**Understanding classification failure in Machine Learning using  
CNNs and GANs**

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ABSTRACT

In this sample-structured document, neither the cross-linking of float elements and bibliography nor metadata/copyright information is available. The sample document is provided in “Draft” mode and to view it in the final layout format, applying the required template is essential with some standard steps.

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CCS CONCEPTS

• Image Classification • Machine Learning Failure • Neural Networks • Convolutional Neural Networks • Generative Adversarial Networks

KEYWORDS

Image Misclassification, Adversarial Attacks, CNNs, Conditional GANs

ACM Reference format:

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1. Introduction

Understanding how and why neural networks can be fooled into misclassifying images is an interesting topic that has been widely explored. This topic has gained much attention of researchers as we are rapidly entering the world of self-driving cars and these kinds of failures can causes major hurdles in bringing technologies to the mainstream society. Some papers [5] show that one-pixel change is enough to force a misclassification. This can be done using CNNs or GANs [5], and even uses evolutionary algorithms in some cases [6]. We want to try to this for ourselves and explore some possible reasons to explain this phenomenon. We plan on trying to work with GANs, something outside both of our machine learning experience.

Deep neural networks have been widely used for classifying images with the high accuracy. This project is our quest to explore the tolerance and identify particular weaknesses of image classifying networks to different types and degrees of structured, random and specialized noises. The addition of the noise is  
almost indistinguishable to the human eyes but surprisingly it can completely fool neural networks. Moreover, another important point which drives this research is its application in a real-time scenarios e.g. If a self-driving car just ignores or misclassifies a stop-sign or a pedestrian because its neural networks have mis-classified its sensors’ input images. With this we hypothesize that:

1. It should be possible to identify certain noise thresholds beyond which a network starts regularly failing,
2. Similarly, certain noise patterns may be more disruptive to the classification process of trained networks and even pre-trained networks.
3. Training GANs on random and structured noise datasets may help us understand the failure of the machine learning models or the solution to overcome this problem.



Figure 1: Figure Caption and Image above the caption [In draft mode, Image will not appear on the screen]

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2. Background

In the below paragraph, it is explained how alt-txt value is placed in **MS Word 2010**. To add alternative text to a picture in Word 2010, follow these steps:

1. In a Word 2010 document, insert a picture.
2. Right click on the inserted picture and select the **Format Picture** option.
3. Select the **Alt Txt** option from the left-side panel options.
4. In the "Title:" and "Description:" text boxes, type the text you want to represent the picture, and then click "Close".

3. Motivation

Below are steps to place alt-txt value in **MS Word 2013/2016**. To add alternative text to a picture in Word 2013/2016, follow these steps:

1. In a Word 2013/2016 document, insert a picture.
2. Right click on the inserted picture and select the **Format Picture** option.
3. In the settings at the right side of the window, click on the "Layout & Properties" icon (3rd option).
4. Expand **Alt Txt** option.
5. In the "Title:" and "Description:" text boxes, type the text you want to represent the picture, and then click "Close".

4. Methodology

4.1 Dataset

German Traffic Sign Recognition Benchmark Dataset [2]  
Published by researchers at the Ruhr-Universität Bochum, Germany in 2011 for the International  
Joint Conference on Neural Networks (IJCNN). The dataset has the following properties:  
• Single-image, multi-class classification problem  
• More than 40 classes  
• More than 50,000 images in total  
The images in this dataset are ~ 32x32 images of road signs. Below are a few samples:

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5. Results

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1. Conclusion

ACKNOWLEDGMENTS

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