Review of: "Limitations of and Lessons from the Learning of Large Language Models"

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Potential competing interests: No potential competing interests to declare.

PRELIMINARY STATEMENTS

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I must say that my confidence level is low, which makes some technical parts of the paper difficult to understand. See below for comments to make your paper readable to a wider audience (including me, for a deeper understanding)...

The summary below is based on my understanding of the paper. If it contains deep errors, this reflects my difficulty of understanding it...

SUMMARY

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LLMs are based on a sequence of tokens bound to a maximal size that is rather large (1000s) but finite. The author infers from that fact that the "inference capabilities" of learning based on LLMs are local, in some way. Now, it is argued from other studies that "local inferences" corresponds to restricting the logic involved: intuitionistic logic requires "local" inferences, while classical logic (including, e.g., the excluded middle) cannot be inferred by means of local inferences. From this, it is concluded that LLMs cannot handle classical logic, hence a limitation of these models, as they are currently defined and implemented.

GENERAL REMARKS, QUESTIONS, AND SUGGESTIONS

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One interest of this paper is that it can contribute to a debate on the coverage of LLMs from a theoretical viewpoint.

From my opinion, the paper needs some improvements to be more convincing (to me, at least): the argument is presented very quickly and should be improved.

A counter-argument is that the finite size of each element of the dataset is something one cannot expect not to have, given the fact that computers have finite-size memory.

(By the way, it is known from the no free lunch theorem of machine learning that every learning model fails to be the best one for every training dataset and every test dataset.)

Because of this and because of the more particular remarks below (that are also important ones), I suggest that this paper should be reworked in depth to make it more understandable and more convincing.

OTHER REMARKS (but not only details)

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(Page numbering according to the downloaded pdf file.)

Page 1

The third paragraph of the introduction ("The results of this paper...") suggests that your work /might/ give insights on some properties that a training database should have in order to well train an LLM so as to achieve "some logical behavior".

Page 2

In the section "Large Language Models", 2-3 lines before the end: "this is the only piece of information needed in the current argumentation." The phrasing is a little bit odd to me, in particular, because of the use of the word "thing".

About the two rules of lambda-calculus. The right arrow symbol is already used above with a different meaning, and it is confusing.

Last paragraph before table 1:

- There is something missing in the sentence "It was found that proofs in intuitionistic logic and expressions (i.e., programs) in typed lambda calculus."
- "map to long programs": remove "lo"

Page 3

The formal part about the lambda-mu calculus is very hard for me, and I think that the paper can be improved there, either by giving more details and more rigor in definitions or by just giving the consequences of it that are needed, with the appropriate references (I am not familiar with the lambda-mu calculus, and I had to search the web to reach a shallow understanding of what you have written).

In particular, the two rules you present are hard to understand:

- As on page 2, some of the arrows should use another symbol: both rules use "-->" twice, and I imagine that they don't have the same meaning? Trying to match your rules with the ones I find on the web, some "-->" have to be understood as substitutions (that are defined with the symbol ":=" for lambda calculus, on the previous page...).

- [alpha]a is introduced, but you also use the notation alpha[something], that was not.

Page 4

The argument should be developed: this is supposed to be the core of your paper.

Page 5

Reference Parigot, 92: "Lambda-my" should be substituted with "Lambda-mu".