PSPACE Bounds for Rank-1 Modal Logics

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Abstract. For lack of general algorithmic methods that apply to wide classes of logics, establishing a complexity bound for a given modal logic is often a laborious task. The present work is a step towards a general theory of the complexity of modal logics. Our main result is that all rank-1 logics enjoy a shallow model property and thus are, under mild assumptions on the format of their axiomatization, in *PSPACE*. This leads not only to a unified derivation of (known) tight PSPACE-bounds for a number of logics including K, coalition logic, and graded modal logic (and to a new algorithm in the latter case), but also to a previously unknown tight PSPACE-bound for probabilistic modal logic, with rational probabilities coded in binary. This generality is made possible by a coalgebraic semantics, which conveniently abstracts from the details of a given model class and thus allows covering a broad range of logics in a uniform way.