Bayesian Neural Networks

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Abstract

Bayesian Neural Networks are...

Contents

1 Introduction

1.1 History

1987 The patent a 'Method of providing digital signatures' is filed by Ralph C. Merkle[**merkle-pate**

1999 The original patent expires.

2009 Bitcoin uses Merkle Trees for 'block header commitment.'[**friedenbach_alm_2017**]

2009 BitTorent uses Merkle Trees for data integrity[**bep30**].

2 Neural Network

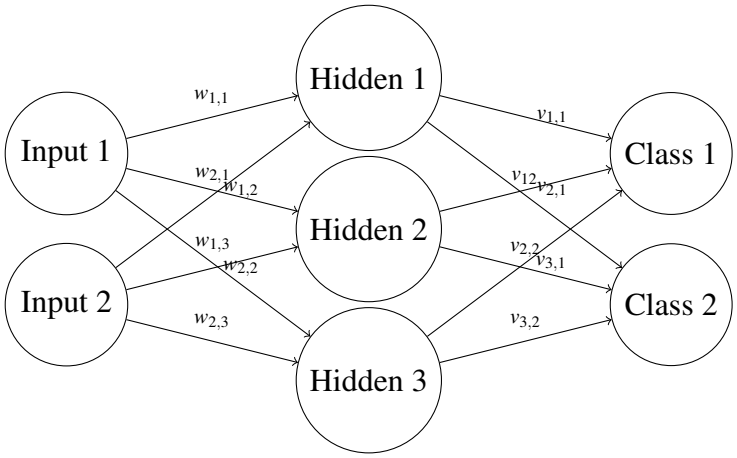


Figure 1: Example neural network

A neural network takes a series of inputs... In figure 1, the network takes two inputs, has one hidden layer of size

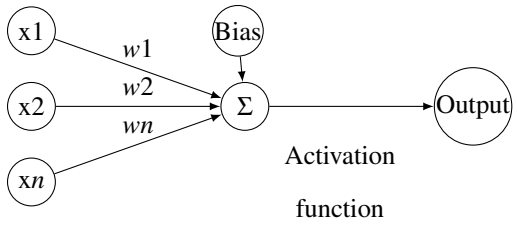


Figure 2: Neural network neuron

Neural networks are made out of a series of neurons... The neurons take a set of inputs, multiplies the inputs by the weights, sums the weighted input, adds a bias, and runs the output through an activation function...

2.1 Convolutional Neural Networks

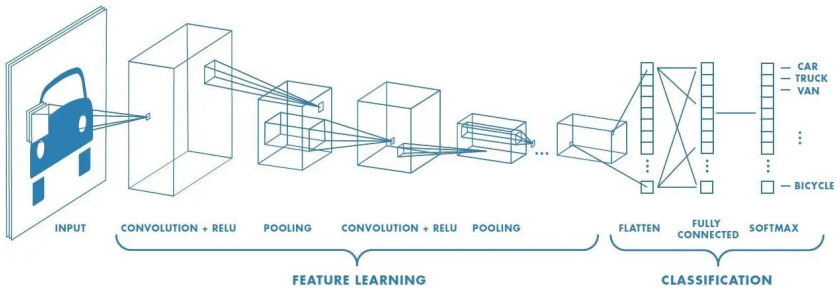


Figure 3: CNN pipeline [4]

Convolutional neural networks (CNN) are a type of neural network that is better suited for image recognition. While this might sound like a seperate model structure, CNNs are largely the same. In figure 3 the difference between a traditional neural network is the convolutional layer. Instead of reading the entire image at once, a convolutional layer slides over the image...

IMAGE OF SLIDING (gif split)

...

3 Bayesian Neural Networks

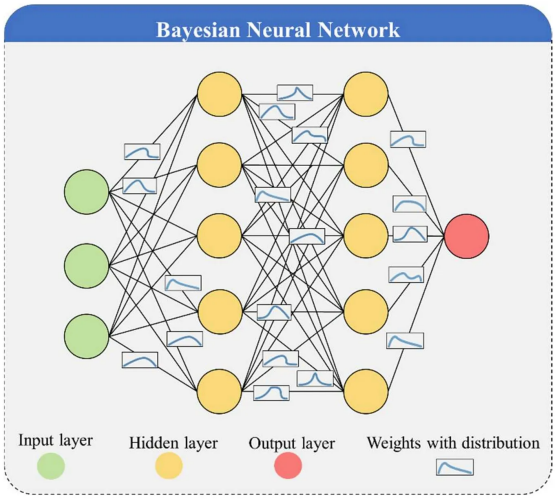


Figure 4: Example BNN [1]

Bayesian neural networks take the same principle as

Similar to a Neural network such as...

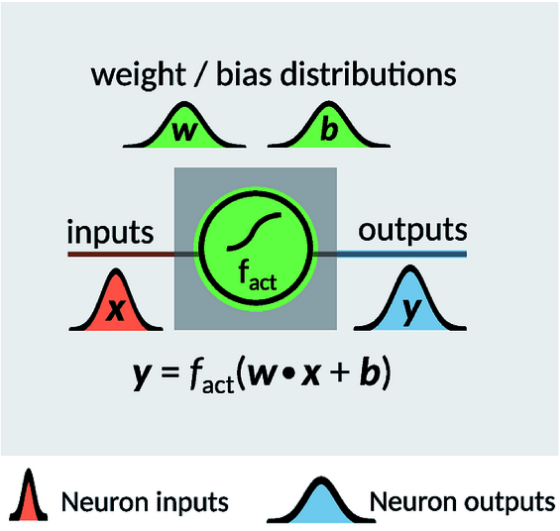


Figure 5: Example BNN Neuron [2]

3.1 Bayesian Convolutional Neural Networks

Bayesian convolutional neural network (BCNN) are similar to CNNs. The difference between is that BCNNs and a CNN is that the BCNN uses a bayesian neuron.

4 Simulation

We use a BCNN implementation from Github based on work from ... [6] [5]

4.1 CIFAR-10

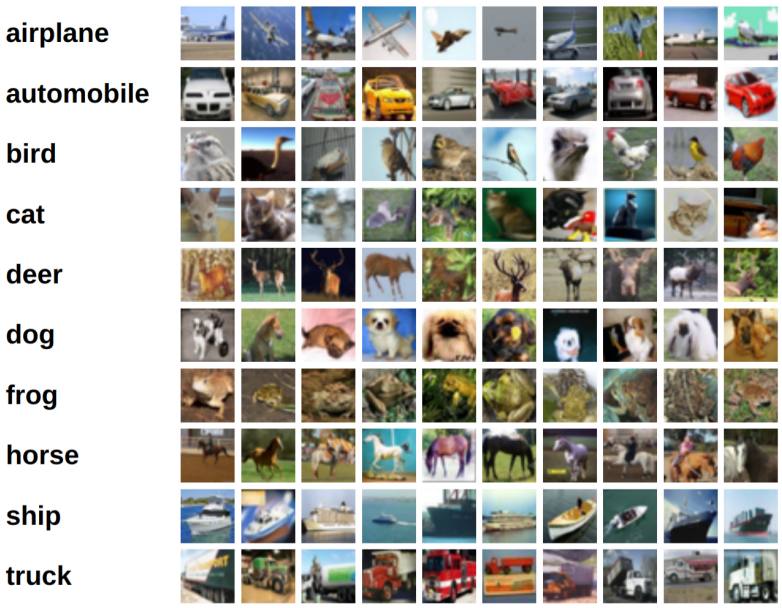


Figure 6: Example CIFAR-10 images [3]

The CIFAR-10 ((Canadian Institute For Advanced Research 10) dataset is a machine learning benchmarking set. It contatins 60,000 16×16 RGB pictures of: airplanes, cars, birds, cats, deer, dogs, frogs, horses, ships, and trucks[3]. It is used...

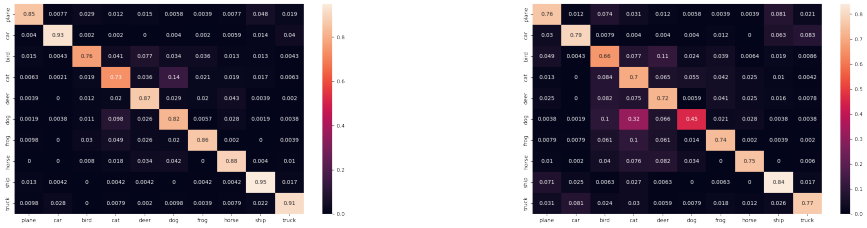
4.2 Hyperparamaters

We used the following hyperparamaters for training:

Hyperparameter	**CNN**	**BCNN**
Epochs	500	500
Learning Rate	....	May be higher (0.01 - 0.1) due to simpler structure
Regularization	L1/L2 weight decay or Dropout common to prevent overfitting	Can benefit from Dropout, but weight decay might be less crucial
Optimizer	Adamw	Adamw

In addition to the above, the two models have the same number of levels...

4.3 Results



(a) CNN (b) BCNN

Figure 7: Confusion matrices

The two have roughly similar accuracies given the model

5 Closing

References

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