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Performance Analysis of Siamese Neural Networks for Similarity Feature and KNN/SVM Classification of MNIST Dataset.

ABSTRACT - Masterthesis

Machine learning, a branch of artificial intelligence, has become increasingly important in science and technology particularly in the interpretation and segmentation of images as well as the detection and classification of objects which are of great interest.

Most of the deep learning models used in modern machine learning approaches require large and balanced amounts of training data to produce convincing results in many applications, however, the associated costs make it quite difficult to acquire enough data to provide such training datasets. Consequently, approaches are of interest that offers robust performance even for unbalanced training datasets of small size.

In this thesis, the deep training model called Siamese Neural Network (SNN) is considered while using the contrastive loss function or alternatives like the triplet loss function for assessing the similarity or dissimilarity of two input images. The feature vectors determined by the SNN for calculating the loss function are stored in a second database as an information-condensed similarity feature according to an encoder output. This database is used as a training dataset for the classification, whereby more conventional approaches such as K-nearest neighbour (KNN) or support vector machine (SVM) are used.

SNN consists of two identical convolutional neural networks side-by-side, each capable of learning a hidden representation (feature vectors) of the input image. This neural network architecture already reliably learns for a training data set of moderate size to distinguish between image pairs that consist of similar and dissimilar images.

The output of a Siamese neural network is a measure of similarity that is determined using the feature vectors obtained from the two input images. The similarity of the two vectors is determined by the Euclidean distance between them. Finally, the SNN used for the similarity feature vector and the conventional approaches employed for the classification are trained and tested as well as exhaustively analyzed and assessed using the MNIST dataset.