

THE STEP TOWARDS ARTIFICIAL NATURAL LANGUAGE

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In the search for a true artificial natural language a number of recent studies have proposed to shift the paradigm to a multi-agent interaction. Hereby shifting away from the usual naming games that produce a mere product of natural language. In this paper, using prior research to pinpoint what is the most efficient way to establish an artificial natural language. That is compositionally as human language and therefore interpretable by humans.

1. Introduction

The communication medium for human has been language for a long time. In this way human are able to communicate all kinds of thing with each other. During research into this field machines—computer running neural networks or another form of artificial intelligence—are used to help figure out how this came to be, how we got to this level of communication. Moreover, to get a better understanding on how we might apply this way of communicating on to machines. These machines are most often trained using big datasets consisting of human-human dialog (Lowe, 2015). Inserting this machine into a dialog from the human-human dataset, supervised to mimic how a human would respond. Doesn't teach the agent the fundamental meaning of language, grounding (mapping words to physical concepts), compositionality (combining simple concepts to describe more complex concepts) or planning (understanding the goal of the conversation) (Kottur, 2017). In order to come closer to artificial natural language machine need to be trained more like humans to operate as one. Humans interact with one and other to learn and get better at language. Agent who are not acting humanly will never proceed further in the world of artificial intelligence. In order to make machine communicate like humans we first need to figure out how we do this as humans.

2. *Natural language*

Starting at the first moment a baby comes in contact with other humans he/she starts learning the language. First by recognizing just tones, low/high pitch, fast or slow. In this way baby are able to distinguish their mother from other humans. Progressing through the years humans learn more about language, how to

use it, what is wrong and what is right. All by the means of interaction. This interactions between humans created our language and will help to keep developing and progressing. So to give machine the same capability—the same complex language. They have to learn like us, interact like us in order to come further in life, their artificial life.

3. First steps

To get a better understanding of the evolution of language, how language developed. Researchers began to use computational models in order to recreate the process we as human made, to come to our natural language. These computer models are based on evolutionary algorithms, a part of artificial intelligence that focuses on the contact between multiple agent. These agent can be seen as a community that interact with each other. Within this part of artificial intelligence there are two dominant paradigms. The first paradigm has been introduced by Steels (Steels, 1997), the language-game approach. The second paradigm has been introduced by Hurford and Kirby, called the iterated learning model (Kirby, 1999).

1. Language-game model

The language-game model works with a large population of agents that have no age and there is no difference in social class, all the agents are the same. Within this paradigm the agents typically start with no prior linguistic knowledge. This way of using a population of agents is mostly used within cultural transmission or in other words horizontal transmission.

2. Iterated learning model

The iterated learning model is usually build with a population consisting of adults and infants. Where the adult agents produce the linguistic utterances and can't learn, the infants can't produce the utterances but do learn. At a predetermined interval the adult agents die—agent is removed from the population—, the infants grow up to adults and new empty infants are born. In comparison to the language-game the iterated learning model typically consists of a small population, sometimes as small as one infant and one adult. Iterated learning is used to investigate how language changes from generation to generation. In other words vertical transmission.

Most of the models created in one of these ways are developing a language from scratch. The interaction between the agents slowly creates the vocabulary that resembles the language of the agents. This gives a good insight in how our language may have been developed throughout the years. But these methods are based on random interactions between the agents.

3.1 Different approaches

In order to investigate a more human like interaction between agents (Lazaridou, 2017) proposed a way to use a multi-agent coordination communication game in order to research the emergence of language. In their research they present a sender and a receiver both created from a simple feed-forward neural network. In the setup two senders are used.

1. Agnostic sender

The agnostic sender created use a generic neural network that maps the input vectors on a game specific embedding space. Followed by a nonlinear sigmoid function. All layers are fully connected with in the neural network.

2. Informed sender

The informed sender also embeds the input vectors in to a game specific embedding space. Then a filter is applied to give the informed sender a bias for combining two input vectors. Followed by a nonlinear sigmoid function. All layers are fully connected with in the neural network.

The key finding in the multi-agent coordination communication game was that the artificial natural language created by the neural networks was not interpretable by humans. Even after grounding the communication with supervised learning to come close to human language.

4 Understandable

With the emergence of artificial natural language machine should be able to communicate with humans as of the machines have been in the community from the start. But as of right now machine that come up with their own language is most of the time not interpretable for humans, thus there is no compositionality.

According to (Kirby, 2002) compositionality is one of the most fundamental properties of the human language. In terms of linguistic semantics it is used to refer to in which way the meaning of an utterance is typically composed through some function of the meaning of parts of the utterance. And in which way those parts are put together. Even though compositional language is one of the most optimal forms, agents tend to learn other equally useful forms of communication (Kottur, 2017). Thus without the need for compositional language it will not naturally appear without the explicit need for it. A way of solving the issue and diverge more toward a human like language system is to use variable-length strings of symbols rather than atomic categories (Havrylov, 2017).

5. Conclusion

In conclusion, the advancements made in artificial intelligence and especially in neural networks made way for new findings within the emergence of natural language. Thus a step closer to artificial natural language. Most work in this field is done based on human-agent interaction to keep the compositionality close to that of the human natural language. In order to advance in this an agent-agent interaction would be more efficient. And with a minimal amount of human supervision the model could become more human like. Hopefully resulting in a true form of artificial natural language.

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