Report of Project

Nirjhar Das
Sophomore, B.Tech in Electrical Engineering(Power)
Indian Institute of Technology, Delhi

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1 Introduction

The field of Machine Learning has advanced in leaps and bounds over the past few decades. With plenty of research papers being published every day, there is significant interest among scholars working in this field to come up with better solutions. Machine Learning primarily relies on mathematics and statistics, including (but not exhaustively) topics like Linear Algebra, Multivariable Calculus, Probability Theory, Convex Optimization and Statistics. Althoughthe field of Machine Learning has existed for long, with primary ideas being stated as early as 1980s, the huge success of Machine Learning that we see today is because of the significant development in Computing Power and availability of huge amount of data on the Internet. Among various Machine Learning algorithms, one that has been immensely successful is Deep Learning.

2 Deep Learning

Deep Learning, although a part of Machine Learning, has evolved into an almost separate branch with huge interest among researchers. The reason behind the success of Deep Learning still remains little known, while its use continues to grow. Deep Learning is being used in a wide variety of tasks, some including our day-to-day experiences, like Virtual Assistants and Machine Translation. Deep Learning, though resource intensive, can deliver state-of-the-art results infields like Computer Vision and Natural Language Processing. Certain Neural Networks have also beaten Human Level performance in tasks like Image Classification.

3 Transfer Learning

As Neural Network architectures become deeper and more complex, thus requiring huge resources to train, it becomes commonplace to use the idea of Transfer Learning to save resources and time. It has been shown[1] that Networks trained on a broader task can be used as a base network for more specific tasks. This project is a demo for Transfer Learning.

4 Inception-V3

With the advent of Convolutional Neural Network[2], the field of Computer Vision has hugely advanced. Multiple novel architectures have been proposed over the years, each with their own strengths and weaknesses. One of the recent novel architectures is the Inception[3] network which uses multiple filter sizes at one go. Inception-V3[4] is an enhanced version with some sophisticated alterations.

5 Project Details

5.1 Problem Statement

The challenge is to classify images into a binary set containing images of disaster-fire and non-fire. The dataset[5] contains a total of 999 images with approx. 700 images of fire and approx. 250 non-fire images. With this small dataset, it is imperative to use Transfer Learning.

5.2 Implementation Details

The Inception-V3 model was chosen because of its great performance with a smaller model size. Note that *a model with greater number of parameters is more prone to overfitting*. The whole data was split into train/validation/test sets of size 70%/20%/10%. On top of the Inception model, two conv. layers and a max-pooling layer was applied. The output was flattened followed by two fully connected layers and a final sigmoid unit. A binary cross-entropy loss was used, with Adam[6] optimizer. The code was implemented in Tensorflow.

Link to GitHub Repository: https://github.com/nirjhar-das/Fire_Disaster_Classification

5.3 Results

The model achieved:

Metrics	Score
Accuracy	97%
Precision	98.67%
Recall	97.37%

5.4 Websites referred

- https://www.tensorflow.org/guide/keras/transfer_learning
- https://keras.io/api/applications/inceptionv3/
- https://scikit-learn.org/stable/supervised_learning.html#supervised-learning
- https://docs.opencv.org/master/da/d6e/tutorial_py_geometric_transformations.html
- https://numpy.org/doc/stable/

References

[1] L. Y. Pratt (1993), Discriminability-Based Transfer between Neural Networks

[2] Yann LeCun et al (1999), Object Recognition with Gradient-Based Learning

[3] Christian Szegedy et al (2014), Going Deeper with Convolutions

[4] Christian Szegedy et al (2015), Rethinking the Inception Architecture for Computer Vision

[5] https://www.kaggle.com/phylake1337/fire-dataset

[6] Kingma & Ba (2014), Adam: A Method for Stochastic Optimization