

Applications of Associative Algebras in Machine Learning

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Automatic differentiation is an established field with many applications in machine learning and computer science, including Gradient-Based Optimization, Neural Networks, Deep Learning, Computer Vision (inverse graphics), Natural Language Processing and Probabilistic Modeling and Inference. In this presentation, we review automatic differentiation and recall the real-like algebras (Liu 2020), which are defined as associative algebras over real number field R . The effectiveness of first-order automatic differentiation in scientific computation comes from its property concerning computing the value of a function from the dual numbers to the dual numbers just once. In the case of higher-order automatic differentiation, we have observed that the mathematical foundation of higher-order automatic differentiation has not been developed extensively. In this respect, we attempt to employ combinatorial techniques along with Leibniz rule in order to generalize some concept from first-order automatic differentiation to the higher-order. Moreover, we recall some versions of associative algebras such as Hom-associative algebras and differential graded associative algebras in order to study higher-order automatic differentiation from an algebraic point of view.