The Center for Cyber Defenders

Expanding Computer Security Knowledge

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Neuromorphic Computing

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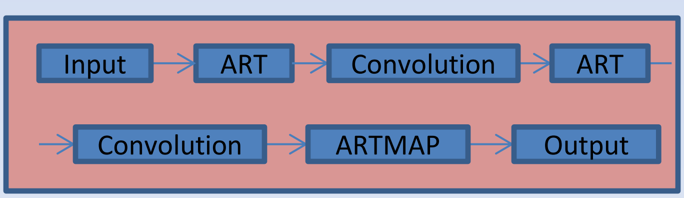
Problem Statement:

- Recent advancements in image object recognition have shown that Convolutional Neural Networks (CNNs) are the key to success.
- Standard neural networks learn through backpropagation, which is difficult to implement with learning hardware.
- Adaptive Resonance Theory (ART) neural networks learn without backpropagation and may be more suitable to hardware.
- ART may recognize a wider range of features in images for use in CNNs.

Objective and Approach:

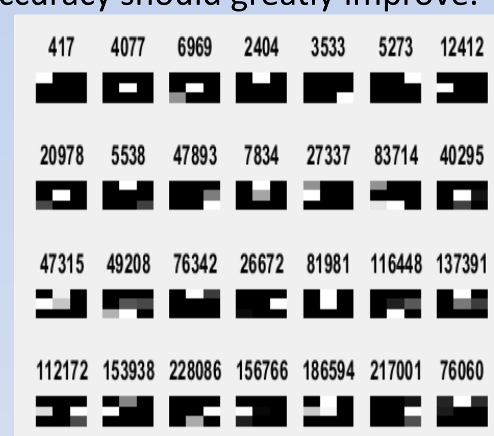
- Design a deep CNN using ART for feature learning, convolution for feature detection, and ARTMAP for classification.
- Conduct experiments on MNIST classification, maximizing accuracy and efficiency of ART learning.
- Evaluate the classification performance compared to other deep neural networks.



Network layer flow

Results:

- The Convolutional ART neural network (CARTNN) correctly learns samples and classifies images in the MNIST data set.
- The CARTNN uses stride, filter size, vigilance, pruning and other variables to determine classification specifications.
- At this time, the CARTNN based neural network is not as accurate as a deep neural network using backpropagation. However, with more modification and testing, the ART neural network's accuracy should greatly improve.



Final filters and filter populations

Impact and Benefits:

- Successfully created a neural network that does not use backpropagation to learn features and classify said features, but uses ART instead.

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