Project Proposal: Converting Handwritten Math to LaTeX, 2023 Edition

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Introduction

Using machine learning to parse an image to text is a common problem closely tied to neural networks. For example, the MNIST dataset is a common introduction to neural networks. [2] When it was originally released, the application of models trained on the dataset was to parse the numerical values written on checks. Google's use of reCAPTCHA also demonstrates how optical character recognition worth pursuing. [1] In our project, we want to apply this technology to the recognition of handwritten mathematical expressions in order to transcribe their content into typesetting languages such as LaTeX.

Dataset

In our project, we aim to address the open problem of optical character recognition. More specfically, we want to address the open problem of converting handwritten mathematical expressions into LaTeX. To do so, we use ICDAR's 2023 Competition on Recognition of Handwritten Mathematical Expressions (CROHME) dataset. This dataset is partitioned into three tasks: online recognition, offline recognition, and bimodal recognition. Online recognition attempts to determine the characters as they are being written. For this purpose, the partitioned dataset for this task includes inkml files, a file format that stores the vectorized data of each expression written by hand, from previous iteratoins of CROHME.[6] In our case, we will likely use the data set aside for task two, offline recognition. This partition of the dataset incudes rendered inkml files and scanned immages. It is meant for models that give the LaTeX expression for a written expression based on the entire expression rather than individual strokes. From the above explanation, it should be obvious bimodal deals with both. Also, it should be clear we are choosing offline recognition given the apparent complexity of online recognition.

While the general problem seems simple, it has several components. A given model has to identify the strokes of a given character, the positioning of the

character, and the relationship between the characters to be able to find a suitable LaTeX expression. Based on the work of Sakshi and Kukreja, there are five main areas of challenges with current approaches: Preprocessing, Input/Output formats and representations, Recongnition model challenges, Compartive analysis and performance evaluation, and Hardware challenges. [3] Based on the content of the class, we can ignore challenges pertaining to hardware, and Input/ Output formats and representation. Between the final three areas, we are narrowing down the exact question we would like to answer. Currently, we believe answering questions relating to the Comparative analysis such as developing guidelines for metric standardization and "forgiven"symbols based on similiarity. Alternatively, we could deal with recognition model challenges by comparing different neural network structures or determining and comparing optimal hyperparameters between models. Finally, we could consider the effect of multiple preprocessing techniques such as illumination, curve and blur, low resolution, noice, and occlusion on model accuracy. For our final project, we choose the final category, considering the effect of preprocessing techniques on model accuracy.

Model

Having narrowed down the problem to model accuracy based on preprocessing technique, we will consider the types of neural networks we will use. Given the informal nature of this assignment, we will take a random group of networks that are used in field. First, we will use WAP (Watch, attend, and parse). It was created in from CROHME 2016 with a few papers written about it.[8] [7] Second, we use another DenseNet based convolutional neural network (CNN) implemented in a paper by Wang and Shan. [5] At the moment, we are still looking into alternate models to use in our project and will finalize the models used in our project following a more thorough literature review. But, we will follow the preprocessing tehcniques Sakshi and Kureja discuss to make a meaningful contribution to the literature.

References

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