Functional Specification

Handwritten Mathematical Expressions

Team: Runting Shao, Ningji Shen, Chang Xu,Summer Ai, Zihui Zhang | DATA 515 - Wi 21

1. Background

As one of the most important subjects in school, math plays a crucial role in helping students develop logical thinking and strengthening their understanding of many other subjects. However, people often find it difficult to calculate math by hand, especially when facing complicated expressions. Although there are many calculators available, formatting math into text can be boring and a minor mistake will lead to a big difference in the result.

In this project, we aim to alleviate people's pain of doing mathematically heavy calculations by building a full stack web application system that takes users' handwritten image (.png format) as input and returns the calculated result as output. Specifically, we will first use machine learning and computer vision to build a model that can recognize numbers and operators in the expression. The expression will then be calculated in the background and the returned result will be displayed on the web page.

2. Functional Requirements

2.1 Users

2.1.1 User Profile

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

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

Computer experience requirement:

1. The users should have basic knowledge of browsing a website
2. The users should be able to convert their image into .png format if the original one doesn't meet the requirement
3. The users should have basic knowledge of uploading images from local computer
4. The users should be able to follow the instruction to click corresponding buttons

Domain knowledge requirement:

1. The users should have basic knowledge of algebra in case they want to check the results returned by the page
2. The users should have some experience in machine learning and computer vision if they are interested in understanding how we recognize the expression

2.1.2 Use Cases

Use Case 1

John is a high school student and he wants to double check his answer for his math homework. He first writes down his math expression, takes a picture of it and saves it as a .png image. Then he goes to the website and clicks on the 'Choose File' button to upload his file. Once the application completes the process of recognizing the expression and running the calculation, our webpage notifies John and he is able to see the calculation result after clicking on the "ok" button. Lastly, he compares the returned value with his answer.

Use Case 2

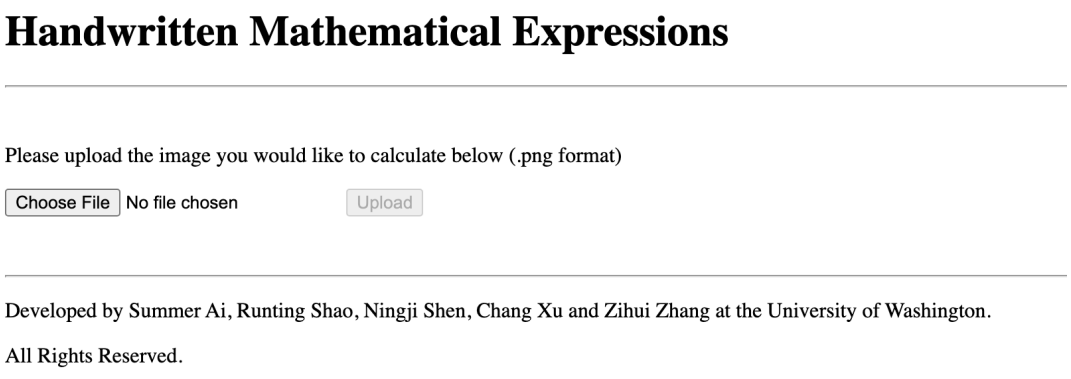
Jennifer is a math teacher preparing for her lecture for an algebra class. She needs to type some algebraic expressions in her power point and is not able to get it formatted correctly. She then writes down her expressions on a piece of paper, takes pictures of them one by one, and uploads her png images onto our system. Then she goes to the webpage and clicks on the 'Choose File' button to upload her picture. Once the application completes the process of recognizing the expression and running the calculation, the webpage will then notify Jennifer and she will be able to see the print-friendly version of her expression, along with the calculation result. She then can take a screenshot of the expression and put it in her power point slides.

2.2 Software Requirements

Our system requires python 3.5 - 3.7 pre-installed. Please refer to README for detailed instructions.

3. User Interface

3.1 Home page



3.2 User interface attributes

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.