LaTeX Dictation

Fall 2018 UROP Proposal

Arvid Lunnemark
`arvid@mit.edu`

Supervisor: Dr. Kyle Keane

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Project Overview

The aim of this project is to create a product that can be used for dictating LaTeX math formulas reliably, by combining speech-to-text APIs, custom logic, and text-to-LaTeX APIs (specifically, Wolfram Alpha and Mathematica). The idea originates from a project created by me, Sualeh Asif and Albert Acebrón during HackMIT 2018.

This project will be supervised by Dr. Kyle Keane within the Department of Materials Science in the Interactive Materials Education Laboratory. Since this is a software project, the work can and will be done remotely with supervision performed via web conference.

Details

The starting point of the project will be the HackMIT product created by me, Sualeh and Albert. In broad terms, it is a website which transcribes speech in real-time using Microsoft's speech-to-text API, and then uses that transcription to create a LaTeX math formula. During the hackathon, we put in the most work in the second part.

We made the conversion from text to LaTeX using two separate methods. The first method was by developing our own math parser from scratch, in Python. This parser could recognize common math keywords (e.g., "pi" for "π" and "is equivalent to" for " $\iff$ "). It processed the string sequentially and converted each word using a simple dictionary of common keywords mapped to their appropriate LaTeX versions. To be able to recognize slightly more complex expressions, the parser recursed as soon as it hit a pair of parentheses. This method was fast, but could only recognize simple formulas, since the list of keywords was hardcoded and therefore far from exhaustive.

For more accurate results, we opted for using the Wolfram Alpha API. We sent the full text transcription to the API, and received properly typeset formulas back, in the Wolfram Language. For unclear reasons, this did not work all the time, since the Wolfram Alpha API would not return the formula in a consistent manner. However, when it worked, we converted the Wolfram Language expression to LaTeX using Mathematica. We could not find a regular API for this, but rather opted for launching Mathematica in a new shell, faking keyboard input and then grabbing screen output while running the TeXForm command. While this process worked, it took several seconds, and it is also not a scaleable solution.

We used both methods for converting text to LaTeX: the first one for real-time transcription, and the second one for error-correcting the first one. For my continued work on this project, my aim is to improve both methods. Particularly, a new solution for working with the Wolfram Alpha API needs to be developed. Furthermore, I will research ways to make the speech-to-text more reliable, in that it should be more suited for math formulas (one of the simple ways we dealt with this during the hackathon was by building a dictionary of common errors, which mapped, for example, "eggs" to "x"). I also aim to improve the math parser for real-time transcription, by adding to the list of symbols and expressions it can handle.

Personal Role & Responsibilities

I will be taking full responsibility for the project, and will work on it independently. I will communicate with Kyle on a regular basis about the progress of the project, and will seek his advice when needed, particularly regarding the use of Wolfram APIs.

Goals

My overall goal is to create a website that lets the user dictate LaTeX math formulas. The website should be useful, in that it should be sufficiently reliable and sufficiently fast. The primary focus will be on converting the transcribed text into LaTeX code, but if it is deemed necessary, the speech-to-text part will also be further developed.

Another goal is to make sure that all code is open-sourced, and also sufficiently well-documented and well-organized so as to enable future improvements from other people.

Personal Statement

My personal motivation for doing this project is two-fold: firstly, I would be able to gain a deeper understanding of the intricacies of LaTeX, Wolfram Alpha and Mathematica, and secondly, I would be given the opportunity to complete a meaningful project on my own, that could actually be useful for other people.