COLLEGE OF SCIENCE
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Using neural network to search for isolated Hα clouds in the Virgo cluster

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Overview

The purpose of this project was to use machine learning to train a neural network which can detect Hα clouds in the Virgo cluster. As galaxies move through the intracluster medium, it affects their evolution, primarily through ram pressure stripping. This removes the cold gas from the galaxy, which can survive in the ICM for a long time. Hα emission trace warm, ionized gas and can be used to detect the stripped gases. Presence of Hα tracks the evolution of the galaxies in the galaxy cluster.

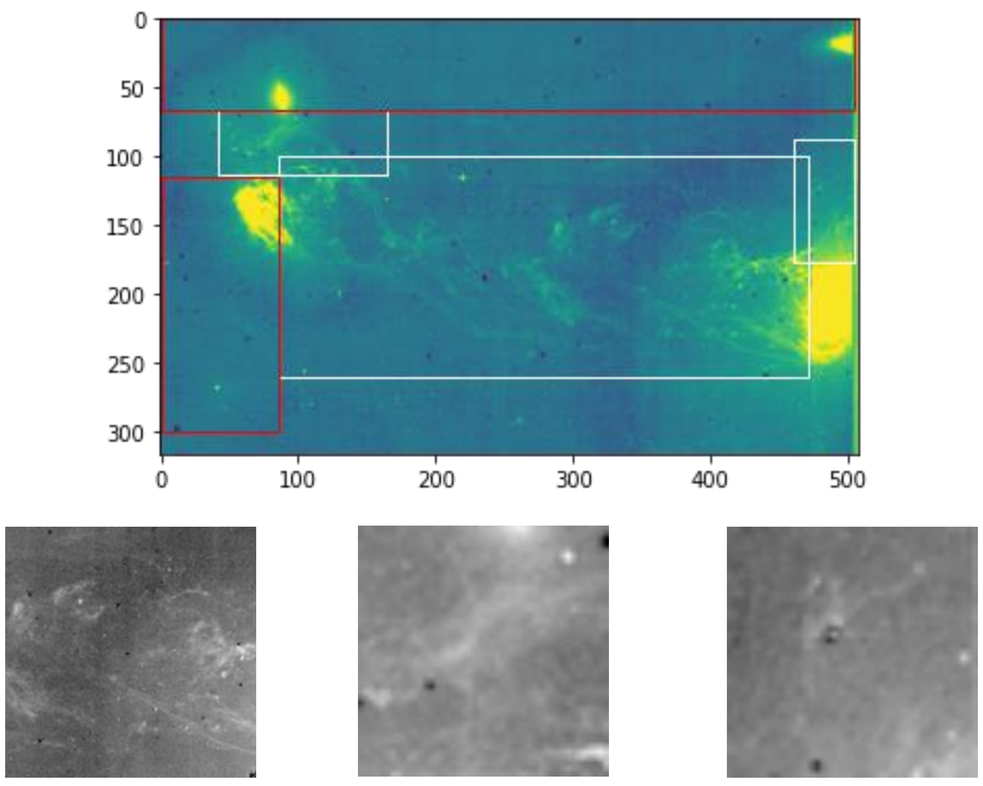

Figure 1. (above) One of the sample images, with boxes noting the location of Hα and non-Hα objects. (below) Three smaller images taken from the initial sample image that comprised the dataset given to the CNN.

Explanation

The base program had already been created by a previous student. The task was to improve upon the program.

Problems that were addressed

- Lower validation accuracy
- Overfitting
- Inconsistent validation accuracy

Solutions that were implemented

- Expanded the dataset by making use of more extensive data augmentation
- Refined dataset to improve accuracy
- Increased base image count from ~2200 to ~3300 images.
- Changing network structure to add more layers (dropout, max pooling, batch normalization)

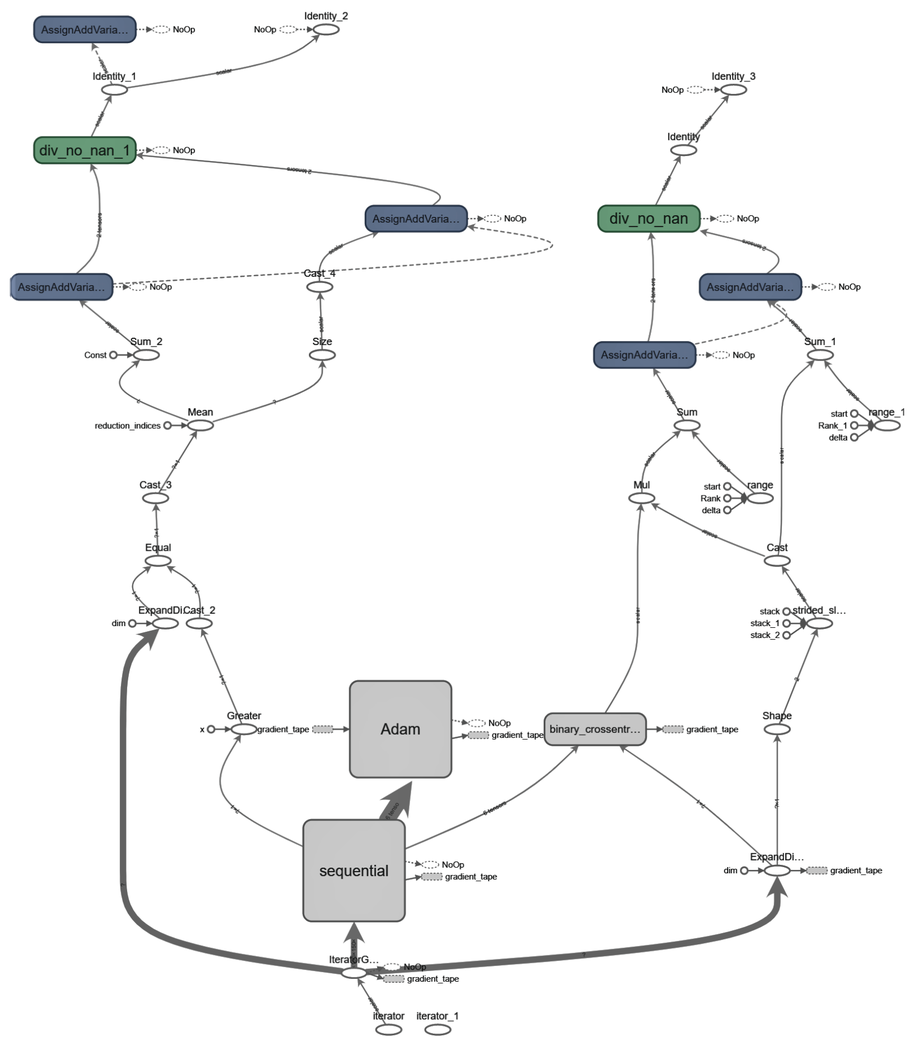

Figure 2. A graph of the CNN structure

Results

The CNN achieved a training accuracy of 80% and a validation accuracy of 76%.

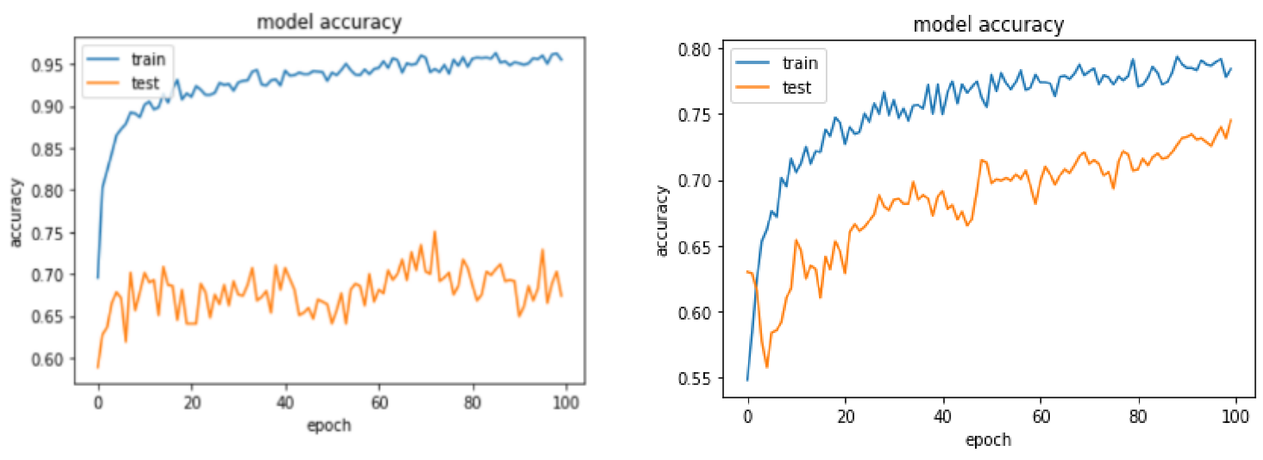

Figure 3. These graphs chart the training and validation accuracy of each epoch while training the CNN. On the left is the original CNN and on the right is the latest CNN.

Impact

While the dataset used to train the CNN was from VESTIGE and, thus, consisted only of galaxies in the Virgo cluster, the software can very easily be used to identify Hα in other datasets. Automated identification of Hα will make the process of finding Hα clouds faster and more efficient. Tracking these clouds gives insight into galaxy evolution in large clusters.

References

1. A. Boselli, A Virgo Environmental Survey Tracing Ionised Gas Emissions (2018)

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