Neural Architecture Search

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Abstract—This document is a search algorithm for finding the Convolutional Neural Network with best performance for searching in a Neural Architecture Search using the fashion-mnist dataset.

Index Terms—Convolutional Neural Network, Genetic Algorithm.

I. Introduction

In Neural Architecture Search, we firstly design a Convolutional Neural Network having normal(NC), reduction(RC) and final layers.The parameters are changed in the layers in a random manner and then Genetic Algorithm is used for searching the best performing Neural Architecture.

II. Convolution Neural Network

A. Description

A Convolutional Neural Network(CNN) is a Neural Network which is used for classification, image processing, Natural Language Processing(NLP) and other correlated data [2] .Convolutional Neural Network is based on shared-weight architectural model of convolutional kernel which slides along the input features(image, matrix of numbers in our case) and provide responses which are commonly known as feature maps.If a node of layer in the system is connected to some nodes in previous layer and in the next layer , the node receives information from the layer beneath it ,does something with it and sends information to the next layer [4].Every incoming connection is assigned a weight . It's a number that the node multiplies the input by when it receives data from a different node.

B. A normal(NC) CNN layer

The CNN Architecture that we use is a sequential model with no skip connections.The first layer is used for taking input(fashion mnist dataset in our case) [1].In our project the input image is of dimension 28×28. In this layer we use stride=1, padding=SAME and the kernel size ranges from 1 to 8, and any of the following activation functions such as relu, sigmoid, tanh, gelu, swish.

C. Two reduction(RC) CNN layers

After normal layer we add two reduction layers in our model,in which we take stride=2, padding=valid. The number of filters, activation function as well as kernel size of both the reductions layers are same

D. Final layer

It is the final layer where we do Global Average Pooling, due to which the input is resized and then the resized input is passed on to the dense layer with 64 units, and we take activation function as sigmoid. Then we get 10 units of output each one of which corresponds to a particular unique feature in the fashion mnist dataset that we had used.

Fig. 1. Convolutional Neural Network. [5]

E. Training the model

To train our model we have compiled and fit our model. In compiling phase, optimizer function is used Adam and loss function is categorical cross-entropy.In fit phase ,we pass batch size which indicate number of images to be processed in one time and number of epochs to train our model.This function is trained our model on training dataset.

III. Genetic Algorithm

A. Introduction

Genetic algorithm is used to search the optimal solution.In other algorithms, which generally find the solution for searching, but in this case , solution is already available and Genetic algorithm finds the optimal solution among them. It is used to solve the complex problem(NP-Hard). It has various phase ranging from initial population generation to calculate fitness, finding out the best selection among the population, doing the cross-over of the two best fit individual and then finally mutating the gene of reproduced offspring, so as to provide diverse characters in it.

B. Initial population generation

Available solution is used as initial population. Here in our project for this phase we had used initial population as a function in which first we initialise it by providing random values to the parameter of our model and then we append each of the solution into population list which indicates our whole population.

C. Calculate fitness

In this phase, Genetic algorithm calculate the fitness function for every individual chromosome(solution).

D. Selection

In selection phase, it select the chromosome(solution) which has maximum fitness value. We have used Roulette wheel method for selection.

E. Crossover

In this phase , we do crossover over two chromosome(solution) and it generate the new solution for searching.the generated solution better solution after cross over.

F. Mutation

There is many ways to do mutation. Mutation is also used to find new better solution. After doing crossover and mutation we have a new better solution and compare with threshold. If we get our solution's fitness more than threshold value then we stop the execution.
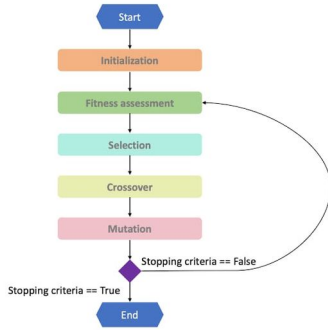

Fig. 2. Genetic Algorithm [3] .

RESULT

On fashion mnist dataset we get 85% accuracy on test dataset.

CONCLUSION

A correct combination of all the parameters that needs to be passed to Convolutional Neural Network for best performance using Genetic Algorithms is found out.The final Genome String is passed to the code upon which the results are calculated and evaluated.

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