

CSCI 5922: Project Proposal

Siamese Convolutional Neural Network for Verification Problem

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March 13, 2019

1 Introduction

Conventional wisdom says that deep neural networks are really good at learning from high dimensional data like images or spoken language, but only when they have huge amounts of labelled examples to train on. Humans on the other hand, are capable of one-shot learning - if you take a human who's never seen a spatula before, and show them a single picture of a spatula, they will probably be able to distinguish spatulas from other kitchen utensils with astoundingly high precision.

A Siamese Neural Network is a class of neural network architectures that contain two or more identical sub networks. 'Identical' here means that they have the same configuration with the same parameters and weights. Parameter updating is mirrored across both sub networks. It is used to find the similarity of the inputs by comparing its feature vectors.

2 Applications

- Face Recognition based upon Similarity
- signature/authorship verification
- Blood Cell Classification
- Fingerprint verification
- Detect minute changes in Documents

3 Problem Statement

We will be implementing a Siamese convolutional neural network to determine whether two pieces of handwriting are written by the same author or not. We

would like to examine questions such as whether long pieces of handwriting must be present to achieve good results, how many samples are needed, what features are important, and how different architectures perform on this task. For this project we would be exploring various CNN architectures like VGG, ResNet, GoogleNet and maybe others to determine which one performs best.

If time permits we would also like to visualize filters and understand what kind of features do different filters learn in different architectures.

Authorship determination is in forensics, signature verification, Here are some web sources to learn about Siamese Neural Networks. In addition, handwriting analysis is an established area of study in forensics, but there has not yet been any formal experiments measuring the accuracy of such analysis.

4 Feasibility

We think this project is feasible because getting a baseline Siamese Neural Network architecture is straightforward and not complex. Labelled data is available with over 1500 pages of scanned handwritten sentences [1].

Challenges may involve training a complex architecture for a Siamese CNN.

We would require a GPU in for training this complex architecture.

5 Proposed Approach

The dataset contains over 1500 pages of scanned handwritten sentences with their writers. One step is to construct pairwise dataset used to train our model. We need to separate validation and test data making sure data is agnostic of specific author handwriting styles sets. Step two is data preprocessing, which involves data cleaning, padding, removing unnecessary noise etc. Step three is constructing the architecture starting with concatenating two basic siamese neural nets and adding softmax for classification. Once this baseline architecture is ready, we can add transfer learning using various pretrained models like VGG and ResNets. We think that ResNet should perform better as ResNets try to learn the differences/errors as features. We may try Ensembling by getting multiple models together.

6 Resources

You can read/learn about Siamese Convolutional Neural Networks from the links given below:

- Quora

- Medium
- BecomingHuman.AI Blog

References

- [1] U.-V. Marti and H. Bunke. The iam-database: an english sentence database for offline handwriting recognition. *international journal on document analysis and recognition*, 5(1):39–46. 2002.
- [2] Gregory Koch, Richard Zemel, and Ruslan Salakhutdinov. Siamese neural networks for one-shot image recognition. 2017.
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- [4] William Weidong Du, Michael Fang, and Ming Shen. Siamese convolutional neural networks for authorship verification. 2017.