APPROXIMATE DYNAMIC PROGRAMMING APPROACH TO STOCHASTIC MATCHING

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We consider a class of stochastic control problems where the action space at each time can be described by a class of matching or, more generally, network flow polytopes. Special cases of this class of dynamic matching problems include many problems that are well-studied in the literature, such as: (i) online keyword matching in Internet advertising (the 'adwords' problem); (ii) the bipartite matching of donated kidneys from cadavers to recipients; and (iii) the allocation of donated kidneys through exchanges over cycles of live donor-patient pairs. We provide an approximate dynamic program (ADP) algorithm for dynamic matching with stochastic arrivals and departures. Our framework is more general than the methods prevalent in the literature in that it is applicable to a broad range of problems characterized by a variety of action polytopes and generic arrival and departure processes. In order to access the performance of our ADP methods, we illustrate computationally tractable upper bounds on the performance of optimal policies in our setting. We apply our methodology to a series of kidney matching problems calibrated to realistic kidney exchange statistics, where we obtain a significant performance improvement over established benchmarks and, via upper bounds, illustrate that our approach is near optimal.