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Efficient Scheduling Strategies for Jobs with Precedence Relations

Abstract: In this talk, we consider the problem of optimally scheduling a number of jobs to be processed according to a predetermined partial order. To be more precise, jobs are divided into groups. Within each group, jobs can be processed in any order. However, there is linear order among job groups. Each job under processing evolves stochastically as a Markov chain and earns rewards as it is processed, not otherwise. The Markovian reward depends on an unknown parameter. The objective is to minimize the difference between the optimal reward when the parameter is known and the expected reward. We established an asymptotic lower bound on this difference and construct policies which attain this lower bound. The basic idea underlying this construction is to apply an uncertainty adjustment to the certainty equivalence principle, where the uncertainty adjustment refers to sequential testing with unequal allocation of processing time and the certainty equivalence principle refers to optimized allocation assuming the parameter estimate is correct. Examples of computerized adaptive tests and multi-phase project management are given for illustration.