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Sampling from the low temperature Potts model through a Markov chain on flows

We consider the algorithmic problem of sampling from the Potts model and computing its partition function at low temperatures. Instead of directly working with spin configurations, we consider the equivalent problem of sampling flows. We show, using path coupling, that a simple and natural Markov chain on the set of flows is rapidly mixing. As a result we find an ε -approximate sampling algorithm for the Potts model at low enough temperatures, whose running time is bounded by $O(m \log(m) \log(m\varepsilon^{-1}))$ for graphs G with m edges.