

***Chosen Model: Deep Belief Network***

*Proposal*

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A deep belief network (DBN) is an artificial neural network model that is composed from multiple Restricted Boltzmann Machines (RBMs) that are stacked and trained in a greedy fashion [[1]](https://www.zotero.org/google-docs/?mZBNvf). A Boltzmann Machine (BM) is a neural network model where each neuron is connected, via weighted edges, to every other neuron in the network; those in the same layer and those in the different layer. An RBM is a restriction of the connections of a BM, where each neuron is only connected to neurons in the different layer [[2]](https://www.zotero.org/google-docs/?HaP2Ye). A BM consists of a visible (input) layer and a hidden layer, where each element in both layers has a bias. An RBM has the same architecture as a BM, but without the elements’ connections in the same layer:

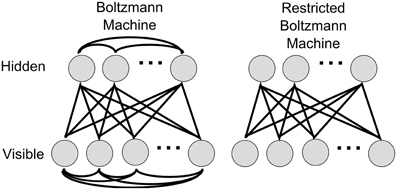


Figure 1: BM vs RBM

Source: [[3]](https://www.zotero.org/google-docs/?DZrr2G)

DBNs are unsupervised models that use backward propagation technique after good initialization of weights using RBM training. In addition, ReLU activation function is used in DBNs, which prevented DBNs from overfitting resolved the vanishing gradient descent problem [[4]](https://www.zotero.org/google-docs/?1Eem3A). Note that the fine-tuning part of the model can be either supervised or unsupervised depending on the cost function used for backward propagation.

An advantage of a DBN model is that the usage of hidden layers and connection between neurons increases its robustness in classification and allows it to be implemented on different applications and data types. However, that same network configuration makes a DBN model a complex architecture that is costly in terms of both computation and time.

DBNs are used in various applications including electroencephalography [[5]](https://www.zotero.org/google-docs/?WiDYte), speech recognition [[6]](https://www.zotero.org/google-docs/?fHiX75), text classification [[7]](https://www.zotero.org/google-docs/?6LwgLP), and image classification [[8]](https://www.zotero.org/google-docs/?l25sxT).

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