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CS 4395 Overview of NLP

1. Natural Language Processing (NLP) is a branch of AI, which is under the broader category of computer science as a whole. NLP is concerned with processing human languages with computers through algorithms. This makes automation of tasks, such as online language translations and spell checks, much easier. Altogether, NLP gives computers the ability to understand human languages in the same way human-to-human dialog works.
2. AI and NLP are related in the sense that NLP focuses primarily on human linguistics in the form of AI. As mentioned in question 1, this allows computers to understand and work with human language in the same way humans can. Similar to the relationship between machine learning and AI, NLP is a subfield of AI.
3. Natural language understanding is the equivalent of a human understanding what someone is saying when that person speaks. Natural language generation is the equivalent of a human saying something. This concept explains how NLP and ML each respectively aid in the overall process of AI.
4. A few modern examples of NLP applications include smart assistants, email filters, chatbots, grammar correction software, and online monitoring tools.
5. The three main approaches to NLP include: rules-based approaches, statistical and probabilistic approaches, and deep learning approaches. Rules-based approaches use context-free grammars or regular expressions to convert, generate, and check the grammar of certain words and sentences in a language. An example of a rules-based approach would be categorizing various words with the same meaning to group sentences together. Another example of a rules-based approach would be the computer program, ELIZA, created in the 1960s, which had feedback to user input in a stored, regular expressions method. Although rules-based approaches are relatively simple, they are difficult to scale with the complexion of human languages. It is difficult to compress so many different rules to fulfill the various needs of the human language.

As various ideas began to develop, rules-based approaches were knocked-off by the generation of mathematical approaches: statistical and probabilistic approaches. These approaches use a predictive method to work with languages in a manner that

probabilistically makes more sense compared to its counterpart. Using statistical models, this method checks the probability of sequences and words in a language in order to incorporate these models into various systems. Statistical and probabilistic approaches also include classic machine learning algorithms, which contain Naïve Bayes, Neural Networks, etc. An example of a statistical and probabilistic approach would be speech recognition in a manner that realizes one term may imply something rather than its sole meaning. For example, if the phrase “small brother” was to be translated, the language model would recognize that “younger brother” is being implied instead of “little brother” in size.

As data evolved and became more available, deep learning methods came into play from neural networks. This allowed for more space and processing power, which enables stronger applications to be analyzed. Examples of the deep learning approach in NLP would be the “smart compose” feature for Gmail and “Hey Alexa” for Amazon. These “smart assistants” use higher modeling for predictive suggestions for the users. Although deep learning expands the scope of NLP applications, traditional approaches, such as the rules-based approach and the statistical and probabilistic approach, are still tied together with deep learning because of limitability of data space. All three of these approaches are incorporated for several projects to ultimately collaborate.

6. My personal interest in NLP comes from the automation aspect of the field. As tasks become automated and we essentially run ourselves out of jobs, I would like to learn more about the barriers in NLP and see if there are workarounds for them. At my previous internship, I worked with security automation, and I thought this class would be great for my overall understanding of automating processes and simplifying algorithms. I would like to use the knowledge from this class to fortify my current understanding, and I would like to learn something new in terms of the linguistics side of this class as well.