Lab1 Report
Design of Embedded and Intelligent systems

Group1

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1 Introduction

The Lab has mainly two tasks one is pattern recognition and other is a statistical analysis on the hypothesis.For pattern recognition we wanted to use something that can be used for our project and have chosen an image recognition for our camera part where the images are classified into dense traffic, accident and fire categories.We use a CNN model to train them since image recognition can give more good results with deep learning or CNN.

2 Task1-Pattern Recognition

We have done pattern recognition for the images that is taken with a camera and to classify them on to traffic, accident and fire for the robot to detect and to act accordingly. we can use it for the re-routing or localisation with drone purpose for our robot. The code is done is such a way that we can add more data and layers for better accuracy and categorical detection in case we needed. Like human or animal detection etc. We used Convolution Neural Network as our model and CNN can give better results for image detection and we wanted use something we haven't used in our course structure before and have used CNN. We have used a simple CNN with a single CONV2D layer, Max pooling layer and dropout values with a 64 layers dense layer.

Data():Done by Ionnis - We have downloaded a dummy data from kaggle that can suit our image recognition criteria. We have used Trafficnet dataset V1 for our image recognition. It was a huge data with 4400 images altogether but due to timing constraints we have sub sampled to about 96 samples in all categories together and trained on 3 categories.

Data Prepossessing():Done by Ionnis- Since the images were in .jpg format we need to pre-process and need to convert the images from .jpg to numpy array and also converting categories into one hot for Neural network to understand. Also splitting train data into trainX and trainY.This also includes converting the image array from RGB values into binary values and reshaping the data fro the CNN input layers and dense layers. We have to do the same for our test data in order to measure the prediction accuracy. Also after prediction since we have one hot value we happened to convert the data from the one hot to argmax values were we can again make the integer values.Which is easier for getting accuracy score and evaluation.

Training model and feature extraction():Done by Meerashine - We have chosen a simple CNN with very less amount of layers as it is easy to work with and would take lesser time. we used an Conv2D layer with 32 filters and a convolution window of (3,3) with relu activation function since it was image values(and it gave better results). Then we used maxpooling2D layer with (2,2) window that can maximise the features with in small areas.Then we added dropout in between 0.25 - 3 in between our layers of dense and Cov2D to reduce over fitting. Then we added neural network layer of about 64 neurons for our network. All these hyper parameters we mentioned here are tuned in order to get a considerably good accuracy and prediction for our training data, they are still not the best hyper parameters for our model.

Classification and accuracy score():Done by Meerashine - We have used the categorical entropy as our loss value since we need a categorical classification for our model.After predicting with the test data we have used accuracy score in order to compare with the testY data and our prediction.

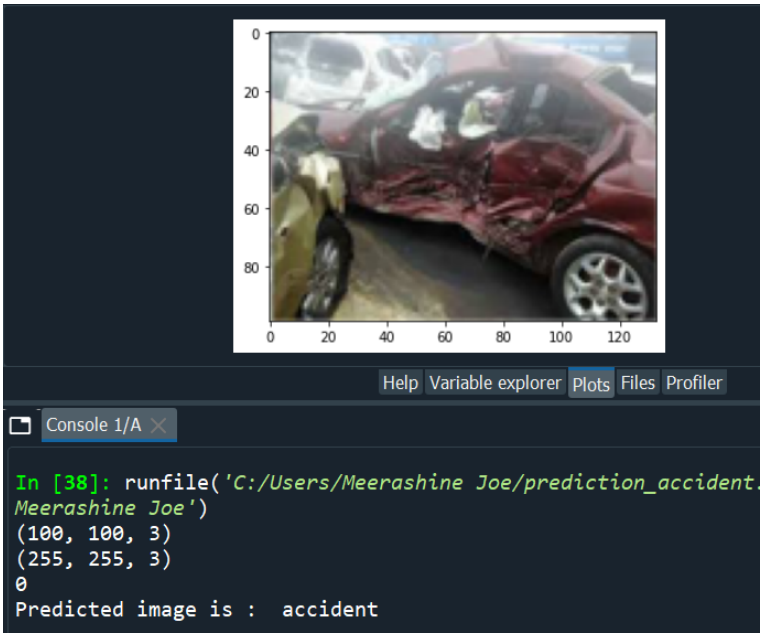
Testing(predict.py):Done by Neenu Ajilkumar - After training and fixing our model we have tested the model by converting some random data from the test data and have tested if the prediction is right or if the model has learned it well or not. Out of random 10 images taken almost 7 of them showed correct predictions.

2.1 Task1-Results

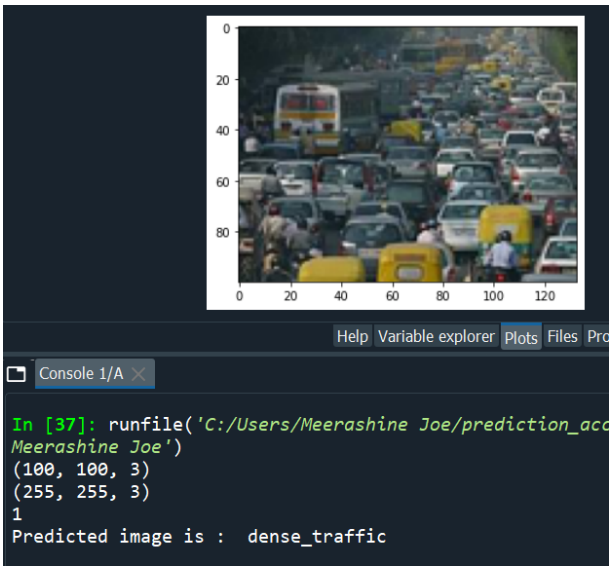
We have trained our CNN with accuracy score of 60 percentage without using any component reduction techniques such as Principle Component Analysis.

```
96/96 [==============================] - 8s 87ms/step - loss: 0.6398 - accuracy: 0.7292
- val_loss: 0.7882 - val_accuracy: 0.6316
Epoch 7/10
96/96 [==============================] - 7s 72ms/step - loss: 0.5715 - accuracy: 0.7083
- val_loss: 1.1582 - val_accuracy: 0.2105
Epoch 8/10
96/96 [==============================] - 6s 67ms/step - loss: 0.4360 - accuracy: 0.8438
- val_loss: 1.2604 - val_accuracy: 0.5789
Epoch 9/10
96/96 [==============================] - 7s 78ms/step - loss: 0.2762 - accuracy: 0.9375
- val_loss: 1.1255 - val_accuracy: 0.5789
Epoch 10/10
96/96 [==============================] - 9s 96ms/step - loss: 0.2040 - accuracy: 0.9375
- val_loss: 1.3496 - val_accuracy: 0.4737
Accuracy score without PCA 0.5694444444444444
```

On testing that with images with different categories the model could predict well. When predicting with an image from accident:



When predicting with an image from traffic:



When predicting with an image from fire accident:

3 Task2 - Significance Test on a Sample Data set

Test of significance is a statistical method to favour one hypothesis over another hypothesis. Significance tests can be used to extract evidence from data that supports a hypothesis. When we draw a sample from a population, there is a possibility that the observed effect is due to sampling error itself.[1]. To rule out this null hypothesis, we find the p value of an observed effect and check if it is less than or equal to the significance level. If the p value is less than the significance level, we can tell with a level of confidence that the sample value is representative of the population. There are different types of statistical significance tests like the P-test, F-test, Z-test and Chi Squared test.
In machine learning, statistical significance tests can be used to compare a machine learning model with a baseline or other models.[2] This can help the choice of machine learning models. While cross validation of machine learning methods, statistical significance can be used to determine if there is any significant deviation in the performance metrics each training-test epoch.

3.1 Task2 - Method

In our approach, we create two random set of values which are normally distributed. This is done using a python script. These distributions have a different mean and different variance Our null hypothesis H0 here is that the two sets of values are drawn from the same distribution and the alternate hypothesis Ha is is that they are drawn from different distributions. While performing f-test on the data set, we found that the data have different variance. Later on, a t-test is carried out on the data set using Scipy and Excel tools.

The *ttest_ind* tool [3] in the statistics library of scipy returns the two statistics which are the statistics value and the p-value.

3.2 Task2 - Results

Running the code gives the output

```
-17.823266082059938 1.6357946437517004e-32
Alternate hypothesis favoured over null hypothesis :
Samples are from different distributions
```

We can see here that the p-value is very much smaller than 0.05 and we can say with a confidence level greater than 95% that the samples come from

different distributions.

While using the Excel tools, below observations were found:

t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	*Variable 2*
Mean	29.74485152	61.46680552
Variance	95.92891608	62.45653472
Observations	50	50
Hypothesized Mean Difference	0	
df	94	
t Stat	-17.82326608	
P(T<=t) one-tail	3.32203E-32	
t Critical one-tail	1.661225855	
P(T<=t) two-tail	6.64406E-32	
t Critical two-tail	1.985523442	

Since t Stat <-t Critical two-tail (-17.63002023 <-2.009575237) we reject the null hypothesis and ensures that each data set differ significantly.

4 Conclusion

The two tasks entrusted on the group for the lab has been executed. A new method for a machine learning and also a method for statistical significance testing has been implemented, tested and the results recorded. The group worked together.

References

[1] Wikipedia contributors. Statistical significance — Wikipedia, the free encyclopedia, 2020. [Online; accessed 5-October-2020].

[2] Stacey Ronaghan. Statistical tests for comparing .... tds article, 2019.

[3] The SciPy community. ttest_ind, 2020.