A categorical framework for coherence theorems

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Categories equipped with coherently associative, commutative, and distributive structures abound in mathematics: in particular, they are the inputs to May's infinite loop space machines, Segal's K-theory, and multifunctorial, multiplicative, and/or equivariant analogues of these by Elmendorf-Mandell, Guillou-May-Merling-Osorno, and Yau. In ongoing joint work with Jonathan Rubin, we establish a general approach to proving Mac Lane-like categorical coherence theorems flexible enough to cover (weak) distributivity laws, module and algebra categories, and the higher arity twisted products that appear in equivariant settings. Building on Mac Lane's original proof, our techniques draw on techniques from combinatorics, logic, and rewriting theory to study the relevant universal parameter categories. Our approach directly clarifies the necessary coherence axioms and can often be presented operadically or multicategorically. In particular, we aim to leverage our work to simplify the characterization of bimonoidal categorical input to Yau's multifunctorial equivariant algebraic K-theory.