

Artificial Reasoning : A Problem Statement

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February 7, 2025

1 Introduction

I've been exploring the unsolved problem of Artificial Reasoning or Hierarchical Planning for 2 years now. During the AI Action Summit 2025 [1], Yann Le Cun introduced this problem and described it as a "great subject for a PhD".

The main question is : how can we incorporate into a learning procedure the ability for an AI to identify, disentangle, and manipulate objects at various levels of emergence without being explicitly instructed to (no hard-coded features). For example, we would like an AI to be able to identify and disentangle a human from their arms, hands and fingers to enable relational manipulation of these objects, whether for planning or causal or logical reasoning. However, the learning procedure should remain agnostic to specific objects and work just as well for a house, its walls, and its windows.

2 Emergence, Complexity, Constraints

Emergence is closely related to the notion of complexity. Within the framework of a Kolmogorovian complexity theory [8], one can describe a sequence of symbols one by one – at the lower end of the emergence scale but with high complexity — or identify patterns — higher on the emergence scale but with lower complexity. It is the definition of symbols that constrains the structure of the sequence and allows these patterns to stand out (through repetition of subsequences, the establishment of an order among the symbols, etc.).

Let us consider another, more physical example: the description of water flow can be achieved through a few simple equations – as opposed to the complexity of tracking the motion of each individual water molecule —because we can recognize its properties of liquidity and viscosity, which emerge due to the fact that molecules are constrained to stay together by gravity and the container.

In summary, the reduction of complexity in observed objects at the macroscopic scale is only made possible by the emergence of properties under the influence of specific constraints.

3 Approaches

3.1 Approaches missing the point

Typically, challenges such as the ARC Challenge [3] are meant to foster interest for Artificial Reasoning. The 2024 version of the challenge [4] triggered the development of new approaches. However, the framework of AI competition suffering from Goodhart's Law, these approaches were intended to solve the ARC Challenge, no to make a step forward toward Artificial Reasoning. Rather than addressing the fundamental question posed by the challenge, literature tend to focus on blindly solving it.

- Approaches relying on the exploration of possible combinations of hand-crafted features [9]
- (Neurally-guided) program synthesis [10][7]
- Test-time training [2]

3.2 Interesting approaches to explore

- Library learning [6]
- Integrating reasoning and planning within an energy minimization procedure [5]

References

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