



FIRE DETECTION USING CNN

ADVANCED MACHINE LEARNING

PROJECT

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INTRODUCTION

- As a new fire detection technology, Image fire detection has played crucial role in reducing fire losses.
- The fire detection is carried out by processing input image from a camera by algorithms to identify fire and risk.
- The three main part stages in the process of image fire detection algorithm includes,
  - Pre Processing
  - Feature Extraction
  - Fire Detection
- The real challenge of our project is to deal with small data as there is no larger amount of data available on this application
- Image Recognition algorithm we proposed based on Convolutional Neural Networks(CNN)

CONVOLUTIONAL NEURAL NETWORKS

- A special kind of multi-layer Neural Networks recognise visual pattern directly from pixel images with minimal pre-processing.

- Has features of Visual Cortex to perform computer vision task.

- It comprised of two very simple elements,
  - Convolutional Layers
  - Pooling Layers

- Best architecture and no need of Feature Extraction. The system learn to do feature extraction.

- The Convolutional Neural Network models that are used in this project below,
  - ResNet50
  - Bayesian Convolutional Neural Network

RESIDUAL NEURAL NETWORK (ResNet50)

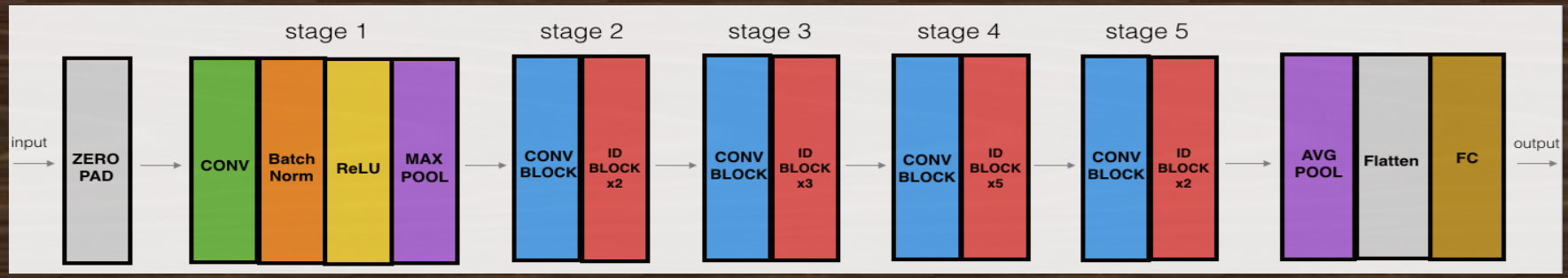
A residual neural network is a classic neural network used as a backbone for many computer vision tasks

Typical ResNet models implemented with double of triple skips that contains nonlinearities(ReLU) and Batch Normalization.

ResNet50 is a convolutional neural network that is 50 layers deep.

The ResNet-50 model consists of 5 stages each with a convolution and Identity block.

The ResNet-50 has over 23 million trainable parameters.



DATASET AND BENCHMARK

- Training the models based on data obtained from following sources
  1. https://www.kaggle.com/phylake1337/fire-dataset
  2. https://cvpr.kmu.ac.kr/

- Also, we have collected few images using Web scrapping.

- Fire Image Dataset

  - A benchmark dataset consisting total of 1500 image dataset which contains of two categories Fire and Non-Fire images.

  - Fire Images contains 1000 images

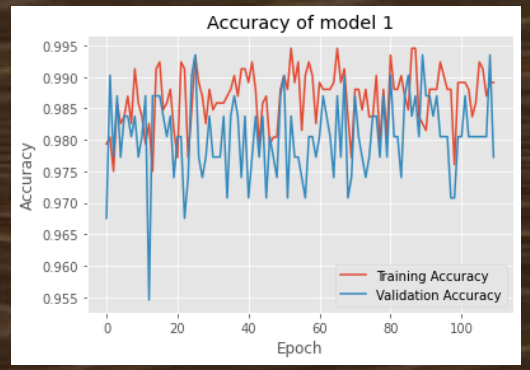
  - Non-Fire Images contains 500 images.

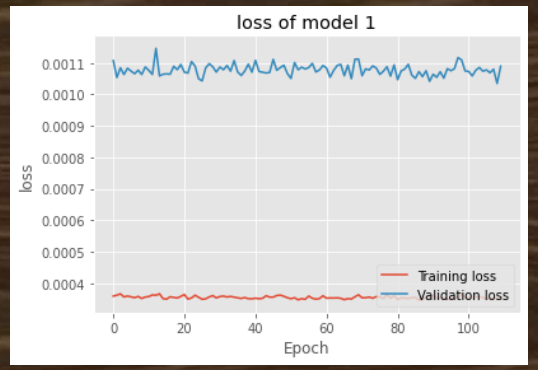
METHODS, RESULTS & FINDINGS

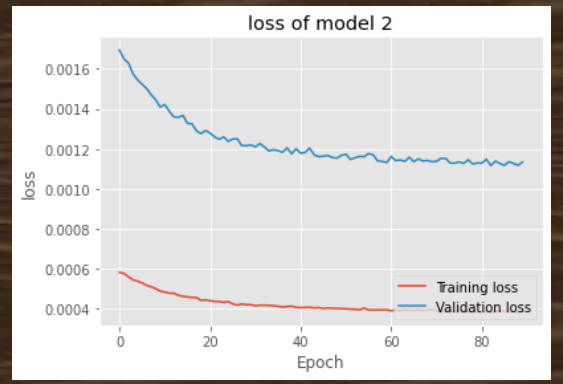
ResNet50:

The pretrained resnet50 model is modified by changing the layers. Adding sequential model and adding layers such as linear, dropout and activation functions such as Relu, Sigmoid and softmax.

The model has been trained with the dataset. For the first model with activation function Relu and softmax, the training accuracy and validation accuracy is 98.81% and 97.72% respectively. For the 2nd model having a dropout layer along with the activation function Relu and Sigmoid, the training accuracy is 96.84% and the validation accuarcy is 98.05%. The accuracy and loss function for both the models are given below:





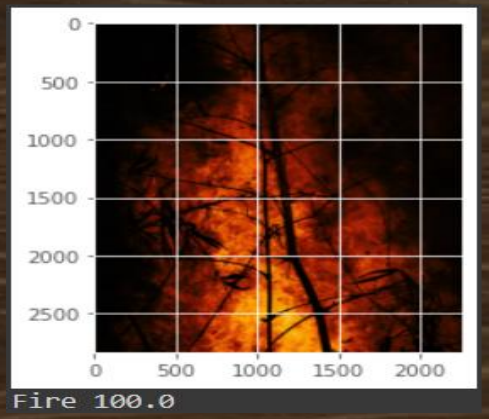


RESULTS & FINDINGS contd.

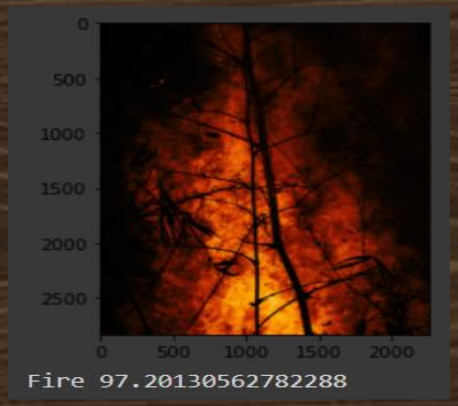
ResNet50 - Testing

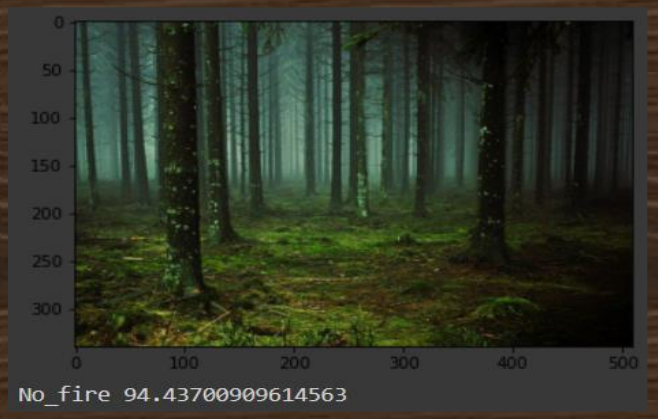
Classification of the image with their prediction is as follows:

Model 1:

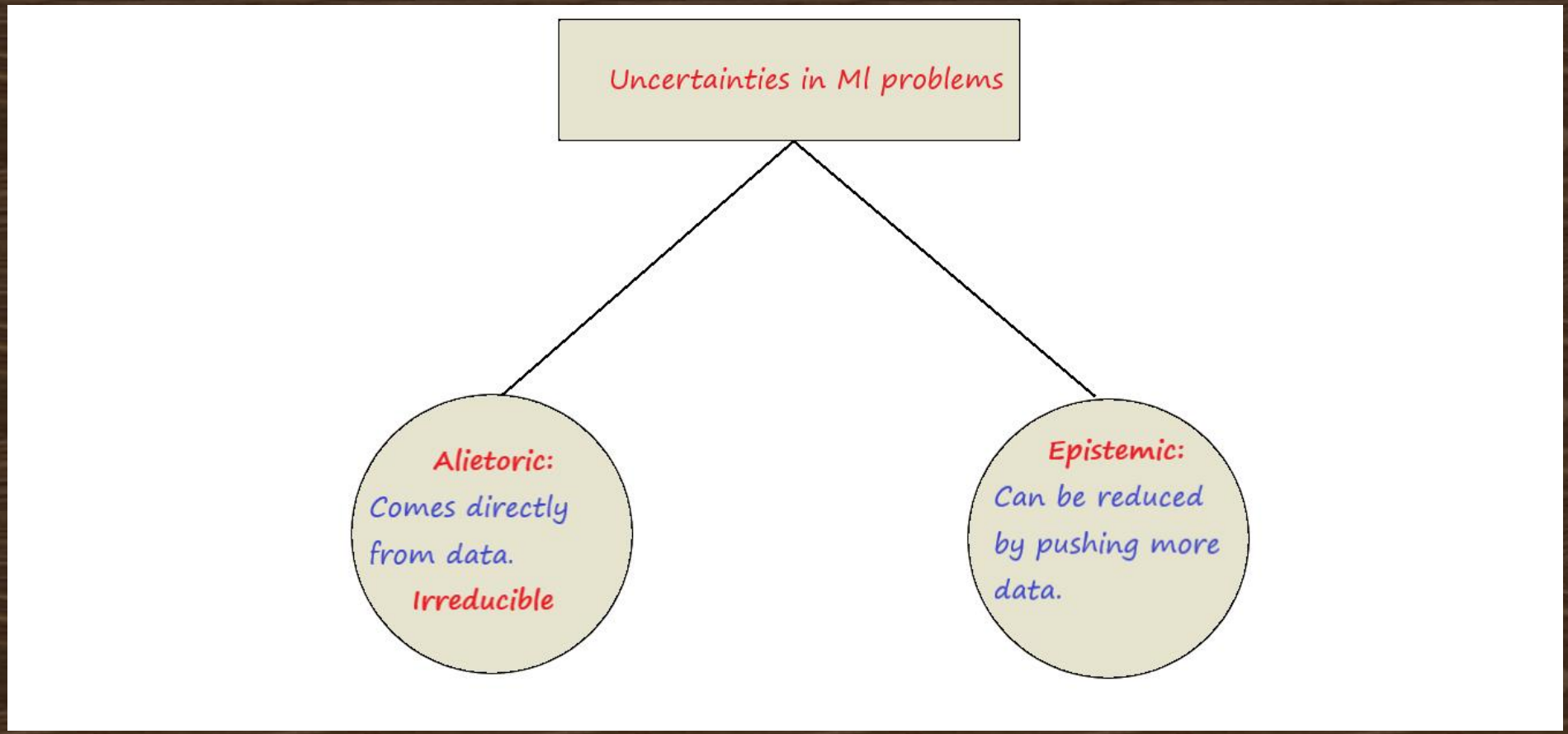


Model 2:

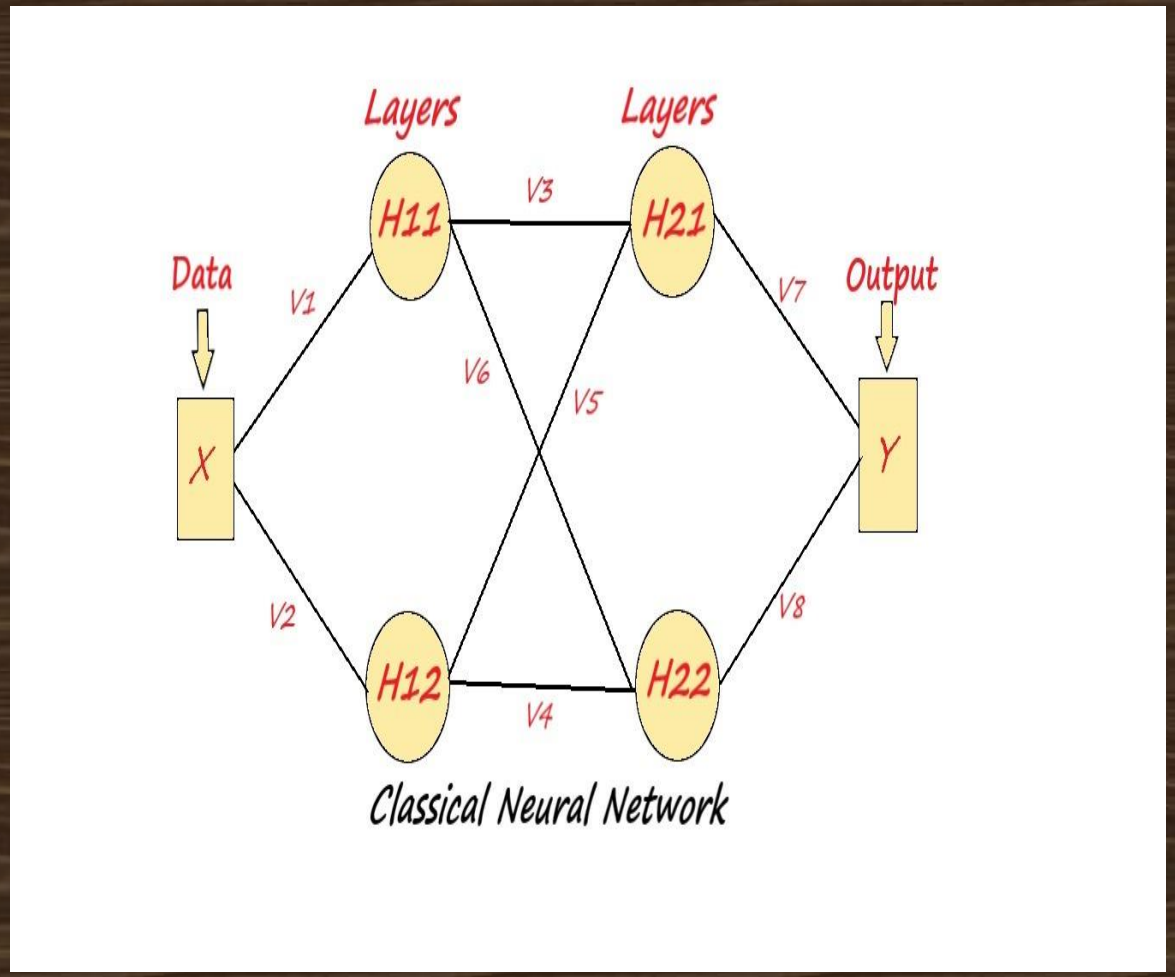


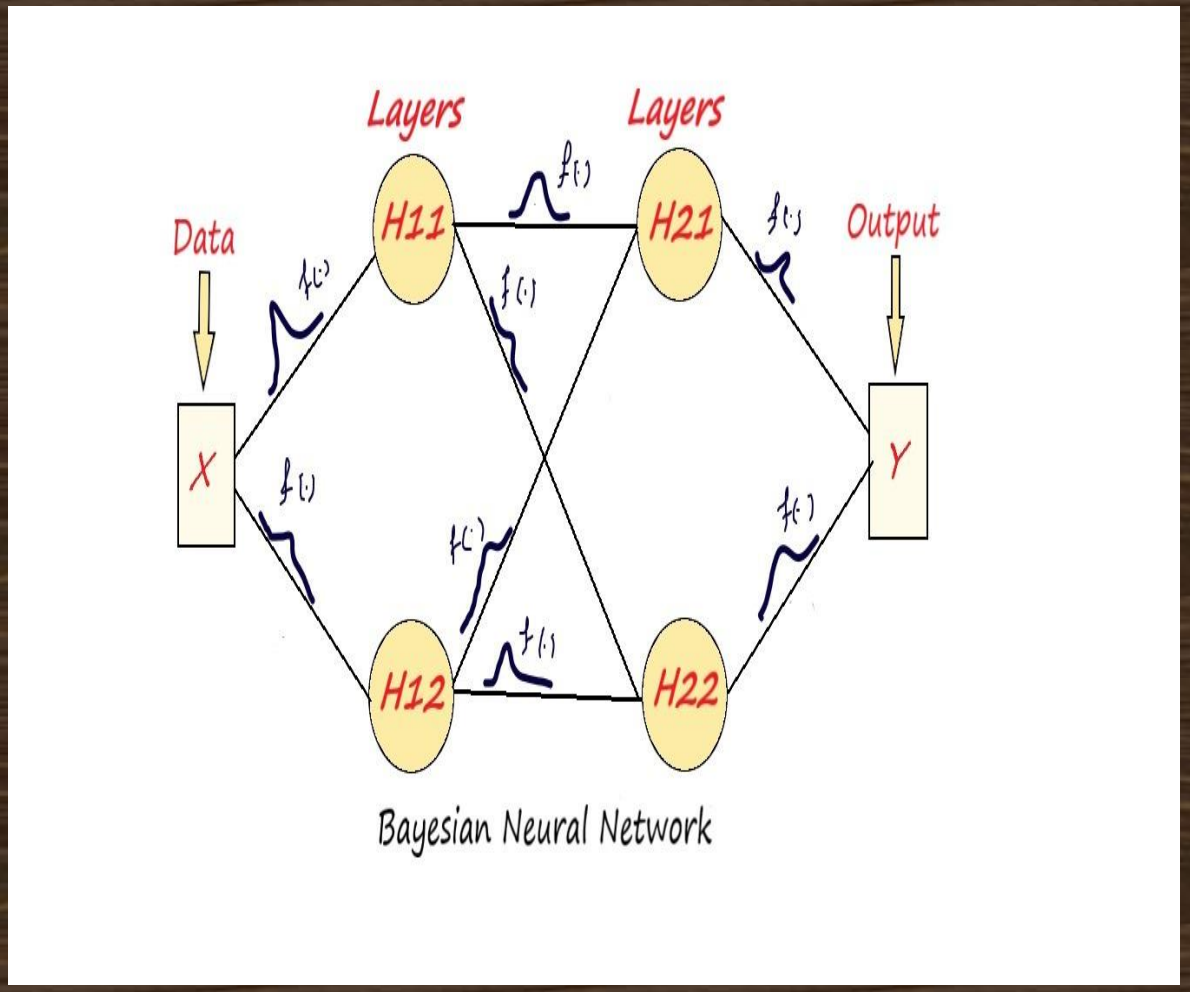


BAYESIAN CONVOLUTIONAL NEURAL NETWORK



Bayesian CNN continued

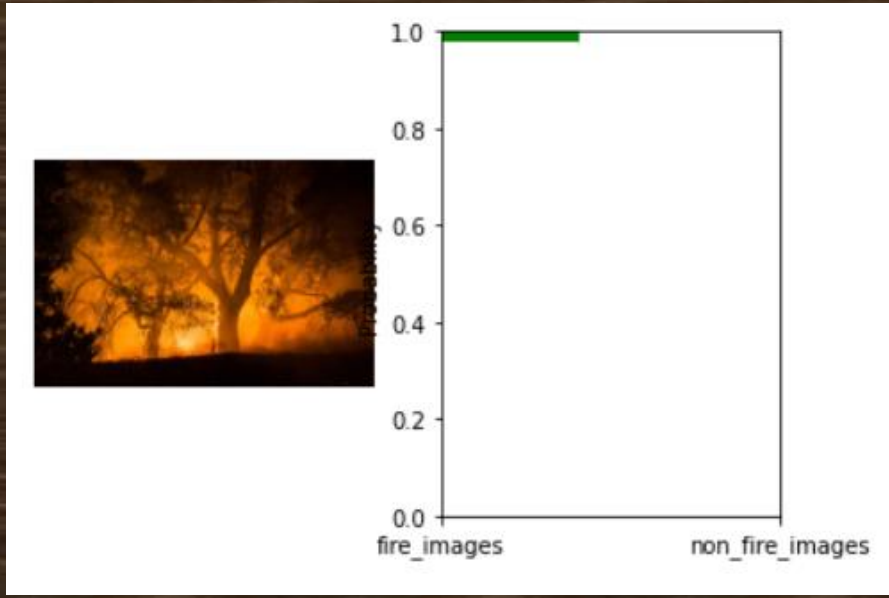


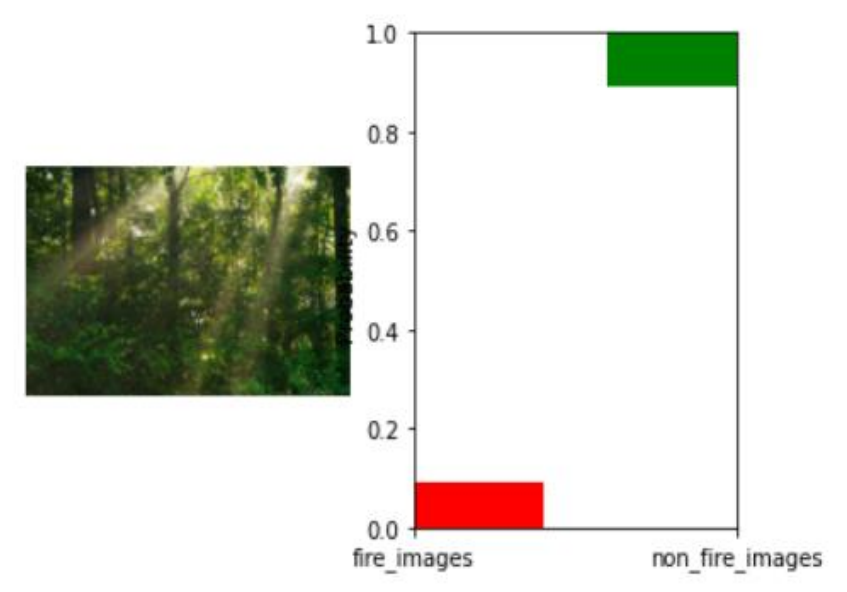


RESULTS & FINDINGS

BAYESIAN CNN - Testing

Classifying the image by predicting using the trained model as follows.



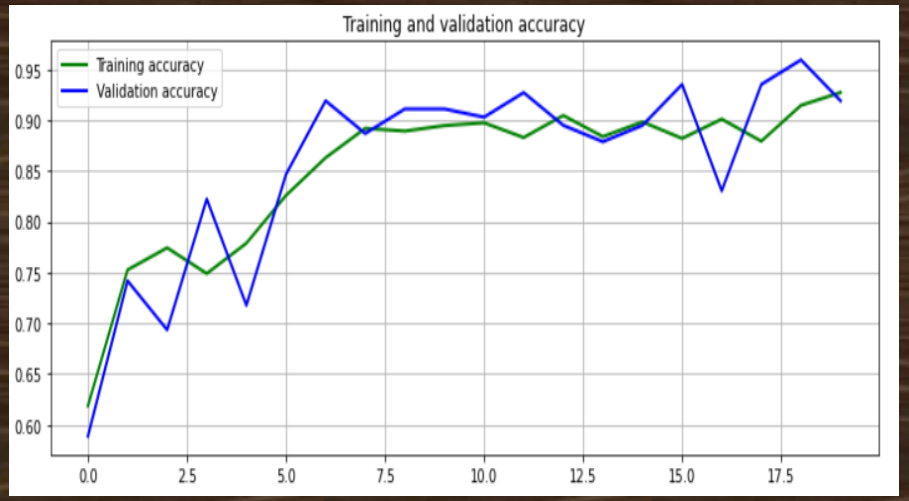


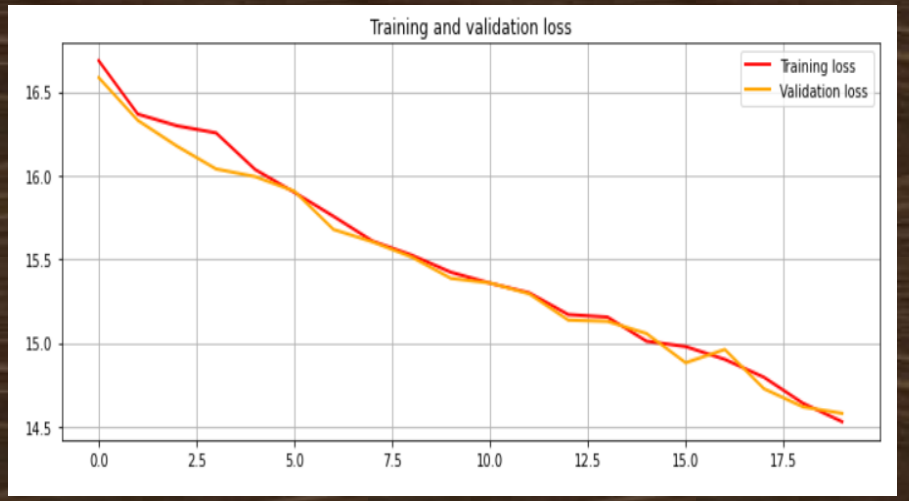
RESULTS & FINDINGS contd.

BAYESIAN CNN

The model has been built trained with training accuracy of 92.75% and validation accuracy of 91.94% after the hyperparameter tuning.

The training and validation accuracy is given below.





CONCLUTION & FUTURE WORK

1. The Resnet50 model works better than Bayesian CNN in terms of accuracy. But the visualization with the probability plot for bayesian CNN model is better than the Resnet50 model.

2. The application can be enhanced by training the model with a larger dataset consisting of fires.

3. The experiment can be conducted with different priors and check the accuracy for the bayesian CNN.

4. The possible extension of the present work can be to use the video data in the training which may be related to the real-life situation where fire has been detected by a detector.

REFERENCES

1. Toulouse, Tom, Lucile Rossi, Antoine Campana, Turgay Celik, and Moulay A. Akhloufi. "Computer vision for wildfire research: An evolving image dataset for processing and analysis." Fire Safety Journal 92 (2017): 188-194.

2. Zhang, Qingjie, Jiaolong Xu, Liang Xu, and Haifeng Guo. "Deep convolutional neural networks for forest fire detection." In 2016 International Forum on Management, Education and Information Technology Application. Atlantis Press, 2016.

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