A Primer on the Signature Method in Machine Learning

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The signature of a path has been recognised in the last few years as a powerful method to store information about a path. At its basic level, the signature is the collection of iterated integrals of a path. This simple definition leads to surprisingly deep properties, which all indicate that the signature is a natural analogue of polynomials on paths. In this minicourse, I will present the definition of the signature and how it arises in several contexts, including control theory and stochastic differential equations. I will demonstrate some of its important properties: these include the shuffle identity, which is responsible for the polynomial-like behaviour on paths, and the Chen identity, which is important for computations. In the last part of the course, I will discuss some recent applications to machine learning, focusing on kernel learning and classification tasks.