

Geometric models reveal the hidden structure of conceptual knowledge

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Abstract

We develop a mathematical framework, based on natural language processing models, for tracking and characterizing the acquisition of conceptual knowledge. Our approach embeds each concept in a high dimensional representation space, where nearby coordinates reflect similar or related concepts. We tested our approach using behavioral data collected from a group of college students. In the experiment, we asked the participants to answer sets of quiz questions interleaved between watching two course videos from the Khan Academy platform. We applied our framework to the videos' transcripts, and to text of the quiz questions, to quantify the content of each moment of video and each quiz question. We used these embeddings, along with participants' quiz responses, to track how the learners' knowledge changed after watching each video. Our findings show how a limited set of quiz questions may be used to construct rich and meaningful representations of what each learner knows, and how their knowledge changes over time as they learn.

Keywords: education, learning, knowledge, concepts, natural language processing

Main text

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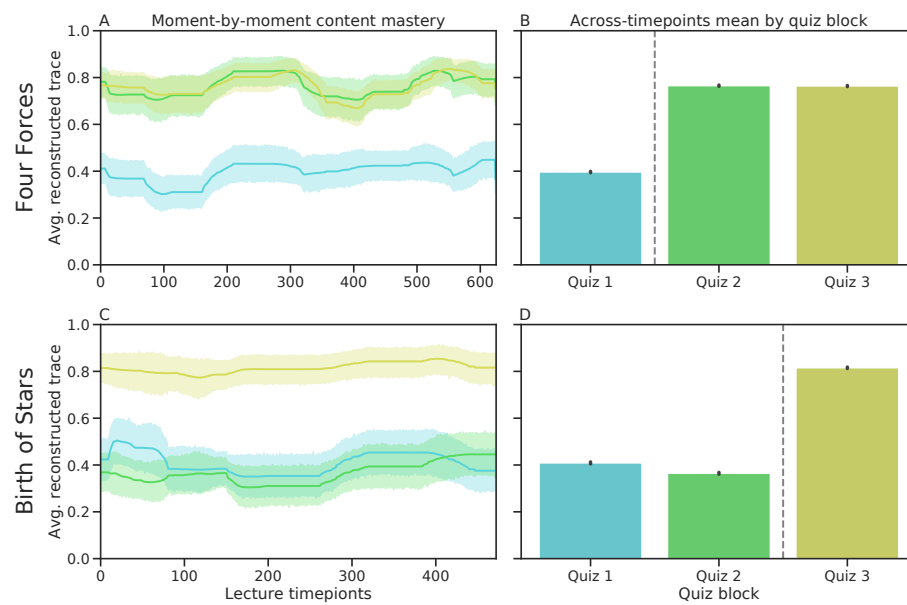


Figure 1: Caption. Placeholder text.

20 References