STUDYING CONCEPTIONS OF THE DERIVATIVE AT SCALE: A MACHINE LEARNING APPROACH

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In this poster presentation, we present a novel approach to study student conceptions of the derivative at scale using methods from machine learning (ML)—automated conversation disentanglement and natural language processing (NLP). Prior work on student conceptions have generally relied on studying small groups of students, and these ML methods provide a way to analyze mathematical conversations at scale, allow for patterns in conversations to emerge, and can help identify relationships between emerging conceptions.

In a seminal report, Zandieh (2000) developed a theoretical framework for analyzing students' understanding of the derivative concept. She used cognitive interviews with nine high school students to describe their understandings of the derivative and found the following conceptions of the derivative: taking derivatives symbolically, derivative as slope, derivative as velocity, derivative as rate or rate of change, derivative as a graph, and derivative as a formal definition or limit of difference quotient. Balacheff and Gaudin's (2002) conception model is used to create an operational (searchable) representation of each of the conceptions listed above. By using conversation data from an open-access, online mathematics tutoring platform we code for operators (what people appear to do in their work) and controls (what people take to be true when they do their work) in order to build a training set aimed at training a set of machine learning models to classify the rest of the conversations (~700,000 messages) by conception type, as well as find connections between different conceptions of the derivative. In our presentation, we (1) show how automated disentanglement models can be trained then deployed to disentangle chat logs into separate conversations and (2) provide details of this preliminary coding work to provide evidence how ML methods can be amenable for studying student conceptions.

References

Balacheff, N., & Gaudin, N. (2002). Students conceptions: an introduction to a formal characterization. *Le Cahiers du Laboratoire Leibniz, 65.*

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