Neuron-Specific Dropout: A Deterministic Regularization Technique to Prevent Neural Networks from Overfitting & Reduce Dependence on Large Training Samples

ROBO076

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All images/graphs were created by the student

Engineering Objectives

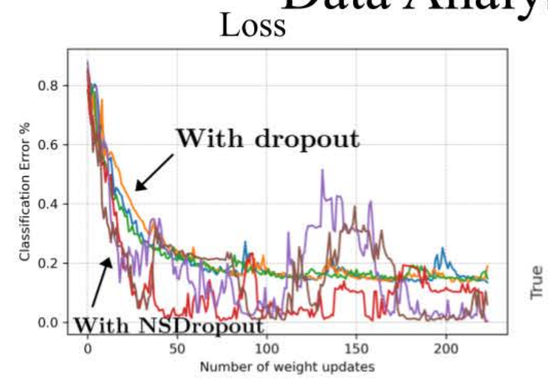
- Overfitting is one of the most significant issues with modern neural networks. When training with millions of parameters, models develop relationships between their inputs and outputs that cannot be generalized.
- In fields such as healthcare, millions of samples of data are often not available to train a model.
- The primary objective of this research is to develop an algorithm that is able to achieve equal, if not better, accuracy than current neural networks while using less data.

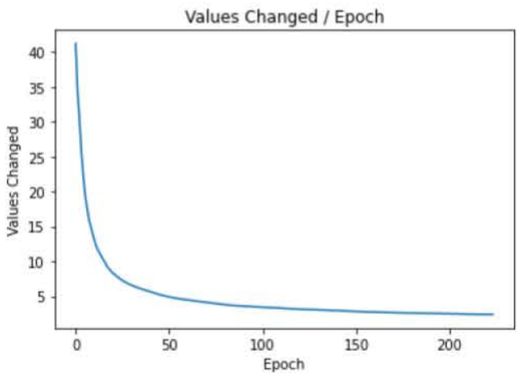
Methodology/Project Design

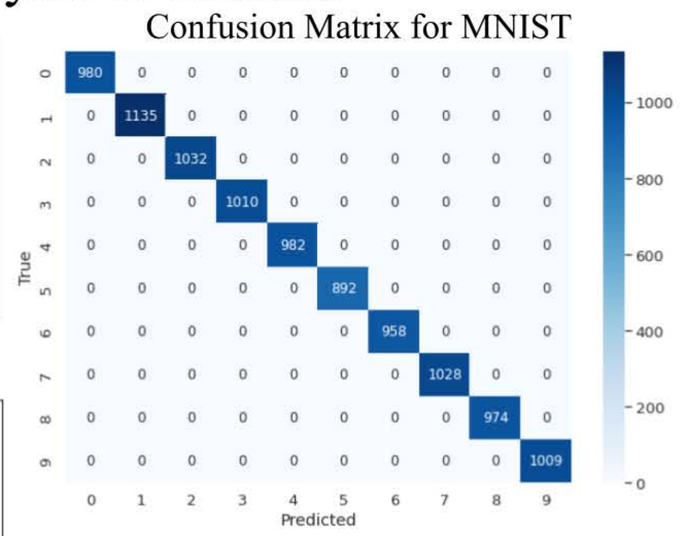
Neuron-specific dropout was created and tested on a custom machine learning framework. NSDropout works by comparing training and validation outputs. It identifies where in a layer they diverge, dropping neurons that have a great enough difference. NSDropout was tested on multiple datasets with varying difficulty and example count. The data sets include:

- MNIST: A standard toy data set of handwritten digits.
- Fashion-MNIST: A standard toy data set of fashion items.
- CIFAR-10: Tiny natural images (Krizhevsky, 2009).

Data Analysis & Results







- Reduced needed data by up to 98.5%.
- Perfect MNIST accuracy

Interpretation & Conclusions

Interpretation of Results.

- An analysis of salient features, including masks, proves that NSDropout works as originally intended.
- NSDropout can be seen as a way to actively prune a neural network.
- Higher than expected results provides evidence that NSDropout could be implemented into different image classification domains.

Conclusion

- With a perfect MNIST accuracy, and best-in-class accuracy for CIFAR-10 and Fashion-MNIST, the newly proposed idea of comparing training and validation has proven to be successful.