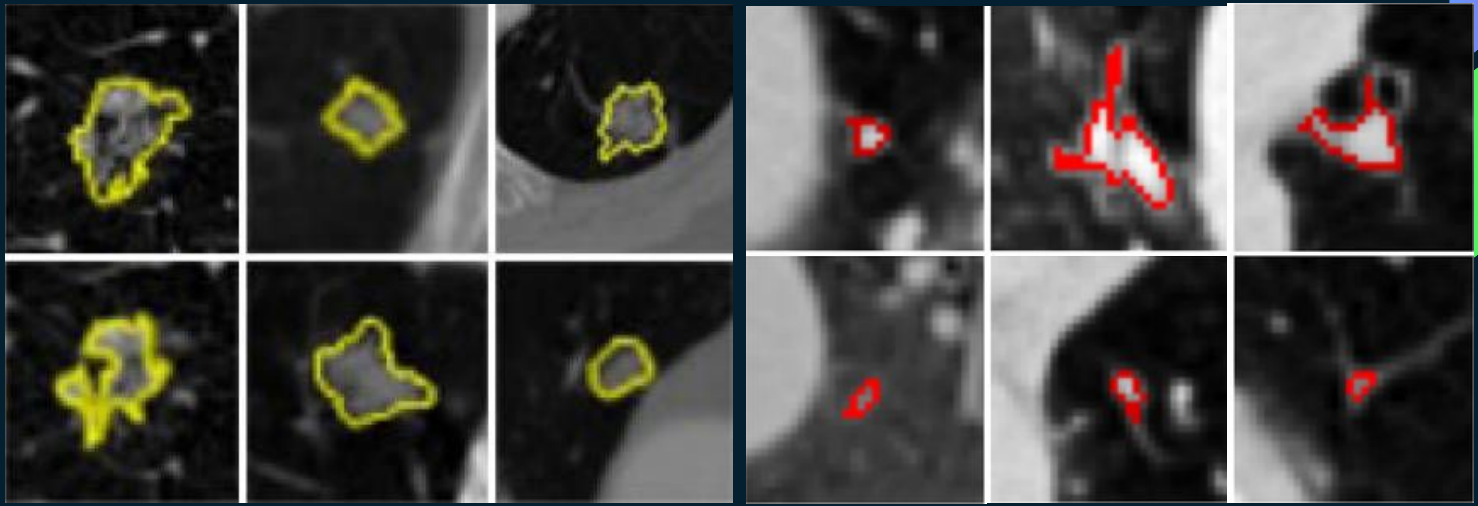

Figure 4. Diagram of detection of lung cancer and false positives

Lung Cancer Diagnosis

- X-Ray Scans
- Sputum Cytology
- Standard CT Scans
- MRI
- Tissue Samples
- PET Scans

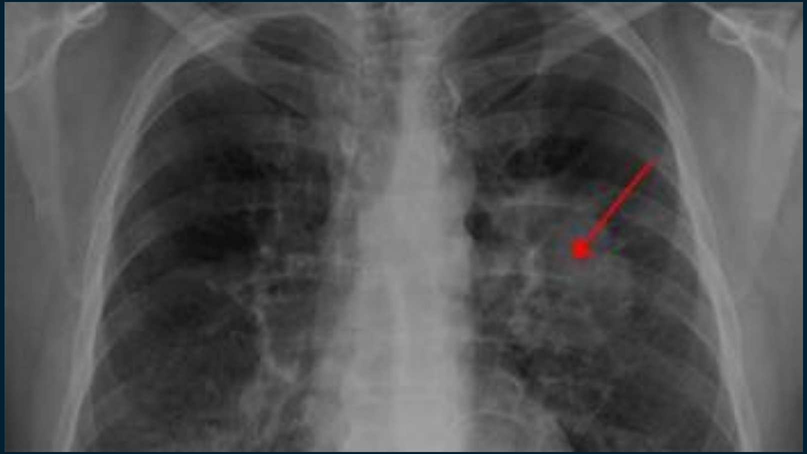

Figure 5. Image of a standard chest x-ray

Research Question, Hypotheses, Purpose

Purpose

- Research the most efficient method of lung cancer detection
- Compare Sensitivity and False Positive Rates

Research Question

- Is the use of CT scans with CNN a beneficial enough a method of lung cancer diagnosis to be used as an alternative to currently used methods?

Null Hypothesis

CNN with CT Scans is not beneficial enough, compared to conventional methods to be implemented

Alternate Hypothesis

CNN with CT Scans is beneficial enough, compared to conventional methods, to be implemented currently

Methods

Data Search

- Systematic Literature Review
- Google Scholar, EbscoHost, Research Gate, Wiley Interstate Journals, NIH

Article Collection

- Selected articles without bias
- Data had consistent variables

Data Collection

- Compared the sensitivity and FP rates between different kinds of detection

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Analysis

- Evaluation of sensitivity and FP rates in CNN with CT scans
- Compare sensitivity rates and FP rates between types of lung cancer diagnosis
- Conduct a T-test to test hypotheses

Table 1: Lung Cancer Detection Frequency and Rate of False Positives Using CNN w/ CT scans

Lung Cancer Detection Frequency	Rate of False Positives
83.4%	8.3%
85.6%	7.6%
86.2%	8.2%
83.8%	6.7%
80.9%	6.6%
88.3%	9.3%
84.8%	5.5%
86.5%	8.7%
83.3%	5.9%
85.7%	8.1%
85.6%	9.2%
87.4%	6.8%
88.9%	7.4%
83.4%	8.7%

(Huang et al, 2018; Khosravan and Bagci, 2018; Ding et al, 2017; Gomez, 2015; Shen et al, 2016)

Table 2: Lung Cancer Detection Frequency and Rate of False Positives Using Chest X-Rays

Lung Cancer Detection Frequency	Rate of False Positives
76.3%	11.3%
75.7%	9.2%
76.2%	12.1%
78.0%	14.2%
79.1%	10.2%
73.2%	9.6%
76.7%	10.8%
77.6%	7.9%
76.5%	11.6%
76.9%	12.3%
72.6%	13.2%
78.1%	9.6%
76.8%	8.9%
80.1%	13.5%

(Toyoda et al, 2008; Khosravan and Bagci, 2018; Athey et al, 2012; Gomez, 2015; Huang et al, 2018)

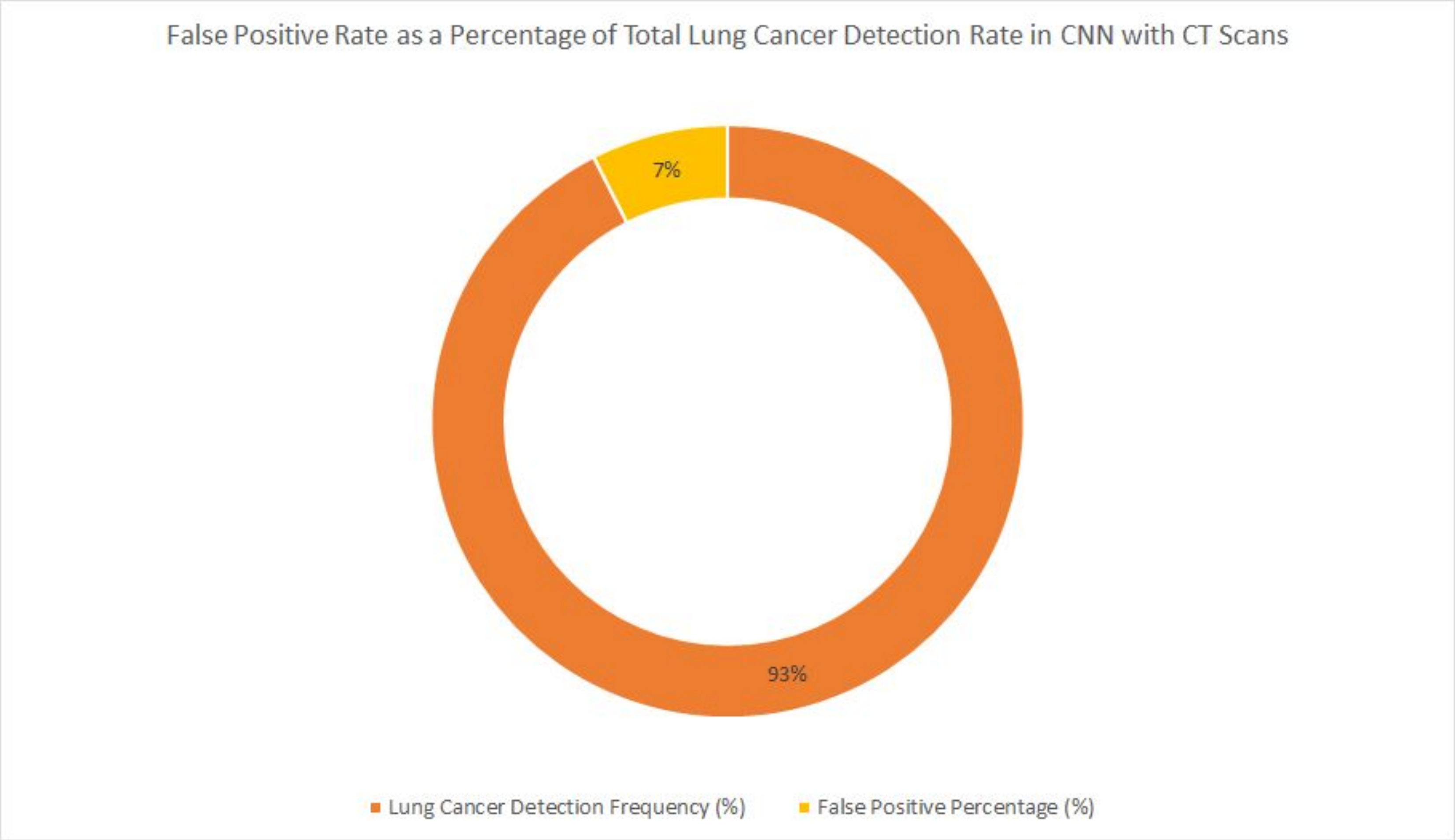

Figure 6. A pie chart of the overall false positive rate out of total detection rate

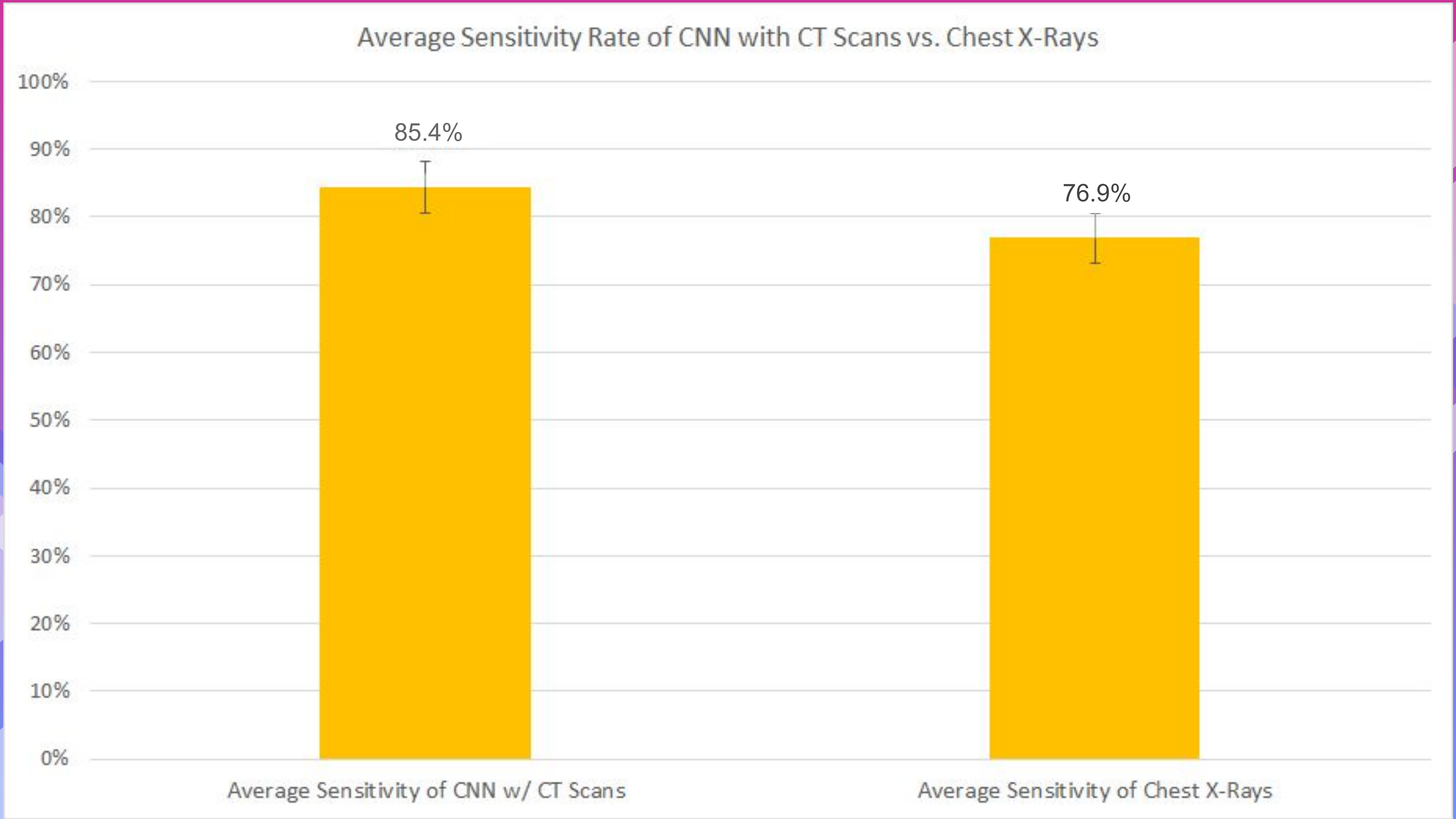

Figure 7. A bar graph comparing the sensitivity rate between CNN with CT scans and Chest X-Rays

→ P=.041

Significant Change between Groups

Discussion

- Significant change between average sensitivities
- CNN have lower average false positive rates
- Would be beneficial to implement

Conclusion

Limitations

- Not a large sample of data on live patients to observe
- Fairly new technology that has further to develop
- Data from papers in other languages

Further Work

- Ways CNN could be implemented for other cancer types
- Improvements to be made to CNN to make it it more efficient
- Ethical Implications of using AI to diagnose cancer

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