Structure preserving discretization of evolution problems with dissipation

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We present a general framework for the systematic numerical approximation of dissipative evolution problems. The approach is based on rewriting the evolution problem in a particular form that complies with an underlying energy or entropy structure. Based on the variational characterization of smooth solutions, we are then able to show that the approximation by Galerkin methods in space and discontinuous Galerkin methods in time automatically leads to numerical schemes that inherit the underlying dissipative structure of the evolution problem. The proposed framework is rather general and can be applied to a wide range of applications. This is demonstrated by a detailed discussion of a variety of test problems.