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Implementation of Multilayer Perceptron for Image Classification

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Abstract. This research proposed to classify images on hands playing rockpaperscissor through hand images. We use Multi Layer Perceptron to classify. There are there class for the classification which are rock class, paper class and scissor class. Dataset for this research obtained from Kaggle Dataset. The number of datasets is 2188 images which are 712 rock images, 726 paper images and 750 scissor images. The Accuracy of this model is very good arround 95%.

Keywords: Multi layer Perceptron, image classification, rockpaperscissor.

Abbreviations: Multilayer Perceptron (MLP), Neural Network (NN).

Running title: MLP for image Classification.

INTRODUCTION

Due to Corona Virus outbreak many families staying home with little to no interaction. Many children have to school from home to prevent corona virus outbreak. The impact of Physical distancing for children is different depend on the children (Kyriazis A., et al, 2020). Isolation makes children fail to understand, confused and scared (Ahadi, et al, 2020). Parents and government have to make a policy that can children grow well during pandemic. The only one to keep connected for socialization is through internet. Children can build network with his/her group through internet and it will be new adaptation for everyone in this era.

By internet we can keep connected each other during social distancing. To prevent negative impact for children during social distancing, social and networking between children and their friend have to keep connected. They can play each other through internet connection. One of popular hand playing for children is rockpaperscissor. In recent years, neural network have developed by many researcher for image classification and recognition (Ramchoun, 2016). Neural network work like human brain when identify something. One of algorithm to classify image is Multilayer Perceptron. Mulitlayer Perceptron is the most utilized model in neural network application using back-propagation algorithm. Architecture of MLP consists of input layer, hidden layer and output layer. A perceptron was modeled after the essential unit of thr human brain-the neuron and has an uncanny ability to learn and solve complex problems. This research describe algorithm backpropagaration in the MLP to classify hand playing image through hand images.

MATERIALS AND METHODS

Study Area

A multilayer perceptron is a variant od the original perceptron model proposed by Rosenblatt in 1950 (Rosenblatt, 1958). It consists one or more hidden layer between input and output layers, the neurons are organized in layer, the connection are always directed from lower layers to upper layers, the neurons in the same layer are not interconnected.

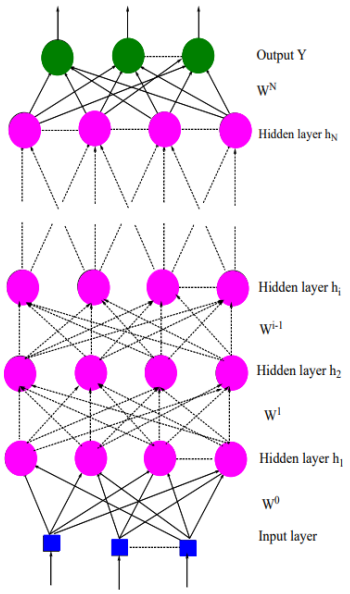

Figure 1. Feed forward nural network strucutre (source : Ramchoun et al, 2016).

We can assume that we used an input layer with n_0 neurons $X = (x_0, x_1, \dots, x_n)$ and have sigmoid activation function $f(x) = \frac{1}{1+e^{-x}}$

Obtaining network output we have to compute each unit in each layer. Now consider a set of hidden layers $(h_1, h_2, \dots, h_n)$. Assume n_i are neurons number by each hidden layer h_i. So the output of the first hidden layer

$$h_i^j = f\left(\sum_{k=1}^{n_{i-1}} w_{k,j}^0 x_k\right) \quad j = 1, \dots, n_i$$

The outputs of h_i^j of neurons in the hidden layes are computing here

$$h_i^j = f\left(\sum_{k=1}^{n_{i-1}} w_{k,j}^{i-1} h_{i-1}^k\right) \quad i = 2, \dots, N \text{ and } j = 1, \dots, n_i$$

Where $w_{k,j}^{i-1}$ is weight between neuron k in the hidden layer i and the neuron j in the hidden layer $+1$, n_N is number of neurons in the Nth hidden layer, Y as vector of output layer, F is transfer function and W is matrix of weight, it's defined as follows :

$$W = [W^0, \dots, W^j, \dots, W^N]$$
$$W^i = (W_{j,k}^i)_{\substack{0 \le i \le N \\ 1 \le j \le n_{i+1} \\ 1 \le k \le n_i}} \text{ where } W_{j,k}^i \in R$$

Procedures

A dataset that we used obtaining from kaggle datasets with 3 categorical rock, paper and scissor. We do image preprocessing and train the model use tensorflow library from Python programming language. The algortihm that we used is backpropagaration and MLP for classification.

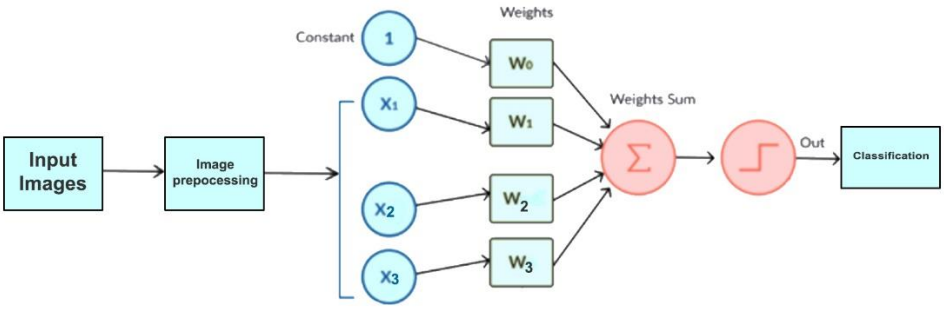

Figure 2. Flowchart Research Procedure.

Obtaining Data

We obtaining data images of hand gestures from rock-paper-scissors game. we have rock, paper, and scisor images with total number 2188 images. the images from dataset consists 712 rock images, 726 paper images, and 750 scissor images. the type of image is PNG with dimension 300x200 and the color type is RGB.

Figure 3. Images of paper, scissor and rock

Image Preprocessin

In this research, image prepocessing that we used is augmentation. Image augmentation enrich the data to make the model know little different shape with origin image. It similar with training data from multi object with different shape.

MLP Model

MLP model consists input layer, hidden layer and output layer. We have three layers input, and some hidden layers for training the model. The hidden layer consists convolutional layer, activation layer, maxpooling layer, flatten layer and dense layer. The part of hidden layer has different weight depend on the input and process into it. Because the data has three categorical we used Sparse Categorical entropy to classify the images. Beside that, into MLP we have to used optimizer to make the model work so the optimizer that we used is adam optimizer.

RESULTS AND DISCUSSION

Obtaining Data

Total images that we obtain from Kaggle dataset is 2188 images that consists rock, paper and scissor images. Then we devided data into training data and validating data. For training data we have 1749 images and for validating data we have 439 images.

Image Preprocessing

In the image prepocessing, we do image augmetation. There are rotation with 20 degree, rescale size, zoom and flip the image in to horizontal. Augmentation enrich the data and make the model training the data into many viewpoint. The augmentation that we do in the following images:

Figure 4. Original image.

Figure 5. Image rotation with 20 degree.

Resclae is a value that we will multiply the data before any other processing. Our original images consists in RGB coefficients in the 0-255, but such values would be too high for our model to process so we target values between 0 and 1 instead by scaling with 1/255.

Zoom range is for randomly zooming image inside the images. We used zoom into 2 upper for each image. The last augmentation that we used is flip image into horzintal that's mean input image will randomly flip input horizontally.

MLP Model

The MLP model that we used consists three main layers, there are input layer, hidden layer and output layer. We have three layers input for rock class, paper class and scissor class. Then in the hidden layer we have 15 hidden layers for training the model. The hidden layer consists four convolutional layer, activation layer, four maxpooling layers, one flatten layer and two dense layer. The arrangement of hidden layer is in the table below.

Table 1. Hidden Layer arrangement.

Layer Type	Output Shape	Parameter
Conv2D	(None, 148, 148, 32)	896
Activation	(None, 148, 148, 32)	0
Maxpooling2D	(None, 74, 74, 32)	0
Maxpooling	(None, 37, 37, 32)	0
Conv2d	(None, 35, 35, 64)	18496
Activation	(None, 32, 32, 64)	0
MaxPooling	(None, 17, 17, 64	0
Conv2D	(None, 15, 15, 64)	36928
Activation	(None, 14, 14, 64)	0
MaxPooling	(None, 7, 7, 64)	0
Flatten	(None, 3136)	0
Dense	(None, 128)	6423040
Activation	(None, 128)	0
Dense	(None, 3)	387
Activation	(None, 3)	0

After the data processing in the Hidden layer, the next process before classification determine the loss function and optimizer. In this research, because there are categorical class we used sparse categorical entropy and adam optimizer. Then we train the data used 50 epoch shows very good accuracy arround 95% to classify the hand gesture images for rock, paper and scissor.

Discussion

This model used backpropagaration algorithm through MLP is an algorithm for classifying hand playing (rock, paper and scissors) through hand gesture images. For future research we hope the model can be applied for helping children to play with their friend through mobile app or the other relevant tools during pandemic.

CONCLUSIONS

MLP model for classifying hand playing image get very good accuracy on 95%. Beside that, time consuming for training data is very fast lower than 60 second the result can display. This model is effective used for image classification on hand gesture for hand playing rock, paper and scissor.

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