Deep Boltzmann Machine

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***Abstract*—Deep Boltzmann machine(DBM) uses a Markov random field for layer-wise pre-training on vast amounts of unlabeled data, and then gives input from the higher layer to the lower levels. The training algorithm is fine-tuned using the backpropagation approach. In this paper,we have used the two datasets MNIST (handwritten digits) and smallNORB (visual object recognition). The results we got were MSE of 28.76 for MNIST using DBM . The results we got after using smallNORB were .**

I. Introduction

A Boltzmann machine (also known as a Sherrington–Kirkpatrick model with external field or stochastic Ising-Lenz-Little model) is a stochastic spin-glass model with an external field, that is, a Sherrington–Kirkpatrick model, which is a stochastic Ising Model. It is a statistical physics method used in cognitive science. It is also known as the Markov random field.

Boltzmann machines are theoretically appealing due to the locality and Hebbian character of their training algorithm (which is trained using Hebb's rule), as well as its parallelism and resemblance to simple physical processes.

Boltzmann machines with uncontrolled connection have not proven effective for practical issues in machine learning or inference, although learning can be made efficient enough to be useful for practical applications provided the connectivity is suitably limited [1].

II. Related Work

The authors presented a Deep Boltzmann Machine for learning a multimodal generative model They demonstrate how to apply the model to provide a meaningful representation of multimodal data. The authors discover that the learnt representation is useful for classification and information retrieval tasks, and so satisfies some notion of semantic similarity. A probability density over the space of multimodal inputs is defined by the model. It is possible to generate the representation even when some data modalities are absent by sampling from the conditional distributions over each data modality [1].

Vidyadhar Upadhya and P. S. Sastry [2] has reviewed the DBM and DBN in this paper.They explained all the concepts with the help of equations and diagrammatic representations.

Leandro Aparecido Passos and João Paulo Papa [3] addressed the problem of fine-tuning Deep Boltzmann Machine hyperparameters using metaheuristic optimization techniques from various backgrounds, such as swarm intelligence, memory- and evolutionary-based approaches. Experiments for binary image reconstruction in three available datasets has been conducted in this paper.

III. Dataset Used

We have used two datasets with DBM for getting the results.The first one is MNIST dataset and second is smallNORB.

A. *MNIST Dataset*

The Modified National Institute of Standards and Technology database (MNIST) is a collection of handwritten digits.So,this is basically a photograph of handwritten characters. In the MNIST dataset, 60,000 examples for training and 10,000 instances for testing.It consists of 28*28 pixel images of handwritten digits.MNIST is taken from a largest set NIST [4].

B. *smallNORB Dataset*

The smallNORB dataset is a dataset for 3D objects shape recognition. It is a collection of 50 toys divided into 5 categories:four-legged animals, human figures, airplanes, trucks, and cars.The objects were captured by two cameras under 6 lighting conditions, 9 elevations (30 to 70 degrees every 5 degrees), and 18 azimuths (0 to 340 every 20 degrees).The training set contains five instances of each category (instances 4, 6, 7, 8, and 9), while the test set contains the remaining five instances (instances 0, 1, 2, 3, and 5) [5].

IV. Results and Discussion

We first tried using the MNIST dataset along with the DBM. After that we tried the Structural sparsity in smallNORB dataset which was giving better results. We got MSE as 28.76 after 50 epochs and the loss was around 0.002 as for the MNIST dataset. For the smallNORB dataset we were getting the MSE of 25 as after 10 epochs.

V. Conclusion

We used the two popular datasets in the paper which were MNIST and smallNORB.We got promising results when we used RBM's in the case of MNIST dataset and structural sparsity in the case of smallNORB dataset.

REFERENCES

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