Control Perspectives of Submodularity

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Submodularity plays a key role in many optimization problems. Although much less known, submodularity also has a ubiquitous presence in stochastic systems, and is often central to their control. This talk highlights some of my personal experiences in working with submodularity in stochastic discrete-event systems. I will focus on three examples: (a) a kanban-controlled production line, (b) a sequential inspection problem, and (c) dynamic scheduling of a multiclass queueing system. I will demonstrate that (a) is associated with an antimatroid structure, which contributes to most of the desirable properties of kanban control; the optimal policy for (b) results from a strengthening of submodularity to so-called K-submodularity; and the algorithm that identifies the optimal control in (c) appears to have an interesting connection to submodular function minimization, an important problem in combinatorial optimiz ation.