Title: Comparing ESBN and transformer on extrapolation tasks

One of the shortcomings of current deep learning architecture is that it fails to solve complex problems particularly problems requiring extrapolation. Cognitive architecture has been a solution to such problems in the past, but it requires extensive training. There has been recent work with transformers that suggests that such architectures are capable of forms of extrapolation. (Cite ESPN paper) However, there are other studies that conflict with this and instead suggest that the transformer lacks extrapolatory capabilities. (Cite other paper)

Emergent Symbol Binding Network (ESBN) is a newly proposed deep learning architecture intended to solve extrapolation tasks. The ESBN network attempted to demonstrate extrapolation by solving four different tasks that require the application of an abstract rule. In all four cases the testing involved symbols not seen during the training. The study tested these tasks in comparison to several different architectures including transformers along with some more traditional architectures. They also compared the performance of each architecture with how much of the training set was withheld. While the ESBN network had 100% test accuracy with as few as 2 training examples the other architectures, with the exception of recurrent neural nets, also performed extremely well given at least 50% of the training set. This indicates that either the extrapolatory potential of transformers and traditional deep learning techniques has been underestimated or the tests used on the ESPN network were not rigorous enough.

In the paper “Attention in Not Enough” four different architectures several of which involved transformers, but not including ESPN, were tested against a working memory cognitive architecture. This also attempted to test extrapolation capabilities by abstracting a word’s role in simple sentences. There were four different versions of this test increasing in difficulty of extrapolation. The working memory model performed at the 100% accuracy expected of it but none of the other models did well on the harder tasks. This suggests that the potential for transformers to do well on extrapolation doesn’t carry to complex tasks.

We wish to explore the extrapolation potential of ESPN networks compared to transformers and cognitive architecture. We will use similar testing to that done in “Attention is Not Enough” in hopes of separating the capabilities of the different models.