

EE5327 Optimization

Paper Implementation(theory)

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Paper Title:

Evolving Deep Neural Networks : A New Prospect

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Summary of the paper

- Use Genetic Algorithm to optimize neural network.
- Optimize slow training procedure.
- Achieve decent accuracy compared to DNN-random weight initialization.

Genetic Algorithm

Genetic Algorithm (GA) is a search-based optimization technique based on the principles of Genetics and Natural Selection. It is frequently used to find optimal or near-optimal solutions to difficult problems which otherwise would take a lifetime to solve. It is frequently used to solve optimization problems, in research, and in machine learning

Working of GA

- Pool of population of possible solution.
- Undergo crossover and mutation to produce next generation.
- Each candidate solution after one generation is given fitness value and solutions with high fitness value is preferred for next iteration to yield better solutions.
- Process repeated over several generation to get optimal solution.

This process is analogous to Darwin's theory of "Survival of the fittest".

Advantages

- Gives "good enough" solutions "fast enough" for real world applications.
- Is suitable for NP-Hard problems.
- Can optimize both continuous and discrete functions.

Disadvantage

One of the major problems of GA is maintaining the diversity of the population. There are two types of co-evolution strategies competitive and cooperative.

- In competitive co-evolution (CCEA), individuals of a population compete with each other giving rise to an arms race to achieve the top position. With this, it is possible to find a simplest solution among the population of solutions that can win.
- Cooperative co-evolution (COCA) evolves solution by recombining individual fragments of sub solutions.

Results

Strategy	Accuracy (%)		Error Rate (%)	
	MNIST	IRIS	MNIST	IRIS
DNN-R	94.3	96.9	0.54	0.31
DNN-CCEA	96.3	98.1	0.201	0.19
DNN-COCA	98.7	98.3	0.12	0.131

Figure: Experimental results with 3 strategies

Results

Strategy	Avg. Time (hours)	Avg. Performance
DNN-R	14.5	2.5
DNN-CCEA	8.3	1.19
DNN-COCA	10.2	1.73

Figure: Training time and performance for MNIST

Our Objective

- Implement GA in python to optimize DNN.
- Get comparable results to the ones in the paper.