Algebra and structure-preserving integrators

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Since the pioneering work of Butcher, it is known that a large class of numerical integration schemes for ordinary differential equations may be encoded algebraically using trees. Order conditions, composition of schemes and other useful properties may then be studied at the algebraic level. In applications, it is often desirable that numerical schemes retain certain structural properties of the underlying equation, such as symplecticity. These constraints may be encoded at the algebraic level. In many cases the algebraic structure simplifies accordingly. We explore the algebraic encoding of such simplifications and their implications for the study of structure-preserving numerical methods.