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Authors

Jagadish, Akshay Kumar
Rmus, Milena
Mathony, Marvin
et al.

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Modeling individual differences in learning and memory using large language models

Akshay K. Jagadish
Princeton AI Lab, Princeton University, Princeton, NJ 08545, USA

Milena Rmus
Human-Centered AI, Helmholtz Munich, Munich, Bavaria, Germany

Marvin Mathony
Human-Centered AI, Helmholtz Munich, Munich, Bavaria, Germany

Eric Schulz
Human-Centered AI, Helmholtz Munich, Munich, Bavaria, Germany

Abstract

Computational cognitive models allow formalizing theories of cognition and arbitration between competing accounts. Traditional cognitive modeling (1) entails carefully handcrafting cognitive models, which require substantial domain knowledge and programming expertise; (2) favors single shared model class for all participants, limiting its ability to capture the full range of individual differences. Recent advances in large language models (LLMs) offer a new route for addressing these challenges. In this work, we develop a pipeline for scalable generation of computational cognitive models that prompts an LLM to propose a bespoke cognitive model for each participant given task instructions, their full behavioral trajectory, and a code template, and iteratively refines its proposal based on its predictive performance. In the domains of planning and working memory, we find the resulting models contain participant-specific mechanisms that accurately capture individual differences in learning and memorization, leading to substantial improvement in predictive performance while passing all posterior-predictive checks.

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