Handwritten Mathematical Expression

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Background

Our program intends to relive people's pain in typing and performing mathematically heavy calculations. It is easy to use as it can quickly convert the handwritten expressions to machine readable results.

User input:

- A PNG image that contains a full length mathematical expression. The input image should be black text on a white background.

System output:

- Print-friendly version of the expression (in LaTeX);
- Calculated result.

User Profile

Our target users are STEM students of all grades and faculties in the education industry who are interested in:

- Checking a previous math expression that they calculated by hand
- Getting the result of a handwritten math expression from the calculator

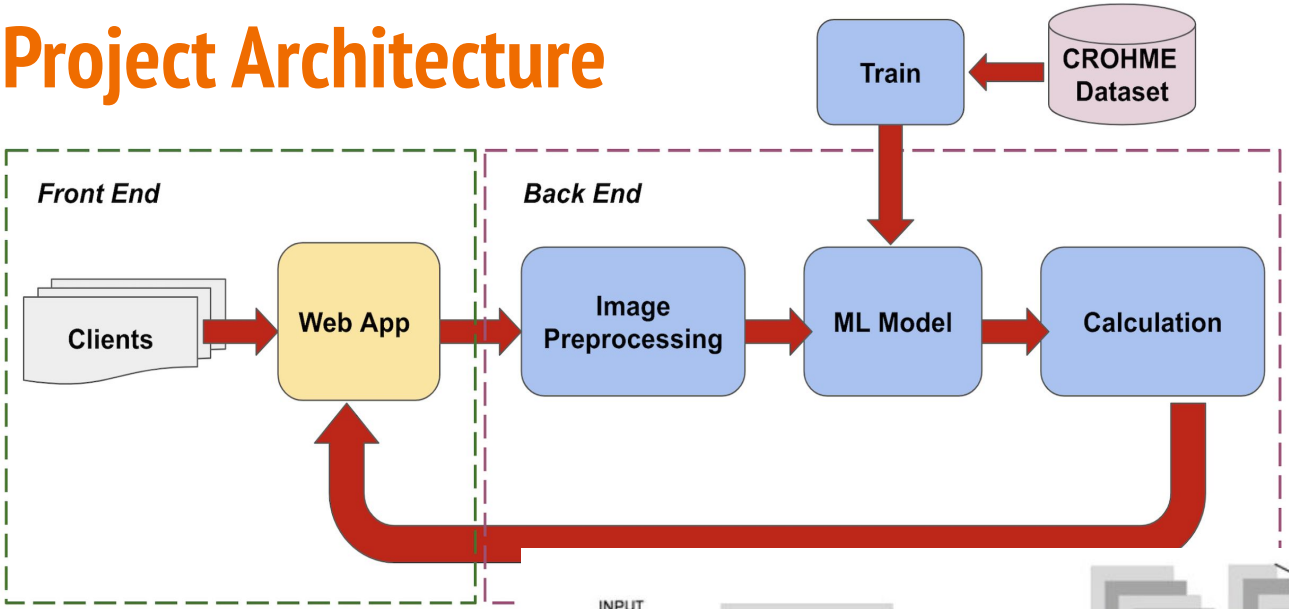
Dataset

Data Source: https://www.isical.ac.in/~crohme/CROHME_data.html

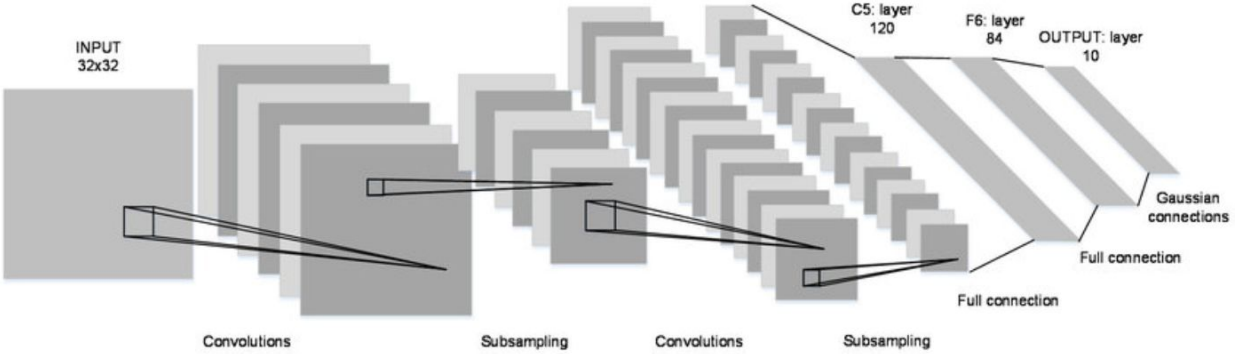
Our machine learning model uses data from competition CROHME 2012 and 2013 for training and testing. This dataset aims at bringing the researchers under a common platform so that they share the same dataset of handwritten mathematical expressions for their respective research and report performance of their systems on a common test data.

All the data files in CROHME 2012 and 2013 contain full mathematical expressions and were stored with **inkml** format, whereas our machine learning model intakes one character in PNG image format. Therefore, we first use an open source tool (RobinXL) to convert all the inkml files to png files, and then perform image preprocessing that separates an expression into segments.

Project Architecture

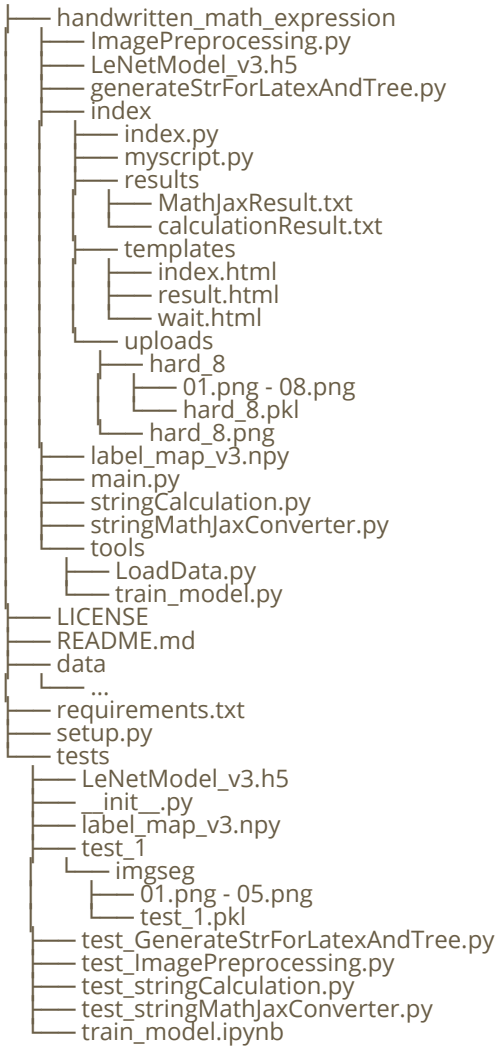


Handwritten Mathematical Expression Project Architecture (left)

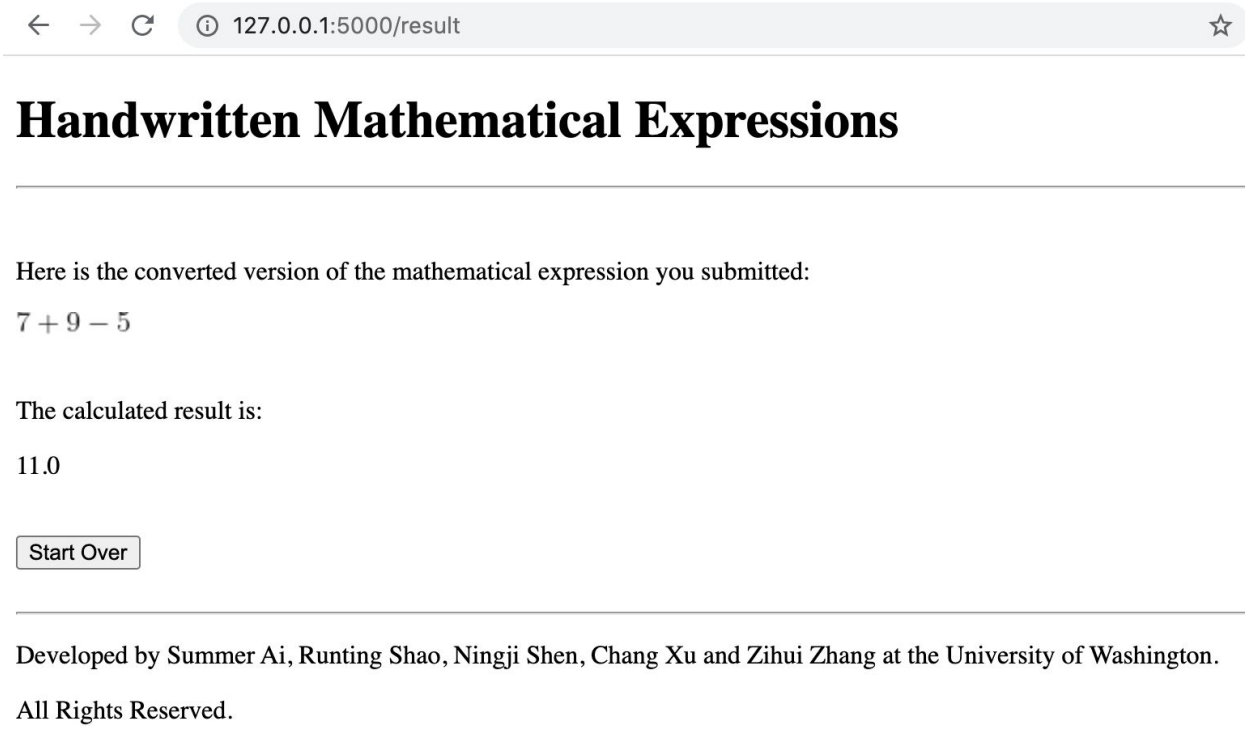


Yann LeCun's LeNet-5 convolutional neural networks (right)

Directory Structure



Demo


127.0.0.1:5000/result
Handwritten Mathematical Expressions
Here is the converted version of the mathematical expression you submitted:
$7 + 9 - 5$
The calculated result is:
11.0
Start Over
Developed by Summer Ai, Runting Shao, Ningji Shen, Chang Xu and Zihui Zhang at the University of Washington.
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Lessons Learned

- Start small, then extend. Change one thing at a time
- Add logging and error handling early
- **Everything takes longer than you think (priorities matter!)**

Future Work

- Improve image preprocessing to improve accuracy of image segmentation
- Improve Lenet model accuracy

Thank You