Symmetries and Integrability Conditions for Difference Equations

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We set up an algebraic framework for symmetries and conservation laws of difference equations. With a difference equation we associate a difference field of fractions. Then symmetries and conservation laws can be regarded as exceptional properties of the field. Existence of an infinite hierarchy of symmetries is taken as a definition of integrability. The concept of recursion operator, which generates the hierarchy of symmetries is adapted to the case of partial difference equations. We have constructed an infinite sequence of integrability conditions for a given difference equation, which are necessary conditions for the existence of a formal recursion operator. These conditions are presented in the form of a canonical sequence of conservation laws for a difference equation. If time permits, I am planning to discuss the concepts of co-symmetries and co-recursion operators as well.