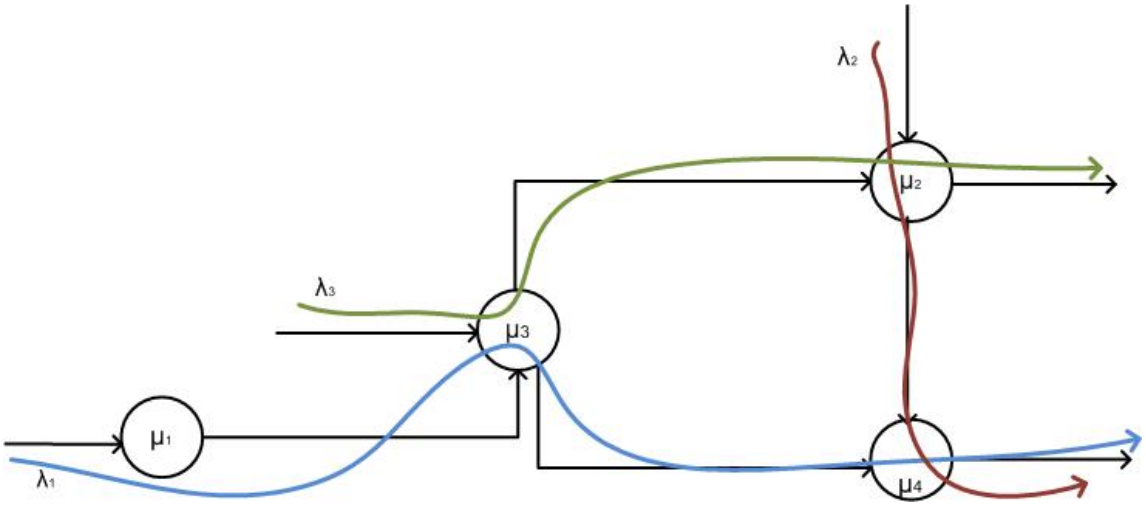
Nikhil Khatu
ECE/CSC 576
Professor Perros

Modeling Performance of LSPs

What is the minimum service rate at each node 1 and 2 in order to guarantee stability?

λ1 = 50/ sec
λ2 = 40/sec
λ3 = 30/sec



<u>The requirement for system stability at a node is ρ <= 1:</u>

- μ1 must service at a minimal rate of λ1 → 50 per second
- μ2 must service at a minimal rate of λ2 + λ3 → 40 + 30 = 70 per second
- μ3 must service at a minimal rate of λ1 + λ3 → 50 + 30 = 80 per second
- μ4 must service at a minimal rate of λ1 + λ2 → 50 + 40 = 90 per second

Assume that all service times (i.e. link capacities) are equal to 100/sec.
Use JMT to solve this network.

What is the throughput of each node?

Node #	Throughput
1	50.040000
2	69.975000
3	80.040000
4	89.980725

What is the throughput of each class?

The throughput of each class is the same as the arrival rate:

Class	Throughput
LSP1	50
LSP2	40
LSP3	30

What is the utilization of each node?

Node #	Utilization
1	.500000
2	.700000
3	.800000
4	.900000

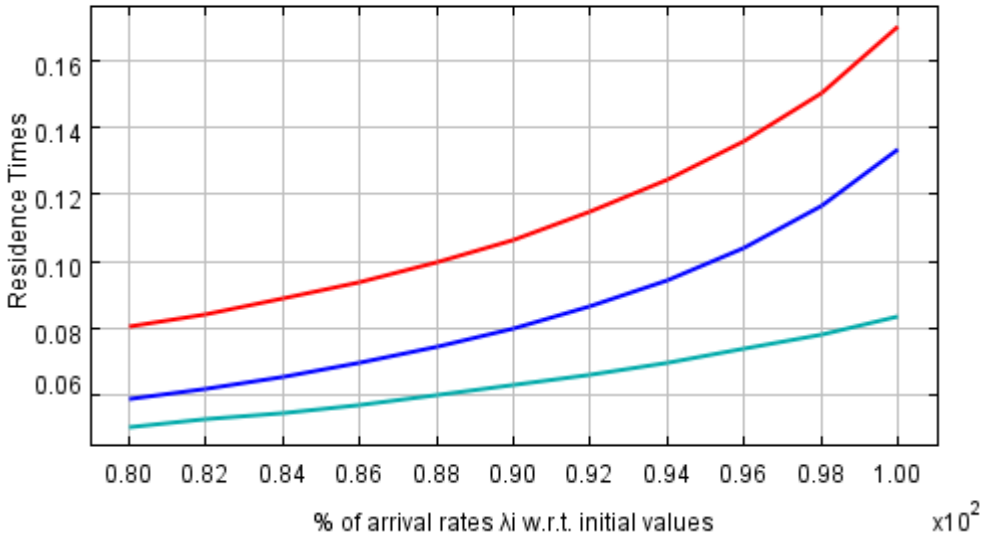
This is expected as calculated earlier. The utilization is the arrival rate divided by the service rate. (100 per second). Each node is utilized at the arrival rate since the arrival rates are under the 100/sec service rate.

What is the e2e mean delay of each class?

Class	end to end delay
LSP1	.170000
LSP2	.133333
LSP3	.083333

The residence time is the amount of time an arrival is spent in each node.
The aggregate of these times is the total time spent in the system: 0.136111 of a second.

Do what-if analysis on the arrival rates, by varying them from 100% of the original values down to 80%. Plot the aggregate residence times (e2e mean waiting time) for each class, and comment.



The end to end delay is amount of time an arrival is spent in the whole system. This is also known as the aggregate residence time. As one can see in the diagram: as the arrival rate is increments the residence time increases exponentially with each step. The delay is introduced in the buffer/queues of each service node. The teal, blue, and red lines correspond to the arrival rates of each LSPs 3, 2, and 1; λ3, λ2, and λ1.