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Hidden Markov processes (HMPs) are important objects of study in many areas of pure and applied mathematics, including information theory, probability theory, dynamical systems, and statistical physics, with applications in electrical engineering, computer science, and molecular biology. This collection of research and survey papers presents important new results and open problems, serving as a unifying gateway for researchers in these areas. Based on talks given at the Banff International Research Station Workshop, 2007, this volume addresses a central problem of the subject: computation of the Shannon entropy rate of an HMP. This is a key quantity in statistical physics and information theory, characterizing the fundamental limit on compression and closely related to channel capacity, the limit on reliable communication. Also discussed, from a symbolic dynamics and thermodynamical viewpoint, is the problem of characterizing the mappings between dynamical systems which map Markov measures to Markov (or Gibbs) measures, and which allow for Markov lifts of Markov chains.

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