Ensemble Deep Learning

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Nevada National Security Site(NNSS)

Mission: Ensure that the nation’s nuclear weapons stockpile remains safe, reliable, and secure

- ✦ Small Scale, High Energy Experiments
- ✦ High Level Computer Modeling

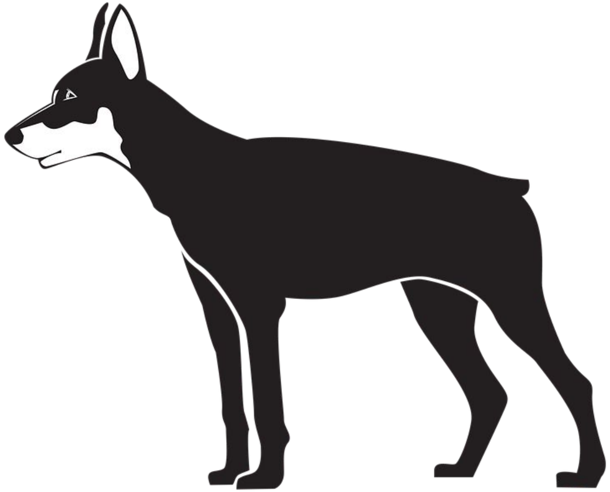
Our Project

1. Create an accurate neural network relating images of metal oxides to their spectra graphs

2. Find an error quantification for the resulting neural network

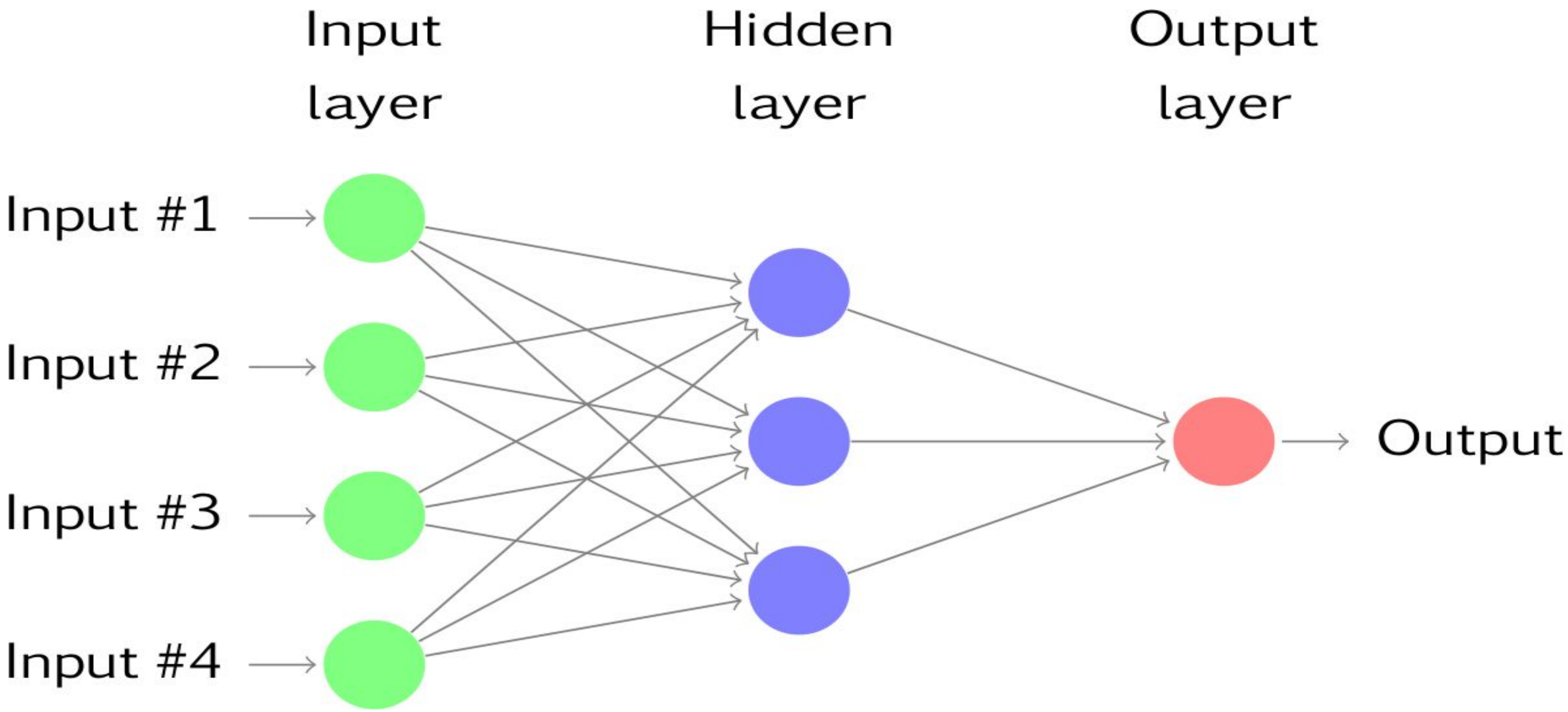
What Are Neural Networks?

Training



Testing

Sample Neural Network



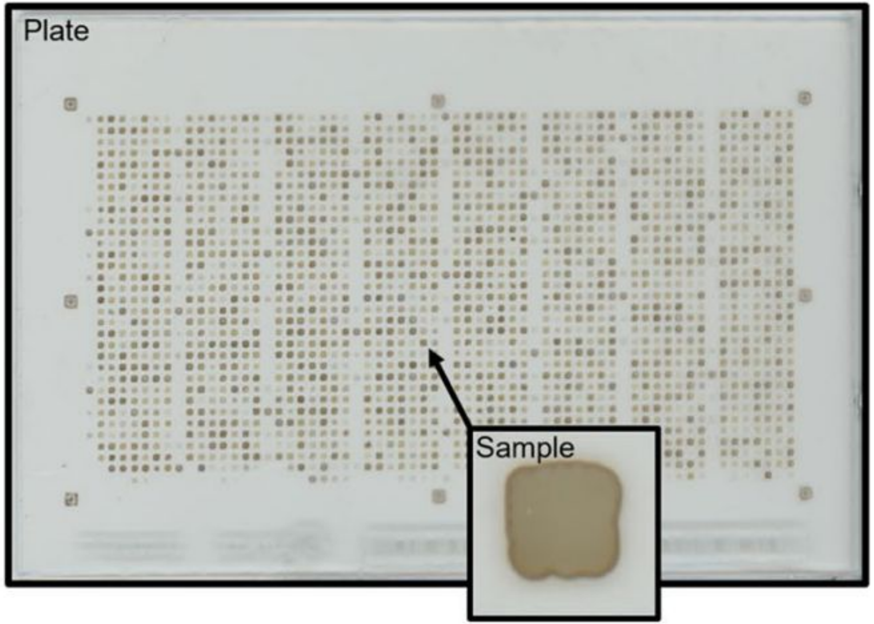
Dataset - Absorption Spectroscopy Data for Metal Oxides

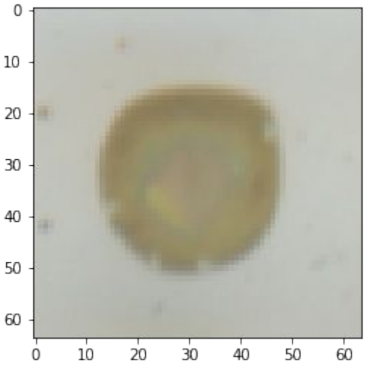
Image Size: (64,64,3,180902)

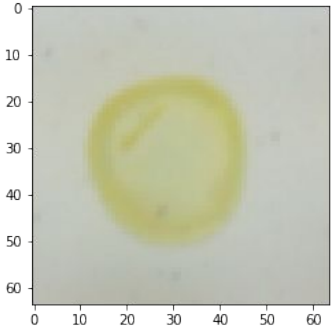
Color values: RGB
Normalized: 0–1 for every channel

Colored region in center representing printed material

“Coffee ring” on outer edge forms due to drying







Data Interpretation

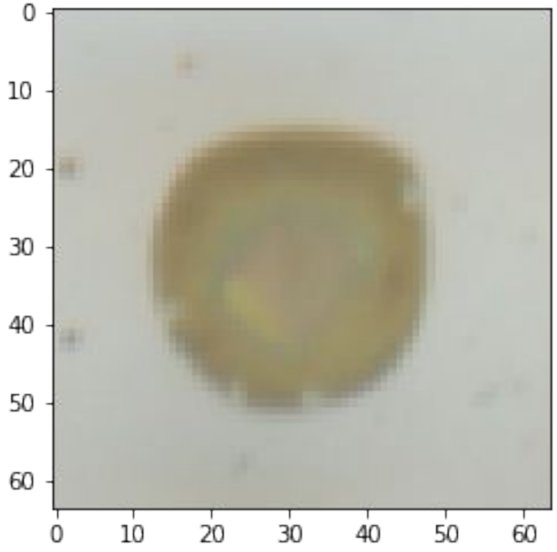
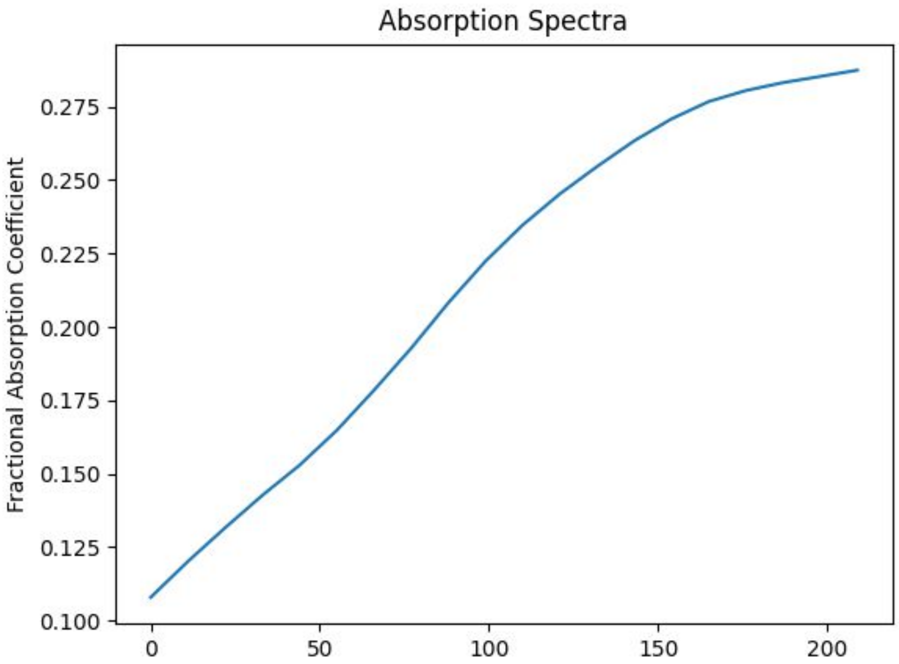
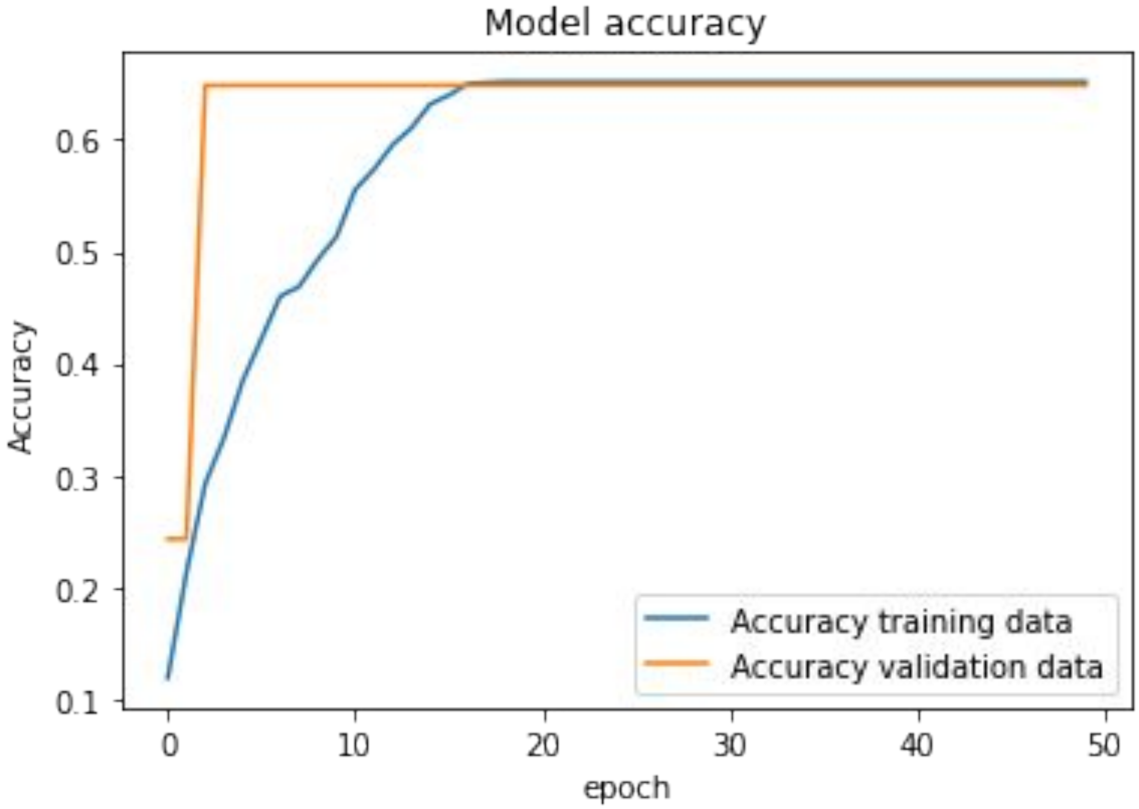


Image of Metal Oxide(Input)



Spectra Graph(Output)

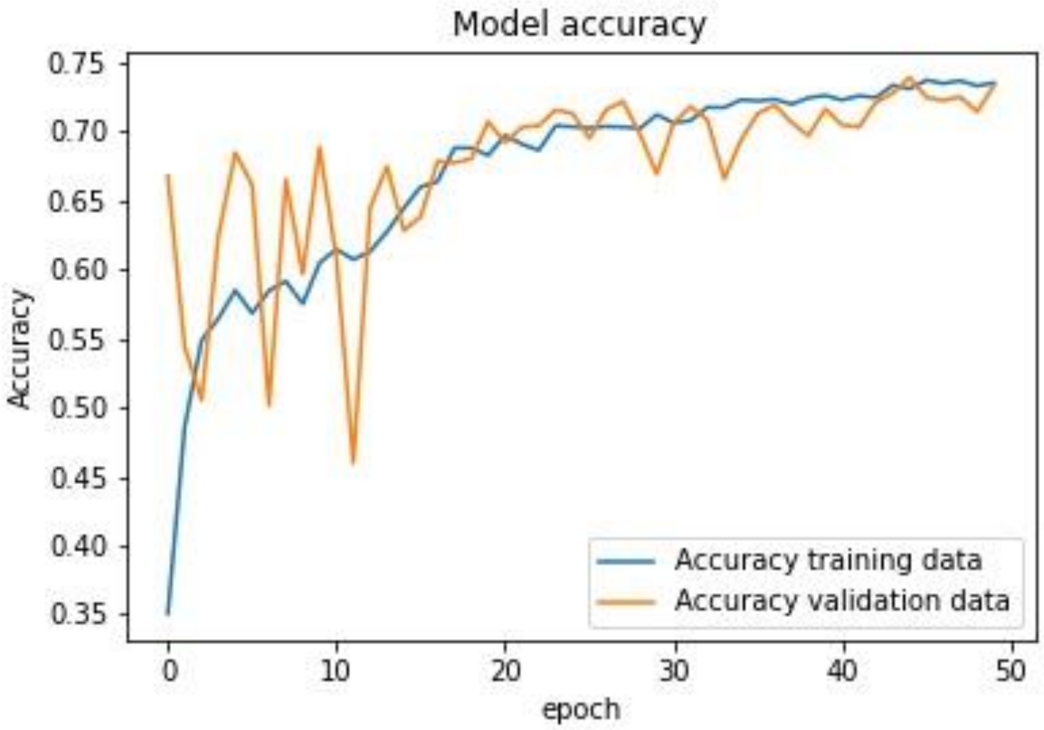
Initial Results



Layers Used

1. Convolutional
2. Dense
3. Max Pooling
4. Convolutional
5. Dense
6. Max Pooling
7. Convolutional
8. Convolutional
9. Max Pooling
10. Flatten
11. Dense
12. Dense
13. Dense

Initial Results Cont.

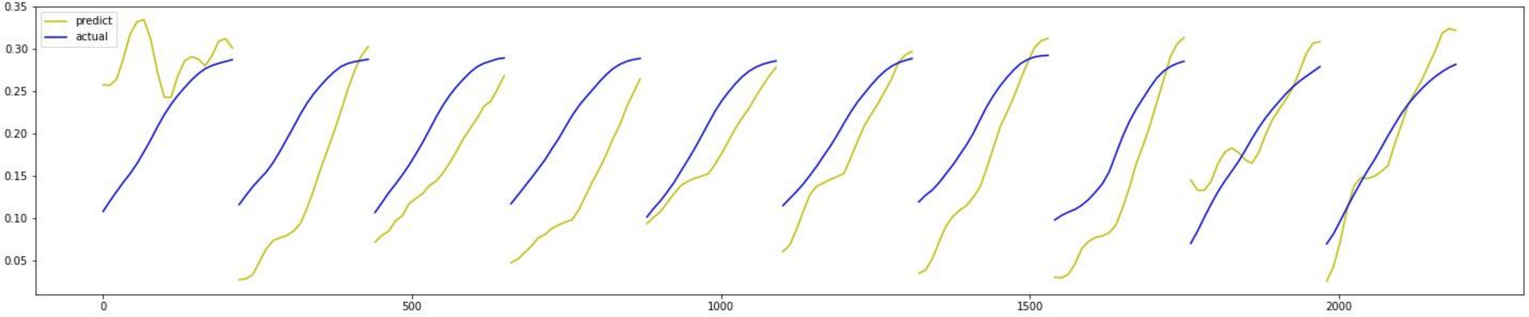


Layers Used

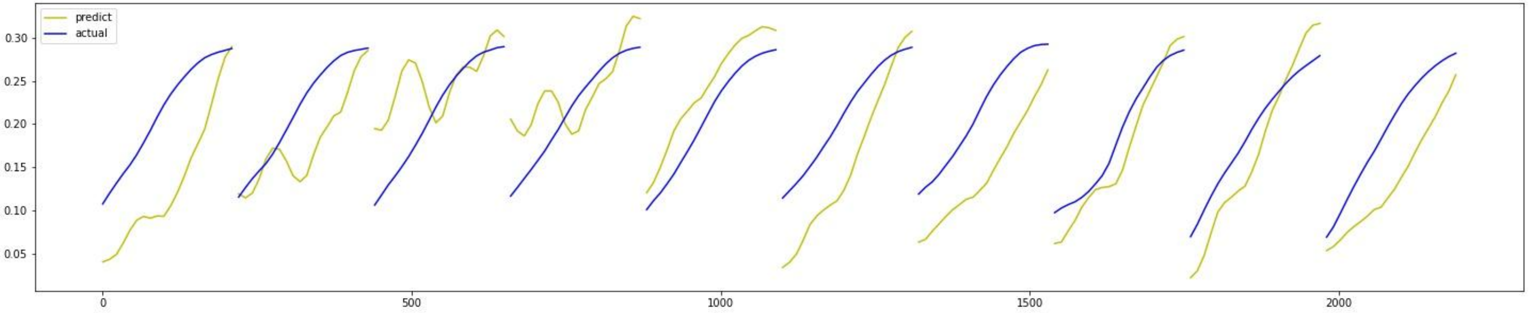
1. Convolutional
2. Dense
3. Max Pooling
4. Flatten
5. Dense
6. Dense
7. Dense

Error Measurement

- Mean Squared
- Mean Absolute
- Mean Squared Logarithmic
- Mean Absolute Percentage



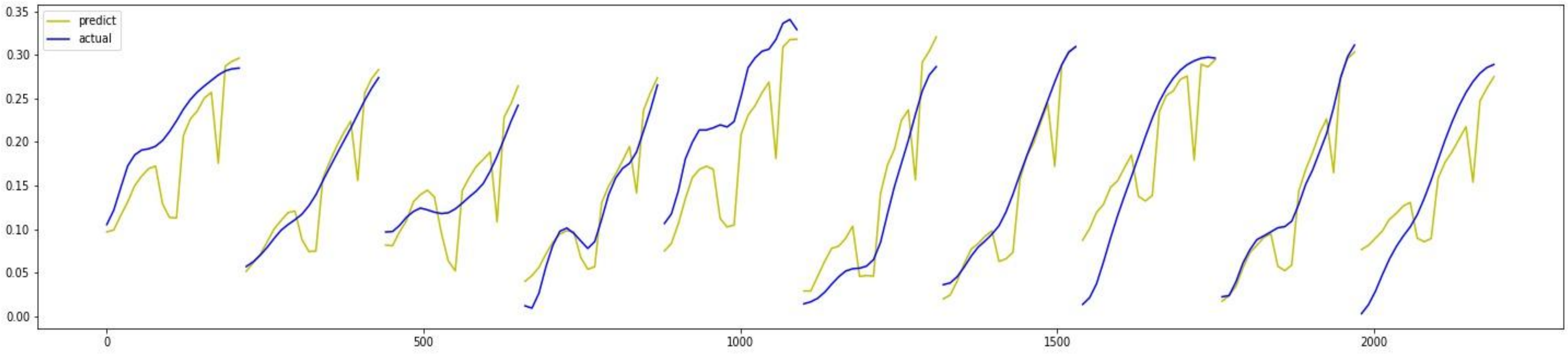
Mean Squared



Mean Squared Logarithmic

Ensemble Network

- 5 neural Networks
- Trained on 4,000 different images
- Averages the result of the 5 neural networks
- Nearly uses all of Google Colab's RAM



Next Steps

1. Implement a Neural Network to handle the outputs of the ensemble rather than just averaging them
2. Implement batch normalization in to the network
3. Continue to experiment with adding and subtracting layers
4. Create a custom loss function for our data