Annual Review

Michalis Panayides

2022-06-21

Motivation

Patients forced to wait for 24 hours in ambulances, data shows

Ambulance crews forced to wait outside A&Es for 24 hours, according to chiefs

Rebecca Thomas Health Correspondent • Tuesday 17 May 2022 08:26 • Comments

(AFP/Getty)

'Appalling' waits for ambulances in England leaving lives at risk

Exclusive: Royal College of Emergency Medicine president says NHS is breaking its agreement to treat sickest in a timely way

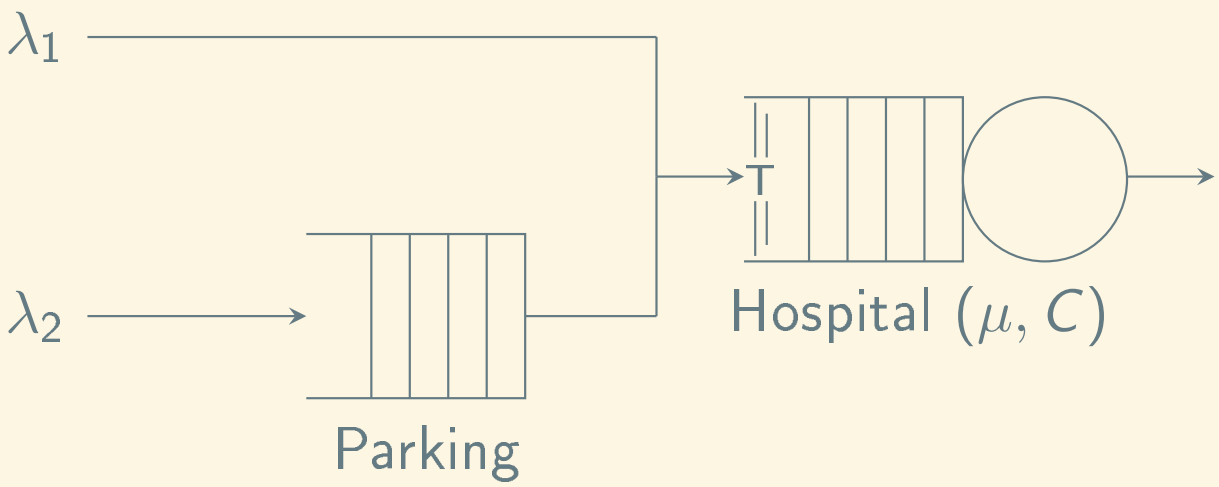
- 'For staff, this is heartbreaking': senior doctor's view on crisis
- 'I feel so let down': long waits for ambulances in south-west

Ambulance handover delays highest since start of winter

NHS 'on its knees' as ambulance response times for life-threatening calls rise to record high

Average response time to deal with Category 1 cases – such as cardiac arrests – is now nine minutes and 20 seconds with rises across all categories.

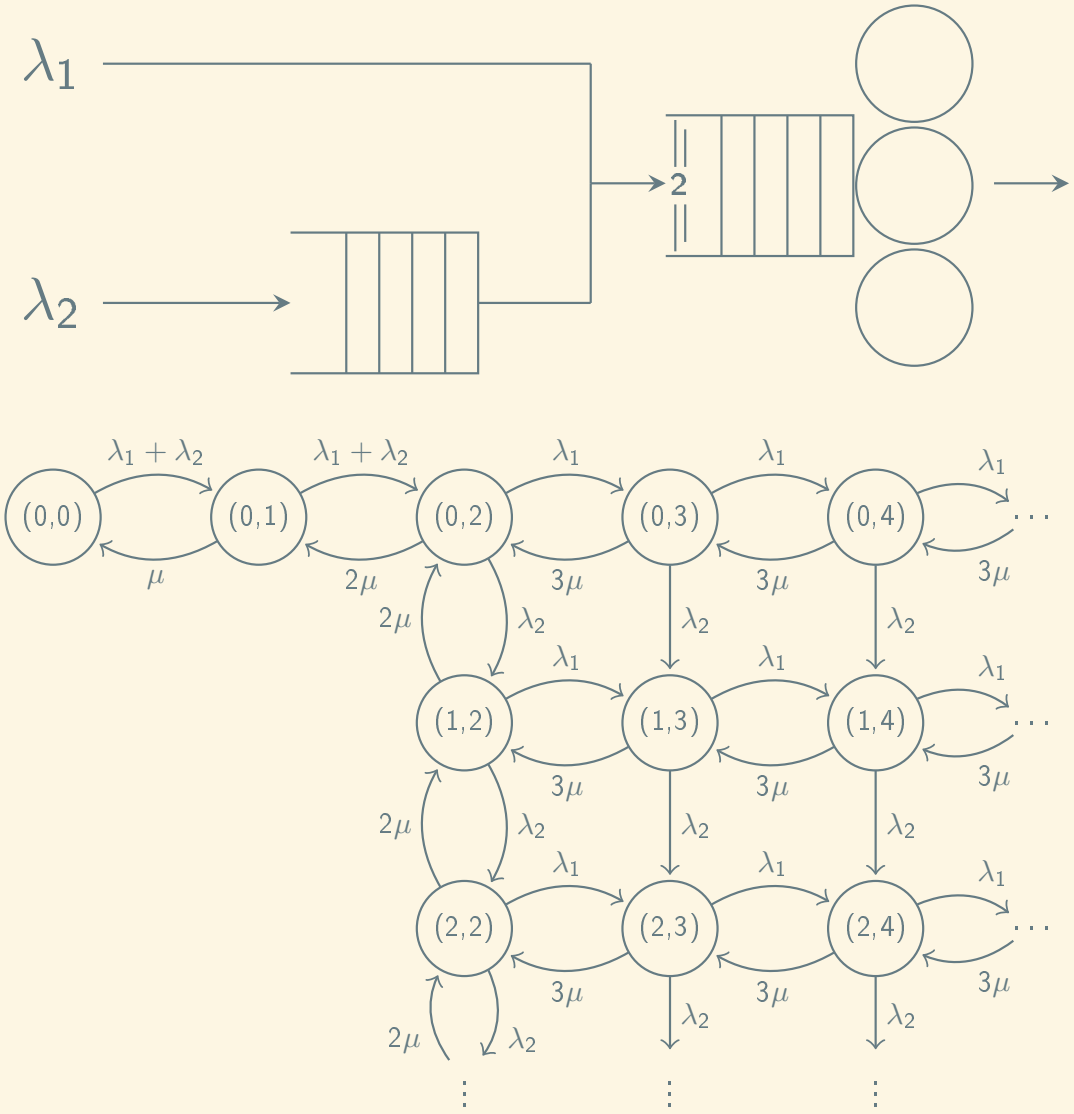
Queues - Custom network of queues



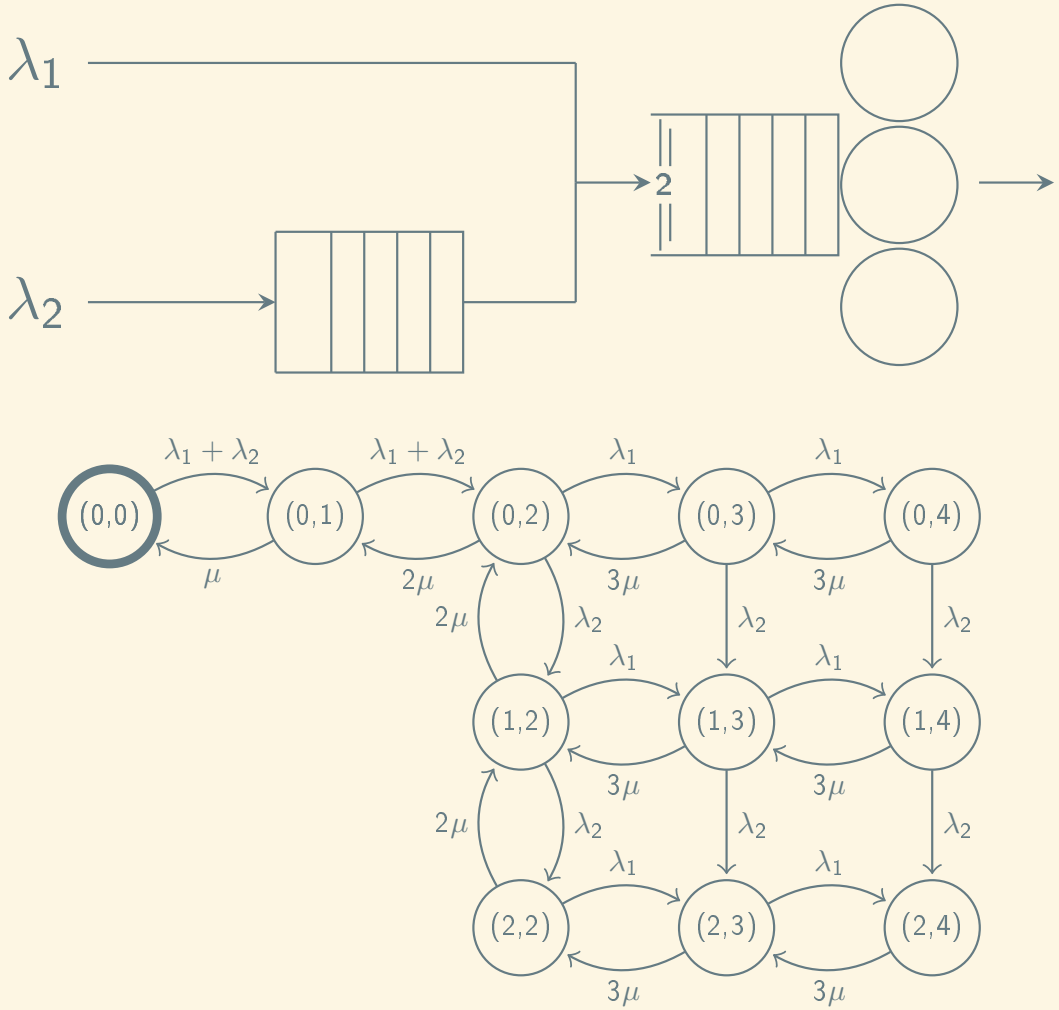
Parameters:

- λ_1: Arrival rate of type 1 individuals
- λ_2: Arrival rate of type 2 individuals
- μ: Service rate
- C: Number of servers
- T: Threshold

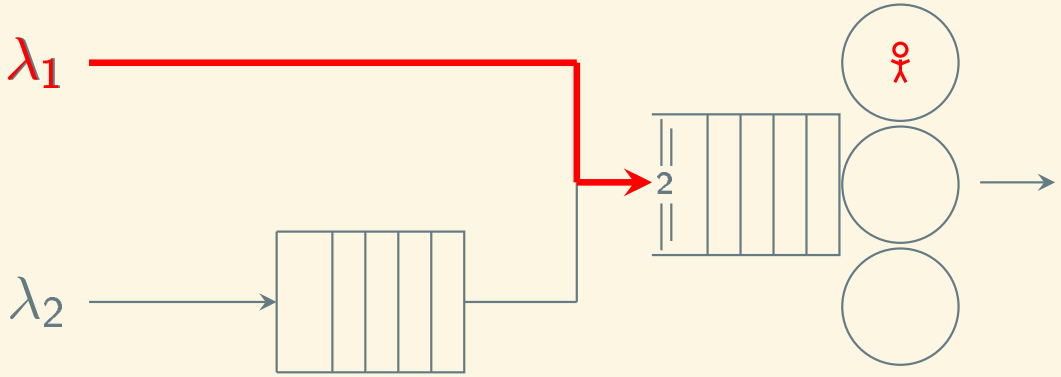
Markov Chain - Custom network

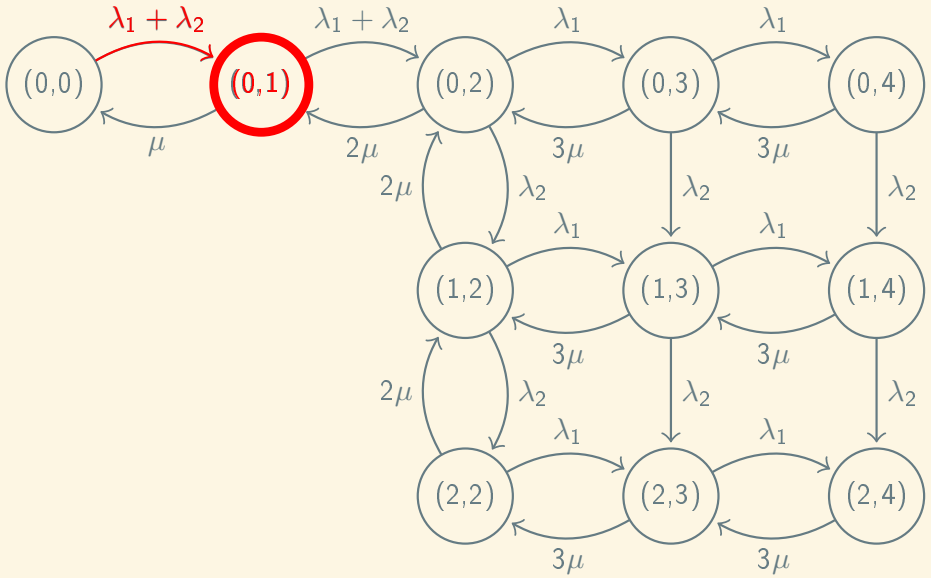


Markov Chain - Custom network - $N = 4, M = 2$

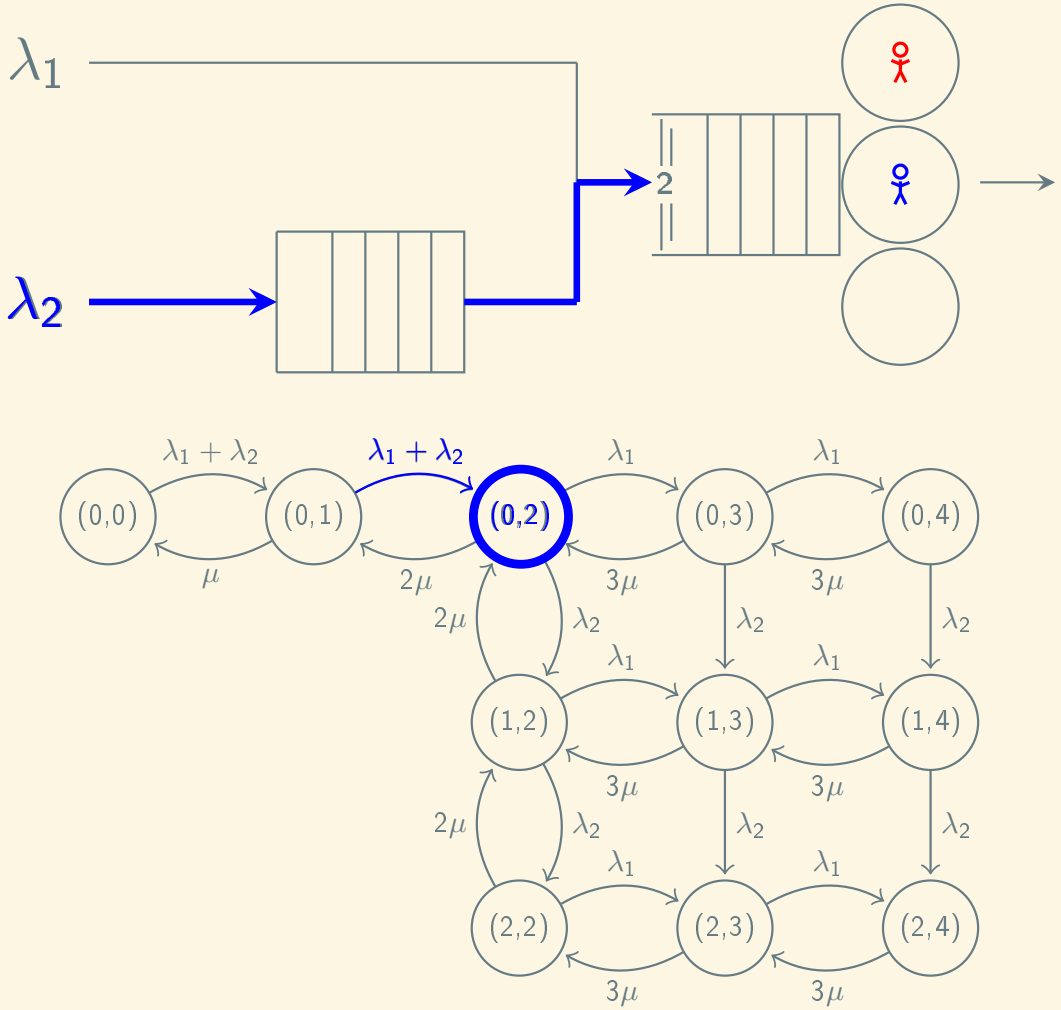


Markov Chain - Custom network - $N = 4, M = 2$

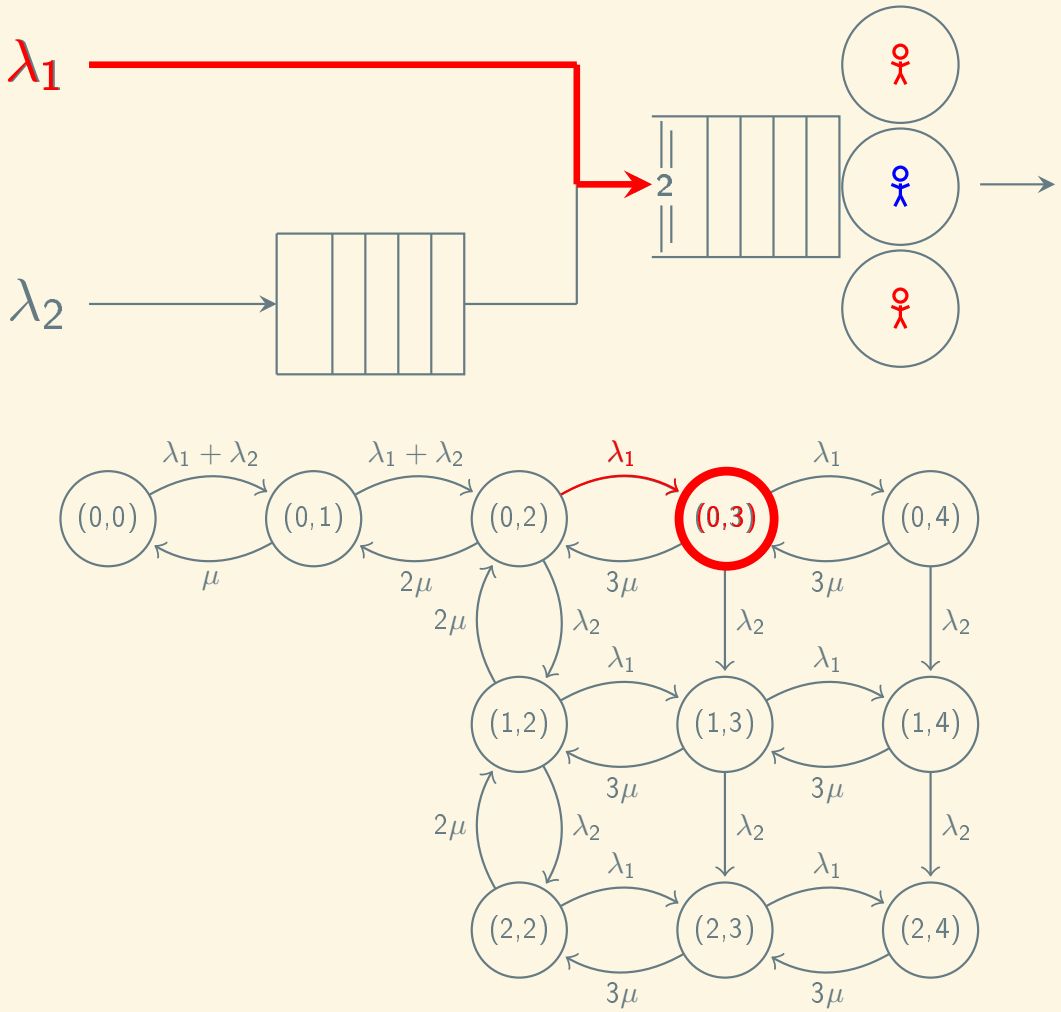




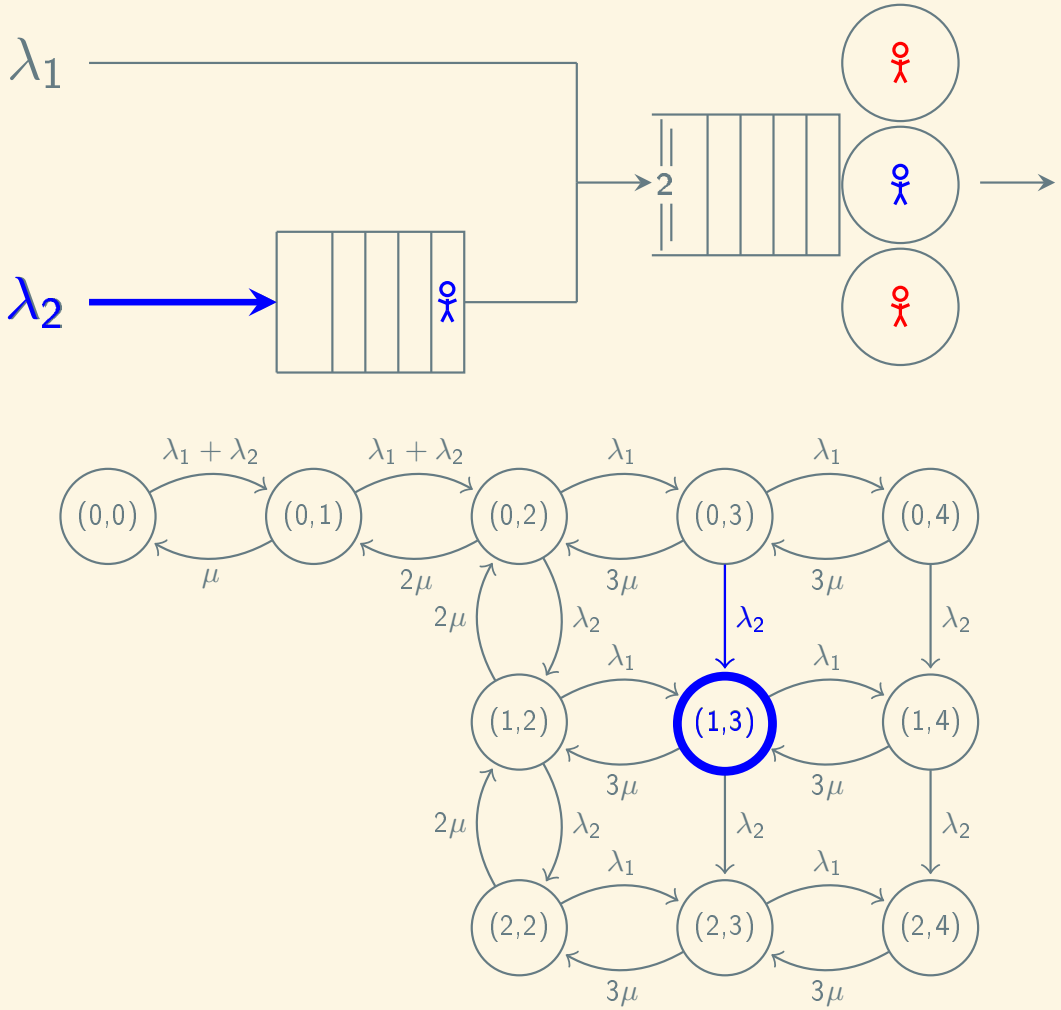
Markov Chain - Custom network - $N = 4, M = 2$



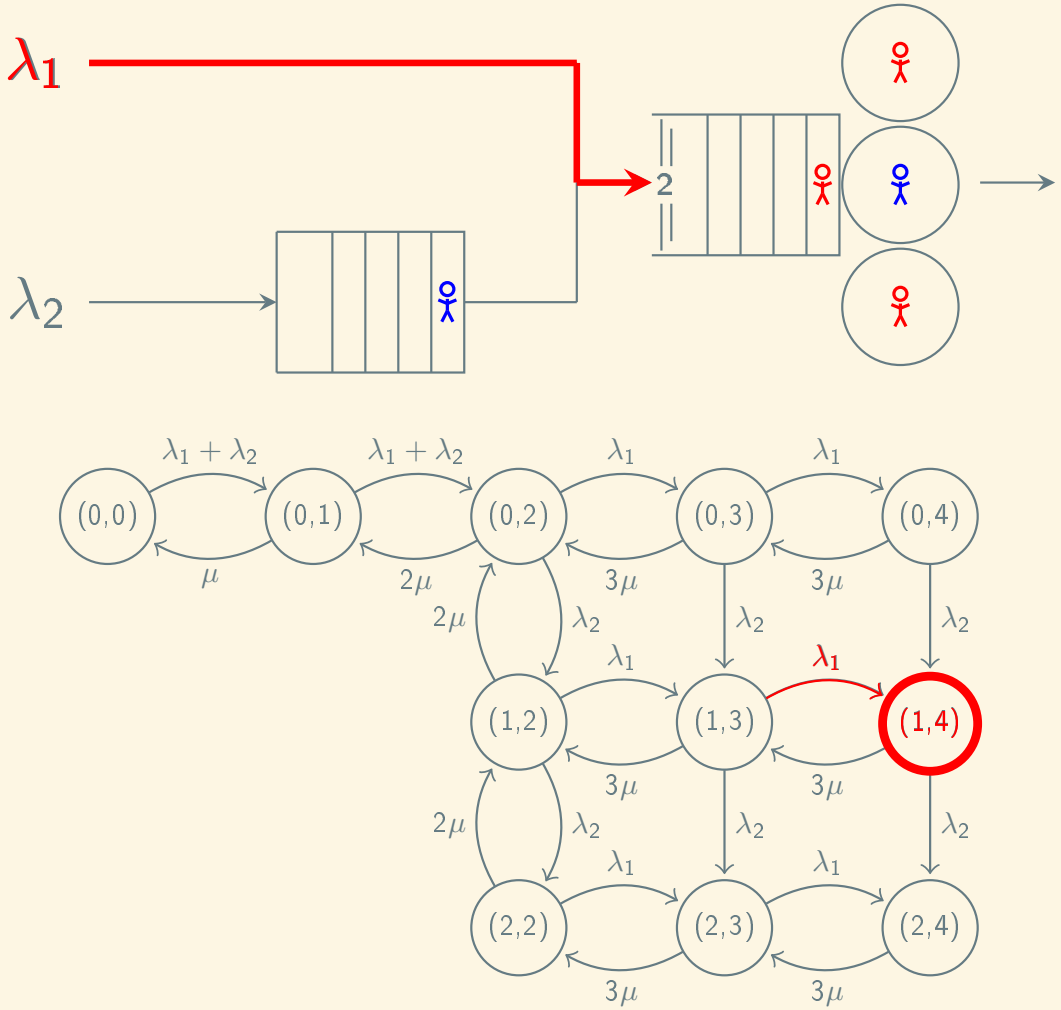
Markov Chain - Custom network - $N = 4, M = 2$



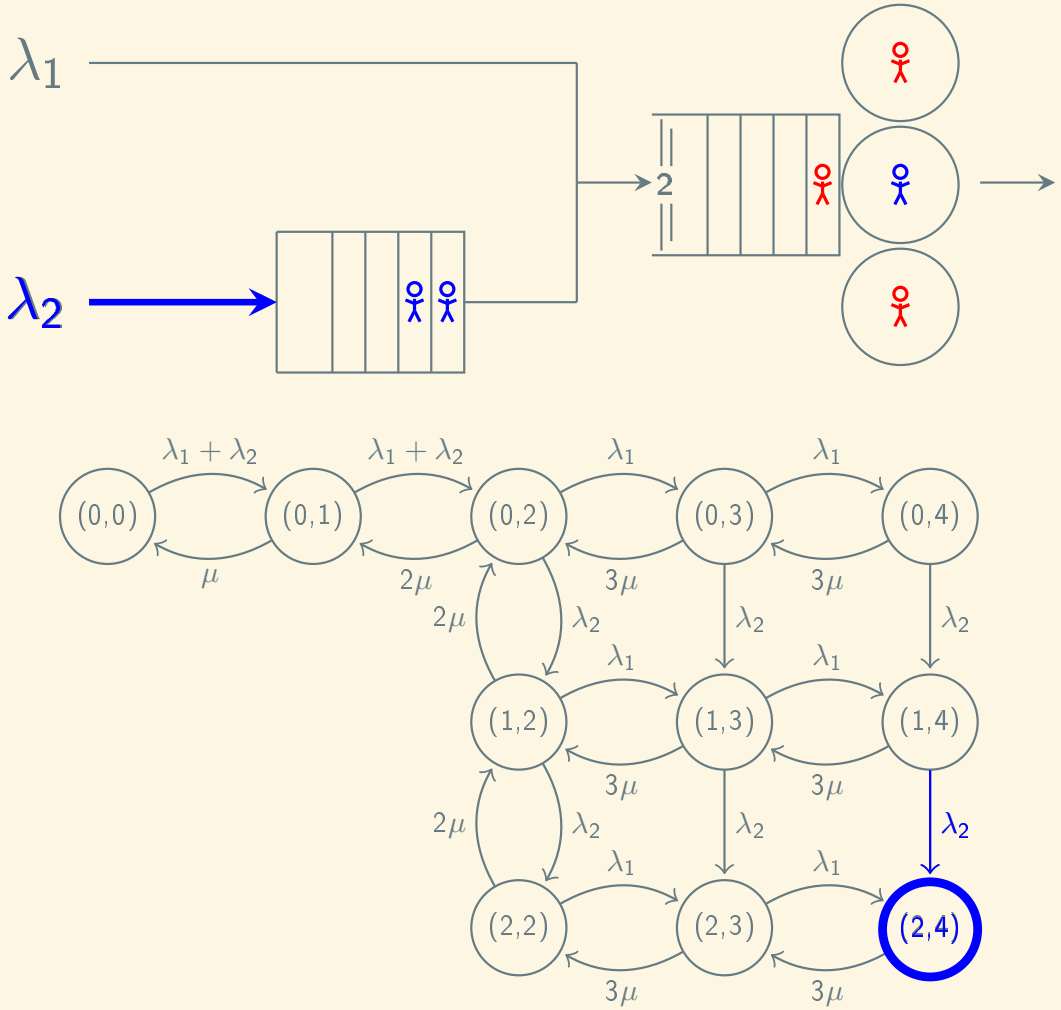
Markov Chain - Custom network - $N = 4, M = 2$



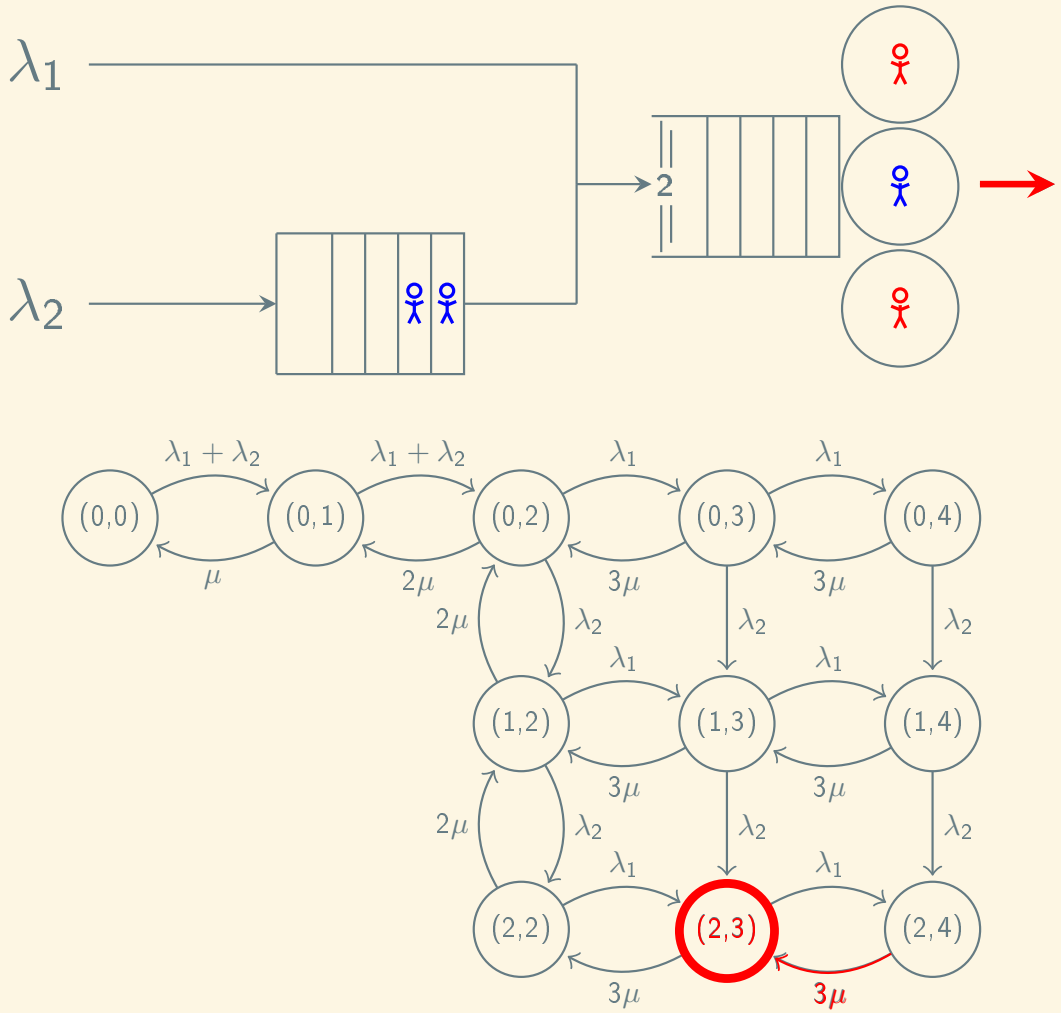
Markov Chain - Custom network - $N = 4, M = 2$



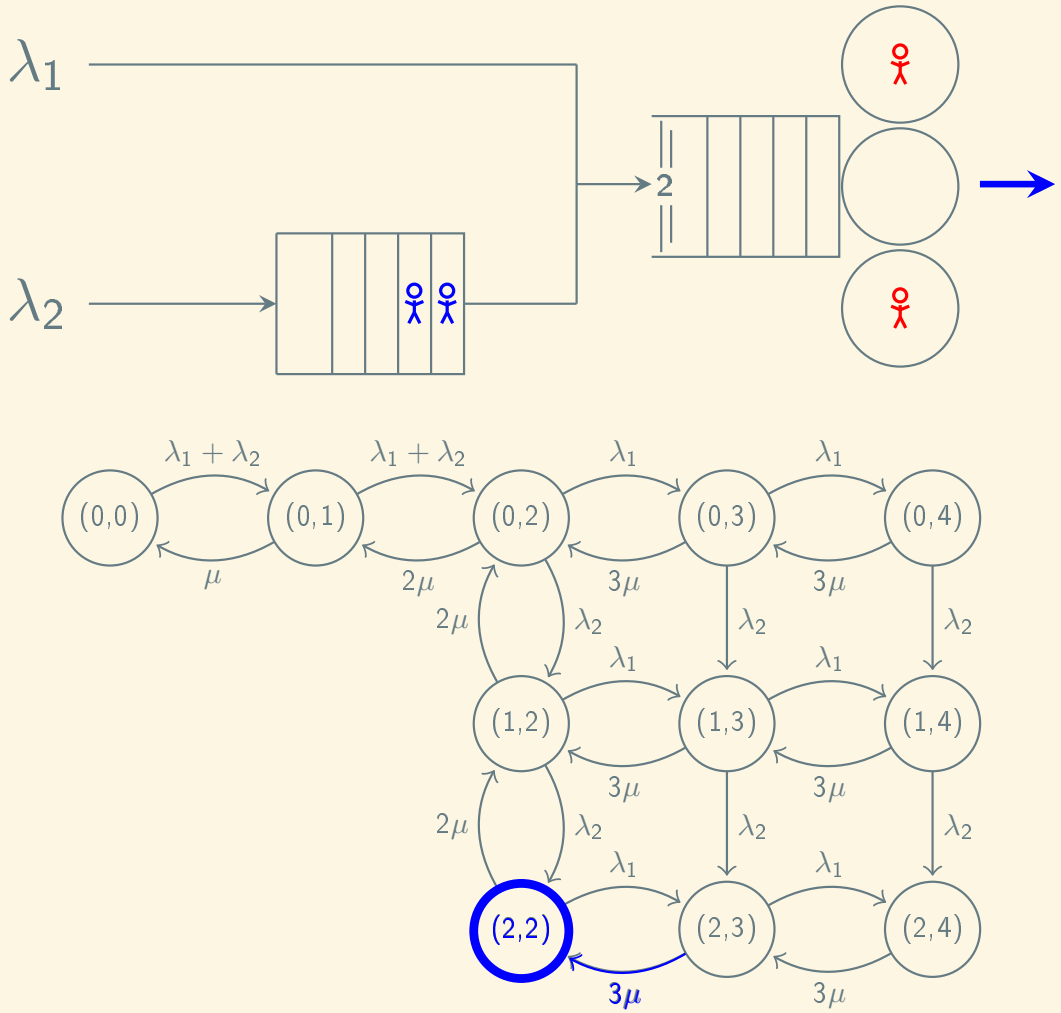
Markov Chain - Custom network - $N = 4, M = 2$



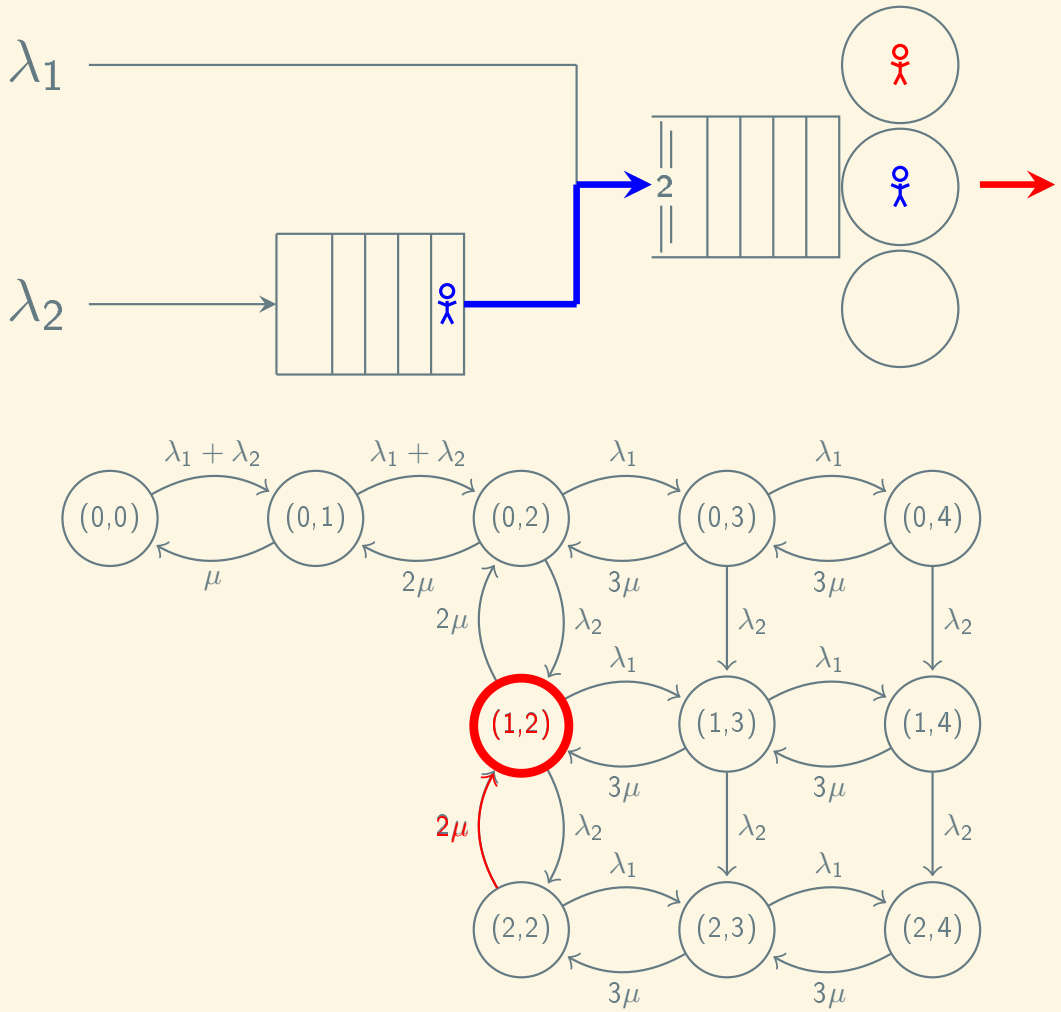
Markov Chain - Custom network - $N = 4, M = 2$



Markov Chain - Custom network - $N = 4, M = 2$



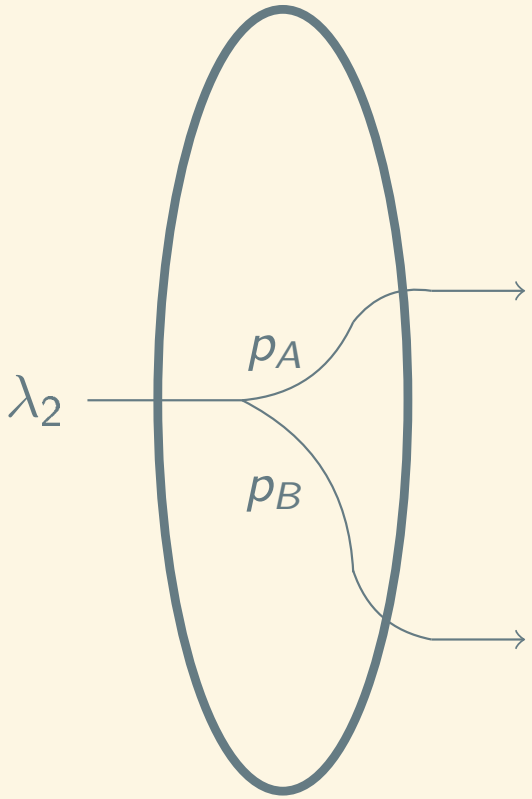
Markov Chain - Custom network - $N = 4, M = 2$



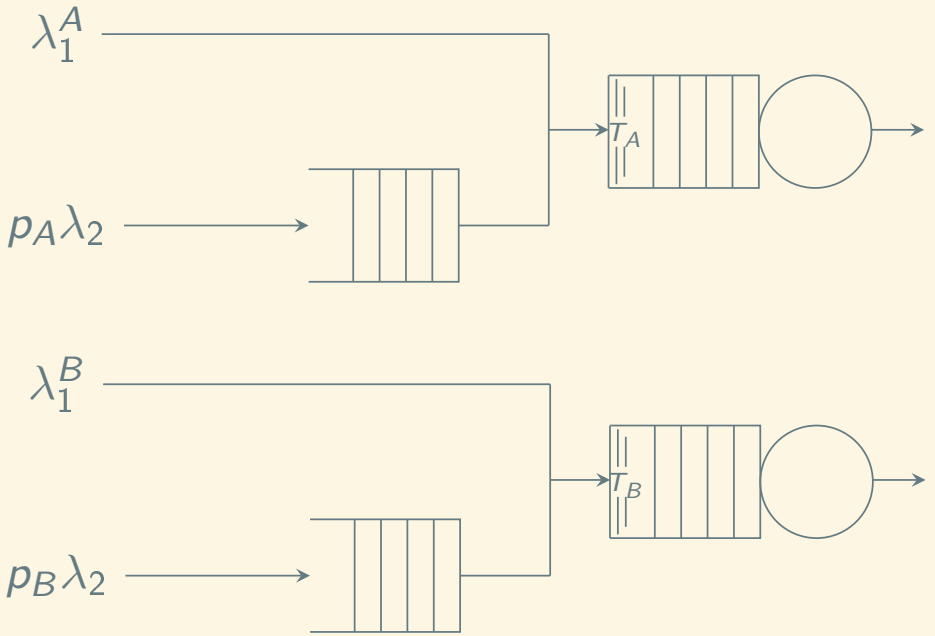
Game - Motivation

Game - Formulation

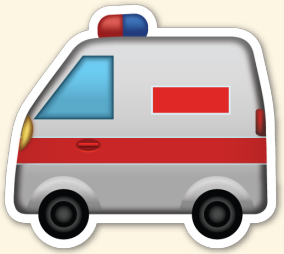
Blocking time

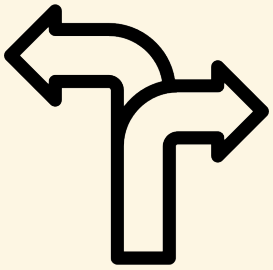


Proportion of individuals within target

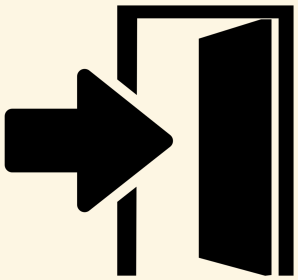


Game - Players, Strategies and Objectives

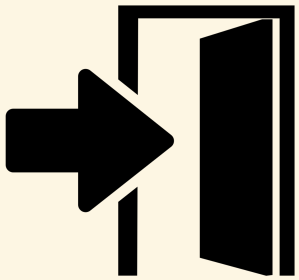




$p_A, p_B \in [0, 1]$
$p_A + p_B = 1$



$T_A \in [1, N_A]$



$T_B \in [1, N_B]$

$\min B$

$P(W^{(A)} < t) > 0.95$

$P(W^{(B)} < t) > 0.95$

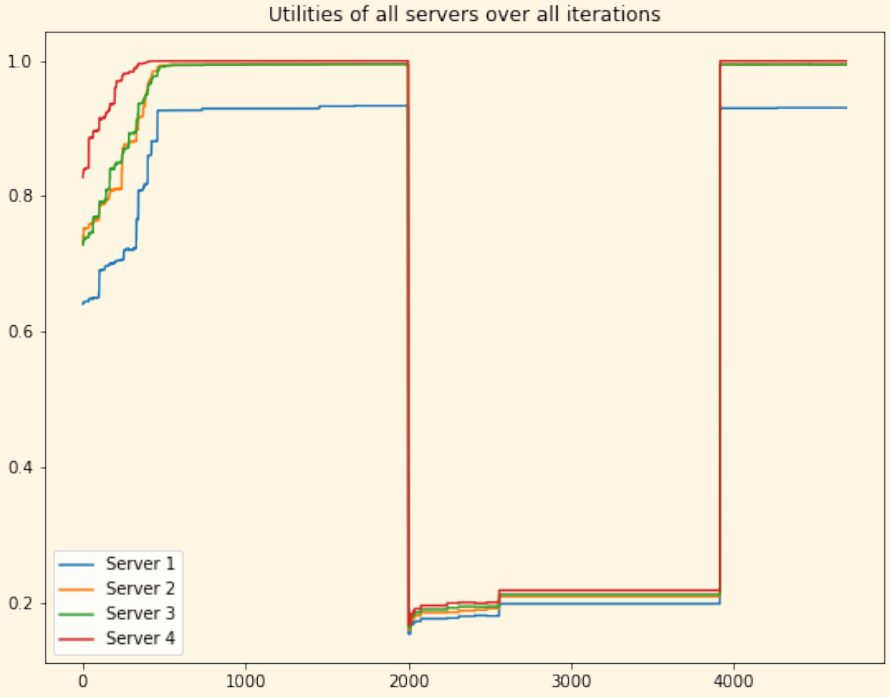
Reinforcement Learning - Server's behaviour

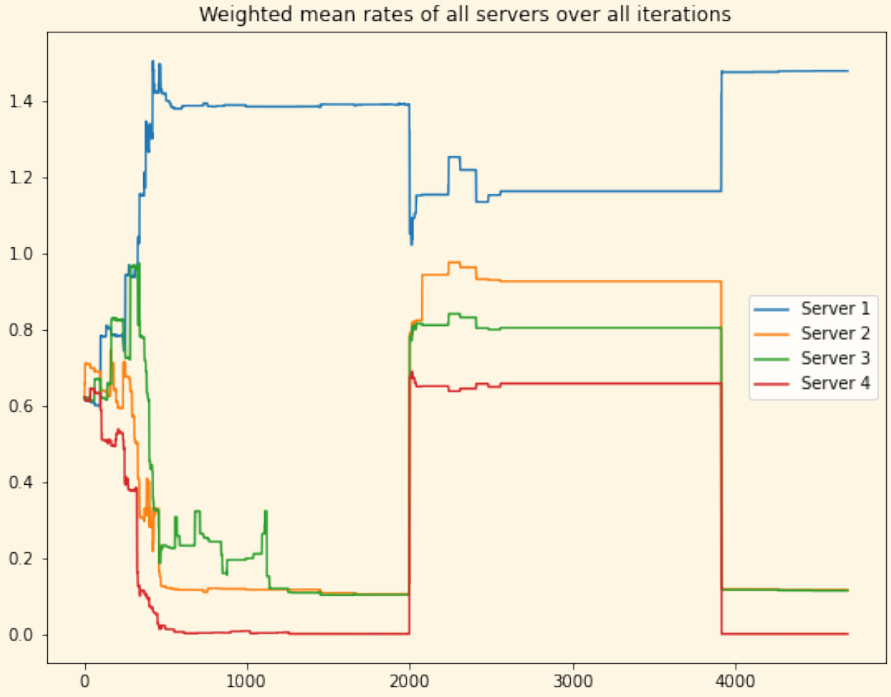



1 2 2 3

$$\text{Utility} = \underbrace{\text{Idle time} + \text{Lost inds}}$$

Reinforcement Learning - Server's behaviour when flooding





Thesis structure

1. Introduction
2. Literature review
3. Queueing model
4. Game theoretic model
5. Methodology
6. EMS/ED application
7. Agent based extension
8. Results
9. Conclusion

Timeline

- Final revision for my first publication
- Simulated Annealing version of reinforcement learning algorithm
- Get some more results
- Thesis write-up