

# Deep Learning

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Machine Learning



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## **Declaration**

This report has been prepared on the basis of my own work. Where other published and unpublished source materials have been used, these have been acknowledged.

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## **Abstract**

ABSTRACT TBD

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# **1 Introduction**

This is a sample section.

## **2 Background**

This is the Background section!

### **2.1 Convolutional Neural Networks**

Write about conv nets, their performance, history etc

### **2.2 Training**

Write about training nets, loss functions, optimisers etc

### **2.3 Prediction**

Write about generating predictions from the networks

### **2.4 Performance Measures**

Write about performance measures - ROC curve, Cohen's Kappa etc Discuss train vs valid performance, overfitting etc.

### **2.5 State-of-the-Art**

What is the current image processing SOTA - e.g. ILSVRC Anything done specifically for radiology?

### **2.6 Pretrained Models**

Discuss the use of pre-trained models - can keep weights the same, replact the head. Describe the structure of the pre-trained models we'll use for comparison: [MAYBE PUT INTO APPENDIX?]

#### **2.6.1 VGG16**

Describe VGG16 An example of a reference: [1].

### 3 Data

Write about the MURA data, show some example images (normal & abnormal), give data breakdowns

#### 3.1 MURA

Discuss MURA - what it is, how it was produced

#### 3.2 Image Examples

Figure 1: Example X-Ray Image



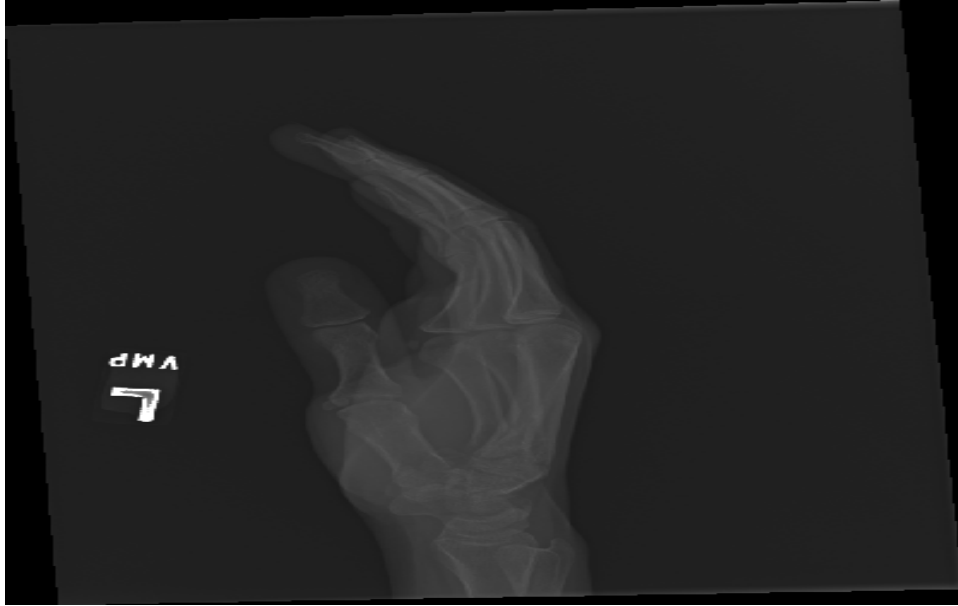
As can be seen in **Figure 1**, the x-ray is of a hand. A side-profile of the hand from the same study can be seen in **Figure 2**.

#### 3.3 Data Breakdowns

Here's another example of a reference: [2]



Figure 2: Another example X-Ray Image



## 4 Model Development

### 4.1 Working Environment

Describe google cloud set-up, GPU, python packages used etc

### 4.2 Data Preprocessing

Describe the preprocessing work done on the data - resize images, normalise values, data augmentation etc

### 4.3 Model

Describe the final ab-initio model I end up with - structure, loss function, training params/hyperparams etc

### 4.4 Predictions

Discuss getting predictions and aggregating down to study-level predictions

## **5 Results**

### **5.1 Baseline Performance**

Give the performance of my chosen ab-initio model

### **5.2 Image Size**

How do my results vary with size of image? Does increasing image size increase scope for

### **5.3 Regularisation**

Perform some regularisation experiments, show results

### **5.4 Pre-Trained Models**

How does my model compare vs a selection of pretrained models

## 6 Conclusions

Include introspective chapter Work here not comparable to clinical setting, e.g. smaller, lower resolution images; radiologist may have a relationship with patient - know medical history, other symptoms etc What is "abnormal"? - type & severity of abnormality not known, MURA paper not clear.

## **7 Professional and Ethical Issues**

Potential Impact on Radiology - Deep Learning tools used to help triage/prioritise radiologists' work, not replace them; Can we trust diagnosis to a computer program? Would you be happy to do so? Conversely - medical errors happen a lot (est. cost \$X p.a.; any specifics for radiology?) but DL tools may at least help cut that down.

## 8 Extensions

Enquire further about what "abnormal" means Alternative data e.g. CheXNet, others(?) Alter NN to accept multiple images simultaneously and so predict based on several views at once (e.g. by weight-sharing, or appening all study images into a single 3D tensor)

## References

- [1] Trevor Hastie, Robert Tibshirani, and Jerome Friedman. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer, New York, second edition, 2009.
- [2] P. Rajpurkar, J. Irvin, A. Bagul, D. Ding, T. Duan, H. Mehta, B. Yang, K. Zhu, D. Laird, R. L. Ball, C. Langlotz, K. Shpanskaya, M. P. Lungren, and A. Y. Ng. MURA: Large Dataset for Abnormality Detection in Musculoskeletal Radiographs. *ArXiv e-prints*, December 2017.