

- a. Natural language processing is essentially making algorithms that allow computers to both generate and understand human language.
- b. Technically natural language processing is a branch of artificial intelligence, just as machine learning is another branch of artificial intelligence.
- c. Natural language understanding and generation are both key parts of NLP and human conversation in general. The difference between the two is that in understanding, each involved party has understood what other parties have said, whereas the generation refers to the actual formation of the responses.
- d. Modern NLP examples include machine translators (google translate), automated assistants, chatbots, and product recommendation systems.
- e. The approaches
  - i. The first main approach to NLP is a rules based approach. This approach involves mapping the natural language input into a clear set of rules that will determine the output. This could be interpreted as rules in the form of context free grammar, or regex. Though this approach can be useful for checking the grammar of sentences or generating syntactically correct sentences, it's very difficult to scale up, as human language is continually changing and is too complex to be covered by a rule set. One example of a rules based NLP approach is Eliza, an early "chatbot" created using regex to mimic a therapist.
  - ii. The second main approach to NLP is a statistical approach. This involves using mathematics to better make predictions and understandings. For example, finding the probabilities and sequences of words has led to better language models, which have a variety of uses such as query prediction. Most classic machine learning models fall into this approach, as they learn through an understanding of probabilities and statistics. Some examples of these models include decision trees, logistic regression and smaller neural networks.
  - iii. The final approach to NLP is deep learning. Deep learning originates from neural networks and the growth of data/available processing power. Because of these newer developments, this approach can be hard to achieve on a large scale, but small scale deep learning is still usable for many NLP problems. Some example algorithms of this approach include recurrent neural networks and convolutional neural networks. This approach is still in its development, with the ultimate goal being to have a human sounding interaction with a computer.
- f. I am interested in NLP because as someone who has a great understanding and interest in compilers (which processes structured languages), I wanted to see how a natural language is processed and understood. I would love to learn more about the techniques behind NLP to one day work on a compiler that is not purely rules based, but better integrates concepts from NLP to have an improved, learning compiler.