DISI – University of Trento

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Simulation and Performance Evaluation

Simulation of a simple queuing network

Configuration for Luca Erculiani

Customers are divided in classes, so the simulation must be class-aware. After finding the results, propose a serving discipline for QS3 that improves the performance of lower priority classes without reducing the performance of classes C_0 and C_1.

Arrival Process

Customers arrive following a Poisson process with $\lambda = 1$. Customers belong to an infinite class set C_i, $i = 1, 2, \ldots, \infty$. The probability of belonging to a class is geometric with base 1/2:

$$P[\text{class} = C_i] = \frac{1}{2^i}$$

Stations

QS1: M/G/∞; the service rate is distributed following a Pareto distribution with the following parameters

$$F_T(t) = \begin{cases} 1 - (\frac{t_m}{t})^\alpha & t \geq t_m \\ 0 & t < t_m \end{cases}$$

with $t_m = 2$ and $\alpha = 2.1$. The service in this queuing station is independent from the customers' class.

QS2: –/M/1/PR; the service time is identical for all customers, with $\mu = 5$; however, service is strictly prioritized, without preemption, i.e., the customer with the lower class index $i = 1, 2, \ldots$ present in the queue is serviced before customers of higher class index, but a customer already in service will finish its service even if customers with higher priority arrive during its service. Within classes the service is FIFO.

QS3: –/G/3/20/FIFO; the service is uniformly distributed with service time $T \in (0.2, 1)$ and the service is independent from the customer class. However the service discipline is customer dependent. Let's name the servers S_1, S_2, and S_3; server S_1 services only customers of class C_1, server S_2 services only customers of class C_2, while server S_x services all other classes. The queue is FIFO with blocking, i.e., if S_1 is busy and the next customer is again of class C_1, then no customer can receive service even if C_2 or

C_x are idle and there are customers of the respective classes. The same applies to C_2 and C_x.

Routing probabilities

$p_{i,j}$ is the probability that a customer services in queue i goes to queue j.

		j		
		1	2	3
i	1	0.0	1.0	0.0
	2	0.0	0.5	0.5
	3	0.5	0.0	0.0
		p_{ij}		