

Climbing towards NLU: On Meaning, Form, and Understanding in the Age of Data

Introduction → The paper discusses how the current “well-performing” Language models might proclaim to have understood/capture the “latent meaning” in a sentence, but since it is trained on forms of a given text, cannot really compete by the complexity of human acquired language. The discussion will involve the different ways in which they claim to learn “meaning” and compare it with human language acquisition methodology.

General Terms → (i) Form - any observable realization of language: marks on a page, pixels or bytes in a digital representation of text, or movements of the articulators. Most of the current LM's use BOW(Bag of Words) as a form. (ii) Meaning(M) - a collection of natural language expressions trying to express your intention behind communicating that information (communicative intent). The communicative intent can be anything abstract and about anyone in reference to the speaker's mind. (iii) Conventional Meaning(C) - type of meaning of an expression (word, phrase, sentence) is what is constant across all of its possible contexts of use. So the claim involves the inability of the advanced LM models to capture M which itself cannot be the ground truth.

Hyped Up Language Models → On deep analysis of LM's' groundbreaking performance on meaning sensitive tasks, it was figured out that the better model was one which was more effective at leveraging artifacts in the data. For example as Williams discussed in his paper, BERT's performance on the English Multi-genre Natural Language Inference dataset could all be attributed to its ability to leverage syntactic heuristics, which, in disturbances with data, can cause a significant drop in BERT's performance.

Meaning and Intelligence → The ability to understand a meaning in a particular language tends to infer about someone's intelligence. On the basis of Harnad (through symbol grounding problem) and Searle's study regarding a system's ability to “understand and perform” proves that it's possible to not understand a particular task but perform well in it and current NLP systems claim to be building systems where not only the runtime system but in fact also the process for building it only has access to form. It will be similar to the inability of a foreign lingual person to understand all meanings given a vocabulary source.

Octopus Test → It refers to a fictional/experimental story that the paper frames. Here A and B are isolated speakers of a native language and on the basis of an endless amount of data, an octopus (alien to the native language) tries to draw patterns of lexical items and their structure. Now when it comes to performing like native speakers, the octopus was so dependent upon the previous chats that A and B had that any new context/situation was not understood by the octopus.

Whatever O learned is a reflection of A and B's communicative intents and the meaning relation. But reproducing this distribution is not sufficient for meaningful communication. Thus creating an argument for the current Language Models.

Constrained thought experiments → These experiments were conducted on two particular domains :- Natural Language (ENGLISH) & Programming Language (JAVA). From the octopus' test we figured out that the LM's lacked ability to not only understand relations of **M** and **C**, but also the reasoning required to come up with answers that are coherent. So we narrowed down

our source to less ambiguous and central oriented like in a programming language. Here the LM is asked to predict the output of the programming language and for the natural language, given a text & set of images, we asked the LM to answer queries based upon pictures. This ridiculous experiment was conducted to prove the point that if the LM's had the understanding of Linguistic "meaning", it would have excelled in those tasks.

Human Language Acquisition → The idea behind Baldwin's research claiming that Humans (at younger age) learn language not by just listening to a different language source but rather by joint attention by the speaker, thus claiming that humans don't learn language on the basis of forms.

** The idea of Pretrained LM for downstream tasks might seem correct given the increased boost in the performance over downstream tasks, but as McCoy found in his paper regarding BERT that it picked up idiosyncratic patterns in the data for their tasks, and not "meaning" raises a doubt over the correctness of the current approach.

Top-down and bottom-up theory-building → The approaches of top down (looking at a more general target) and bottom up (looking progressively from narrow targets to the bigger goals) are applicable in NLP's main target of "General Linguistic Intelligence". But the top down approach gives the view about how we are not working in the correct direction (given the past approaches followed in NLP).

Hill Climbing Diagnostics → There is a five step process one should follow in order to get for a less error-prone approach. (i) Constantly look from top down point of view. (ii) Abide by the limitations of the tasks (assumptions should be carefully derived). (iii) Try exploration for creating new tasks. (iv) Evaluate meaning capturing ability (after all it is the jackpot). (v) In detail result analysis is a must.

COUNTER ARGUMENTS → (i) Definition of Meaning → something which is difficult to understand and explain but negation point that something which cannot be derived from the form of the data and some syntactic structure makes more sense. (ii) An argument stating that some augmentation to forms can help learn like by inputting with some signals during training. But this signal production involves Human interaction and they have access to the grounding in addition to the form. (iii) An argument stating that there are a lot of forms. But language is like Maths, new intents are created everyday, with different types of complexity for forms to accommodate. (iv) An argument stating that aren't neural representations meaning Too? Neural representations neither qualify as standing meanings, lack interpretations, nor as communicative intents as we saw earlier in the octopus example. (v) An argument stating that "But BERT improves performance on meaning related tasks, so it must have learned something about meaning". It does learn something but that too is based upon the syntactic arguments of forms: a potentially useful, but incomplete, reflection of the actual meaning.

Conclusion → So we clearly stated that learning meaning and understanding language is still a distant task for many LM's currently. We also explored the possible methodology one should follow to "CLIMB THE RIGHT HILL".

