Overview of NLP

Natural Language Processing is the translation of human communication into a form that a computer can interact with. Artificial intelligence and natural language processing are not just companion fields, but necessary for each other to move forward- language is simply too complex to be adequately processed through a rule-based system alone, and the commercial use cases of AI would be severely restricted without NLP. Natural language understanding and natural language generation both require the computer to have an internal representation or conception of language conventions, but the goal of natural language understanding is largely to parse what is being fed in into some form of instruction that a computer can understand whereas natural language generation is largely to convey information in a presentable way to a user. Outside of the obvious examples of chatGPT, Siri, Alexa, and the Google Assistant, NLP is used in smaller or more specialized applications such as Bank of America's Erika assistant as well as smaller online shopping websites and tutoring websites.

Rule-based NLP systems are the oldest forms of NLP, dating back to the 1960's. Rule-based systems use tools such as context-free grammars and regular expressions to perform simple processes such as basic machine translation, feedback echoing, and processing basic commands. They are limited in both the complexity of the language they are able to interpret and the knowledge they can speak to, being completely unable to respond anything not built into their ontology. Some examples are STUDENT, an algebra word problem solving agent built in 1964, ELIZA, the therapist simulator mentioned in class, and SHRDLU, a system that allowed user to manipulate simple objects in a physics based environment using language input.

Statistical and model-based approaches started taking over in the late 1980's. Using probabilistic methods such as Bayes Nets/Naïve Bayes and statistical methods such as logistic regression, support vector machines, and decision tree based methods, one can leverage collected data to allow the computer to detect patterns, allowing for far greater complexity to be processed and predictive capabilities. Some examples are email filters, combing of search results to improve search results, and predictive text.

Deep learning is the latest rage in machine learning, and is especially exciting for problems in the NLP domain due to the vast amount of training data in the modern age. While neural networks may perform worse on smaller subsets of data, with large amounts and plentiful computing power offer state of the art performance. Earlier, basic RNNs were used but issues arose with longer statements/documents, so more complicated methods such as the Long-Short Term Memory were developed. Currently, the use of transformers and attention mechanisms are in the spotlight with the recent release of ChatGPT-3.

Personally, aside from general interest in the technology because I find it fascinating, my long-term dream as a cognitive science major is to be able to blend what I've studied about both programming/machine learning and neuroscience in order to work on technology to help those critically injured lead a more normal life, and I'm hoping that what I learn here even if not

directly relevant to whatever I may end up working on will help me learn more generally about computer learning methods.