

Recursive Reasoning with Tiny Networks

Group Project Deep Learning

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Group 7

Background and motivation

In Natural Language Processing, the dominant paradigm is the transformer. In recent years the evolution of this paradigm has involved larger and larger models, with exponential growth in parameters and required computation. Even then, these Large Language Models (LLMs) struggle with complicated tasks requiring thorough reasoning. As reasoning is handled in test-time computing, their auto-regressive token-based nature as well as context length- and self attention limitations makes reasoning fall apart as complexity is introduced. Errors compound and eventually turn into nonsense or false answers, further degrading performance. In other words, the jack-of-all-trades nature of LLMs severely hinders its potential for growth.

Tiny Recursive Models (TRMs)

Joliceur-Martineau [1] defines the Tiny Recursive Model (TRM). Based on a similar model (HRM) inspired by the hierarchy of the brain (Wang et al. [2]), the TRM attempts to solve the above mentioned issues by handling reasoning latently, rather than in lossy token representation. The TRM handles reasoning entirely in its latent space, by recursively updating its latent variable through multiple supervision steps. This allows complex representation of the problem and reasoning state. Additionally, the paper shows that all of this can be handled with tiny models - at least relative to the ordinary size of an LLM. This represents a potential new paradigm for reasoning in language modeling.

Milestones

We aim to accomplish the following:

Reproducing the main results of the original paper

Testing the TRM on different puzzles, comparing it to other models We would like to try out the Towers of Hanoi, as well as a board game, like chess. For the latter, we could evaluate moves made by the TRM using a chess engine.

Experimenting with language generation As mentioned in the paper, it would be interesting to see how the TRM performs at producing natural language output.

References

- [1] Alexia Jolicoeur-Martineau. Less is more: Recursive reasoning with tiny networks, 2025. <https://arxiv.org/abs/2510.04871>.
- [2] Guan Wang, Jin Li, Yuhao Sun, Xing Chen, Changling Liu, Yue Wu, Meng Lu, Sen Song, and Yasin Abbasi Yadkori. Hierarchical reasoning model, 2025.

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