Overview of NLP

Natural language processing (NLP) refers to the interpretation of human languages by computers which involves both parsing text or audio and understanding meaning based on context. NLP is difficult because human language is complex and varied in meaning and expression—quite different to the formal and exact language of computer programs. While historical approaches have involved large rulesets and statistical analysis to process language, artificial intelligence (AI), specifically deep learning, has been used in recent years to deal with this complexity by creating neural networks capable of high levels of pattern recognition similar to that of a human mind, allowing for much more nuance to be understood by computers.

NLP has many applications in an increasingly digital society. A few examples are translation services which must process meaning in one human language in order to convert it to another language, assistant services which perform actions based on human speech, and search engines which rely on providing relevant results to a given query. Two subsets of NLP are natural language understanding (NLU), which is deriving a specific meaning from the syntax and semantics of a human language, and natural language generation (NLG), which is converting specific data into a human language. An example of NLU is speech recognition, while an example of NLG is a voice assistant.

The three historical approaches to NLP are rules-based, statistical or probabilistic, and deep learning. Each approach has its downsides and benefits and has been applied to different areas, and modern NLP makes use of all three approaches to varying degrees.

The rules-based approach involves parsing input based on predefined rules. It has in the past been famously used for the Eliza chatbot, which used regex to detect certain phrases in an input and give an output based on predefined rules. As one might expect, it couldn't compare to the chatbots of today, but nonetheless was famous at the time and, to the creator's surprise, regarded as human-like by many. Another example of a rules-based approach can be seen in simple commands given to smart assistants, such as directing one to turn off another smart device, which involves recognition of phrases like "turn off" and the name of a connected device. A limitation of the rules-based approach is that it does not scale up well, as more and more rules become necessary to properly parse more complex input.

The statistical or probabilistic approach is also referred to as classic machine learning (not deep learning) as it involves computers learning from statistics and can even include basic neural networks. Probabilistic approaches are useful in many areas. For example, autocompletion of text can occur by guessing the likelihood of a user typing a phrase based on historical data. A rules-based approach would not be satisfactory for this scenario due to the amount of data which would need to be handled and the difference in likelihood of each possible completed phrase.

Deep learning, however, makes use of much more complex neural networks and an era of much more data being available for training. There are many modern examples of deep learning being used for NLP, such as sentiment analysis which aids in giving accurate responses to human emotions and the enabling of smart assistants to perform much more complex tasks.

Personally, I chose to take this course because I find AI to be fascinating and the application of AI to human language even more so. Spurred from my recent interest in AI, I have in recent months seen the wonders deep learning can do with language processing. For example, recently I've seen an AI which can receive an instruction, like "go to the living room and pick up the blueberries on the floor", and actually perform that action in a virtual world without being directly guided on how to do so. I have also witnessed services like Google Translate becoming much better at understanding language; in my experience, Google's translation from English to Spanish in particular is excellent and much better than before. The idea of being able to give a computer a complex instruction, for example with smart assistants, is also something that makes me enthusiastic for the future of NLP. I don't know what projects I would create relating to natural language processing or whether or not I will specialize in it for my career, but nevertheless it fascinates me.