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Stability and performance of multi-class queueing systems with unknown service rates: A combined scheduling-learning approach

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We consider a system with N different service modes handling several traffic classes, where a scheduling agent decides which service option to use at each time slot. Each service mode provides service simultaneously to all the traffic classes, at different random rates (possibly zero). Moreover, each job experiences a random slowdown when in service, which is independent among jobs and service options. The scheduling agent can observe the global queue state, but does not have any advance knowledge of the instantaneous rates, service rate distributions or slowdown rate distributions associated with each of the service modes. We propose a threshold-based algorithm where the threshold value is compared to the sum of the square of the queue lengths at that time slot. If the threshold value is exceeded, then the scheduling agent switches the service mode, and it keeps using the same service mode otherwise. We show that the proposed scheduling algorithm achieves maximum stability and also analyse the mean response time of the various traffic classes. In a second step, we extend the scheduling agent in order to learn which service mode to use at each queue state.

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