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Keystone Progress Report

In 2014, SAR professors Jessica Kramer and Melissa Levin developed a problem-solving process, Game Plan. Game Plan was designed to encourage “environmentally focused advocacy skills” in young adults with intellectual and development disabilities (IDD) and to promote independence in goal-setting and problem solving. Results of the study indicated that this pen-and-paper method increased individuals’ participation in their local and school communities. However, it can be inconvenient to rely on pen-and-paper methods given the necessity of having specific physical resources on hand. In collaboration with the Hariri Institute at Boston University my advisor, Professor Dora Erdos, Kramer and Levin set out to develop a mobile implementation of Game Plan. Despite the myriad of calendar and reminder application available to smartphone users, none before Game Plan have provided accommodation for individuals with IDD.

In order to make the user’s interaction with the Game Plan application a more personalized and beneficial experience, my research focuses on using natural language processing tools to allow Game Plan to handle user-defined goals and accurately return potential methods of approach to the goal. Natural language processing, often referred to as NLP, is how a computer is able to process and understand human-language. Computers learn how to understand text input by training to understand grammatical structure and language syntax practices such as parts of speech. I will be using NLTK, a Python programming package to identify which goal category a user-input falls under (volunteering, school, self-care, leisure) to scan a database storing approaches to goals and return these options best-related to the goal classification. I will be conducting my research for the Kilachand Keystone through Honors in the Computer Science major.

A combination of creative and quantitative methods is used in the development of the projected. The first step was to read about and understand how natural language processing works. I read various scholarly articles as well as online documentation from NLTK developers to learn about the evolution of NLP in computer science as well as understand how to use the tools provided by NLTK. After learning how to use these tools within the scope of the project, I collaborated with my advisor to develop an NLP-oriented functionality within the app. This portion of the project was heavily creative. In order to draft several implementations of NLTK for the application, I not only had to think of how the user interacts with the app, but how to develop high-quality code. Since I decided to develop a model that identifies “goal categories” for each user-defined input, I had to construct four training datasets to teach the algorithm how to classify goals. In order to make sure that these training sets were sufficient, sentences in the dataset need to cover all potential versions of a specific “goal sentence”. Given that I was only provided with around five example sentences for each category, it was necessary to use creative thinking in writing the remaining sentences for the datasets. Things I considered when creating example sentences were synonyms for topic-related words, sentences that could appear to fall into both categories, tasks/goals not stated in the provided examples. It was important that I placed myself in the user’s shoes and considered all actions related to a specific category and what they might be aiming to accomplish.

Another creative method used was deciding which parts-of-speech the classifier needed to consider during categorization of sentences. In order to determine what needed to be included in the model, I began by writing down different key words/general goals related to each category. I also made sure to include several examples of “tricky” sentences that might appear to fall under multiple categories to a computer. After examining these sentences, I would code the algorithm to include these parts-of-speech in classification and run the algorithm to determine its accuracy. This stage in classification development is largely trial-and-error based on quantitative results such as accuracy and confidence and continues to be a work in progress as I modify the classifier to handle all four categories.

After the training datasets were constructed and POS determined, quantitative methods were used to determine the accuracy of my classifier. Following training the classifier, the algorithm runs on a test dataset. I used probabilistic classifiers to determine the accuracy of my algorithms as well as statistical information like most deterministic words and word frequencies to understand how my algorithm works and where it can be improved.

Currently, I am approximately halfway through the project. I have successfully completed initial research on NLP, identified a classification model for the Game Plan application, and implemented a working classification model for two of four categories. Next steps include completing a classification model that can identify all four “goal categories”, adding a feature that will suggest solutions based on goal classification, and create a collection of potential solutions that the algorithm will query upon request. In addition to the technical work I need to complete for this project, I also need to prepare final documents for the Symposium and Computer Science department. I intend on writing a brief document that explains my process and findings for the Computer Science department and presenting a demo of my work at the Kilachand symposium. I hope to be able to fully integrate this goal-identification functionality into the app developed by the Hariri Institute in time for the symposium, but I would otherwise demonstrate the algorithm on my personal computer.

Throughout this experience, I have experienced multiple challenges along the way. I am currently struggling to modify my algorithm to be able to decide among four categories as opposed to only two. I am unsure as to where exactly the problem comes from, so I have been researching as well as reached out to a BU professor whose work focuses on NLP. Given that I have never worked with any NLP tools before, there was also a small learning curve that made starting the project a bit difficult. An additional challenge I faced was the lack of testing data provided. I had to design training datasets for all four categories. Training data needs to be large and exhaustive, and it can be easy to miss an important sentence to include. I believe that this may be contributing to the difficulty in modifying the classification algorithm.

Overall, I have not had any communication issues with my advisor. We meet once a week and communicate via email if a meeting needs to get pushed back or rescheduled. I am on track with the project and look forward to seeing my finished product. The Keystone experience has been useful in allowing me to explore my interests in a way that classroom learning does not allow as well as teaching me valuable skills in a field I aspire to pursue professionally one day.