Faculty of Science and Technology, Department of Computer Science

Detection of Wheezes and Breathing Phases using Deep Convolutional Neural Networks

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Abstract

As more and more businesses and organizations are moving away from having a their own dedicated server to renting server space in large server parks, like a cloud, security are becoming a bigger concern than ever before. When we want to perform computation on sensitive data stored on a cloud server a problem arises. As the cloud environment is considered untrusted, the data stored on the cloud server must be encrypted with our own encryption key to make sure the data is secure to attacks from both outside and inside the cloud. so, how can we efficiently perform a computation without exposing the data? One way to do this is to encrypt the sensitive data and store this on the cloud. To perform a computation the data would be downloaded to a private server and decrypted. The computation is performed and the data is encrypted and uploaded back to the cloud. The problem with this approach, it's inefficient, especially when a lot of computation is done and it also requires a private server to perform the computation. Another approach is to use a Homomorphic Encryption(HE) scheme which enables us to perform computation on encrypted data without decrypting it first. This may sound like the holy grail, but there are some issues with HE like performance and key-size. Unfortunately Fully Homomorphic Encryption(FHE) libraries are very limited in Python. In this paper we have implemented a Python API based of a FHE C++ library called HElib and we will take a look at potential usages and limitations to the library.

Acknowledgements

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Background

This chapter describes relevant technical background and relevant work. We will first define the field of machine learning, and then describe the methods that have been used in this thesis. We will explain feature extraction for audio signals using spectrograms. We will also describe recent relevant work that uses the same machine learning methods and feature extractions methods as in this thesis.

2.1 Machine learning

Donec id massa ac leo consequat euismod et a sem. Pellentesque sem justo, vulputate vel neque a, ultrices dapibus ipsum. Vestibulum orci orci, semper ut odio et, luctus condimentum nunc. [1].Mauris vel interdum nunc. Curabitur mi lectus, rhoncus venenatis ullamcorper quis, mattis volutpat dui. Proin at lectus ac metus ornare lacinia et pretium risus [2].

Accuracy

$$\text{Accuracy} = \frac{TP + TN}{P + N}$$

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Recall

Aenean rhoncus, nisi in suscipit aliquet, eros diam tempus nunc, non luctus turpis mauris ut lorem. Nulla sed scelerisque mauris.

$$\text{Recall} = \frac{TP}{TP + FN}$$

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Precision

2.2 Deep learning

2.2.1 Convolutional neural network

Aenean rhoncus, nisi in suscipit aliquet, eros diam tempus nunc, non luctus turpis mauris ut lorem. Nulla sed scelerisque mauris. Figure 2.1 shows an illustration of the convolutional layer.

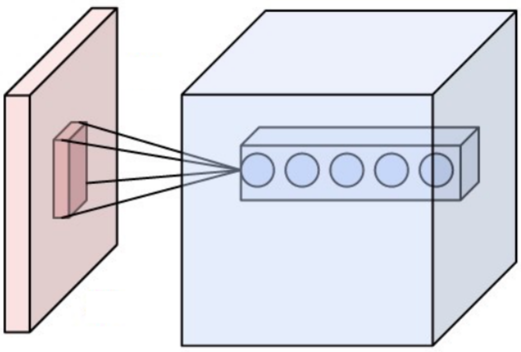
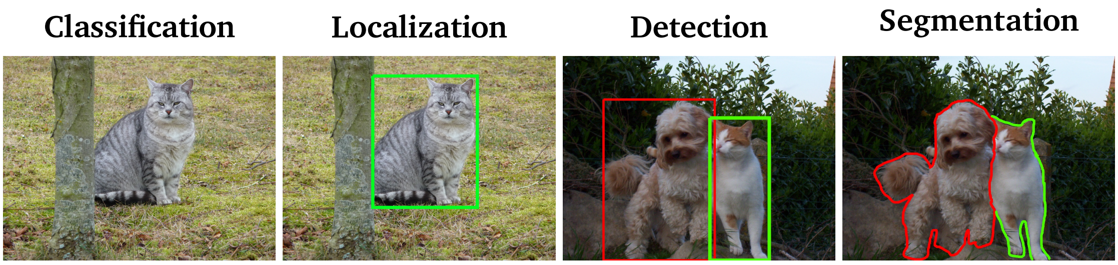


Figure 2.1: Illustration of the convolutional layer . The red box is the input, and blue box is the result. The width and height of the input is preserved, but since the convolutional filter has 32 filters, the depth of the output volume is 32 pixels.



(a) Cat **(b)** Cat **(c)** Cat, Dog **(d)** Cat, Dog

Figure 2.2: Vizualisation of four different image recognition tasks

2.3 Classification vs. detection

- **Classification:** Donec id massa ac leo consequat euismod et a sem. Pellentesque sem justo, vulputate vel neque a, ultrices dapibus ipsum. Vestibulum orci orci, semper ut odio et, luctus condimentum nunc.
- **Object localization:** Donec id massa ac leo consequat euismod et a sem. Pellentesque sem justo, vulputate vel neque a, ultrices dapibus ipsum. Vestibulum orci orci, semper ut odio et, luctus condimentum nunc. the size of the bounding box.
- **Object detection:**Donec id massa ac leo consequat euismod et a sem. Pellentesque sem justo, vulputate vel neque a, ultrices dapibus ipsum. Vestibulum orci orci, semper ut odio et, luctus condimentum nunc.

Methods

In this chapter, we describe the methods used in our approach. We will first describe the dataset, which includes data collection, class distribution and training/test partitioning. We then describe the general design of convolutional neural networks and how we train them. We will describe all experiments performed on the lung sound dataset. The experiments are wheeze detection, breathing phase detection and full file classification. For each experiment, we will describe data preprocessing, model architecture and training details for the best performing model. Finally, we will explain the design and implementation of an prototype that can utilize the capabilities of our lung sound analysis system. The lung sound analysis system is a system that uses the best performing model from each experiment.

3.1 Dataset

Results

Discussion

5.1 asdf

Conclusion

6.1 Future Work

Bibliography

[1] A. Esteva, B. Kuprel, R. A. Novoa, J. Ko, S. M. Swetter, H. M. Blau, and S. Thrun, "Dermatologist-level classification of skin cancer with deep neural networks," *Nature*, vol. 542, pp. 115–118, Feb 2017. Letter.

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Appendices

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Experiment	d	f	f	f
x	x	d	figure	f
x	x	d	f	f
x	x	d	f	f
x	x	d	f	f
x	x	d	f	f

Table A.1: asdf