Dynamic Control of a Single Server System When Jobs Change Status

Presented by:

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From health care to maintenance shops, many systems must contend with allocating resources to customers or jobs whose initial service requirements or costs change when they wait too long. We present a new queueing model for this scenario and use a Markov decision process formulation to analyze assignment policies that minimize holding costs. We show that the classic $c\mu$ rule is generally not optimal when service or costs requirements can change. Even for a two-class customer model where a class 1 task becomes a class 2 task upon waiting, we show that additional orderings of the service rates is needed to ensure the optimality of simple priority rules. We then show that seemingly-intuitive switching curve structures are also not optimal in general. We study these scenarios and provide conditions under which they do hold. Lastly, we show that results from the two-class model do not extend to when there are $n \geq 3$ customer classes. More broadly, we find that simple priority rules are not optimal. We provide sufficient conditions under which a simple priority rule holds. In short, allowing service and/or cost requirements to change fundamentally changes the structure of the optimal policy for resource allocation in queueing systems.

About the Speaker:
Gabriel is a Postdoctoral Fellow in the Department of Industrial and Operations Engineering at the University of Michigan. He received his bachelor’s degree in Mathematics from the University of South Florida and graduated from Cornell with a Ph.D. from the Center for Applied Mathematics, advised by Professor Mark E. Lewis. His research interests are in the area of stochastic modeling and optimization, with an emphasis on Markov decision processes, queueing, and scheduling. His present focus is on how to leverage concepts from these areas to identify effective and practical policies for resource allocation in settings such as disaster response, health care operations and delivery, medical decision making, and healthcare policy.