OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

INF FAKULTÄT FÜR INFORMATIK

# Applied Discrete Modelling

## GSPNs & CTMCs - Examples

# Example: The Hairdresser

One person is at a beauty salon

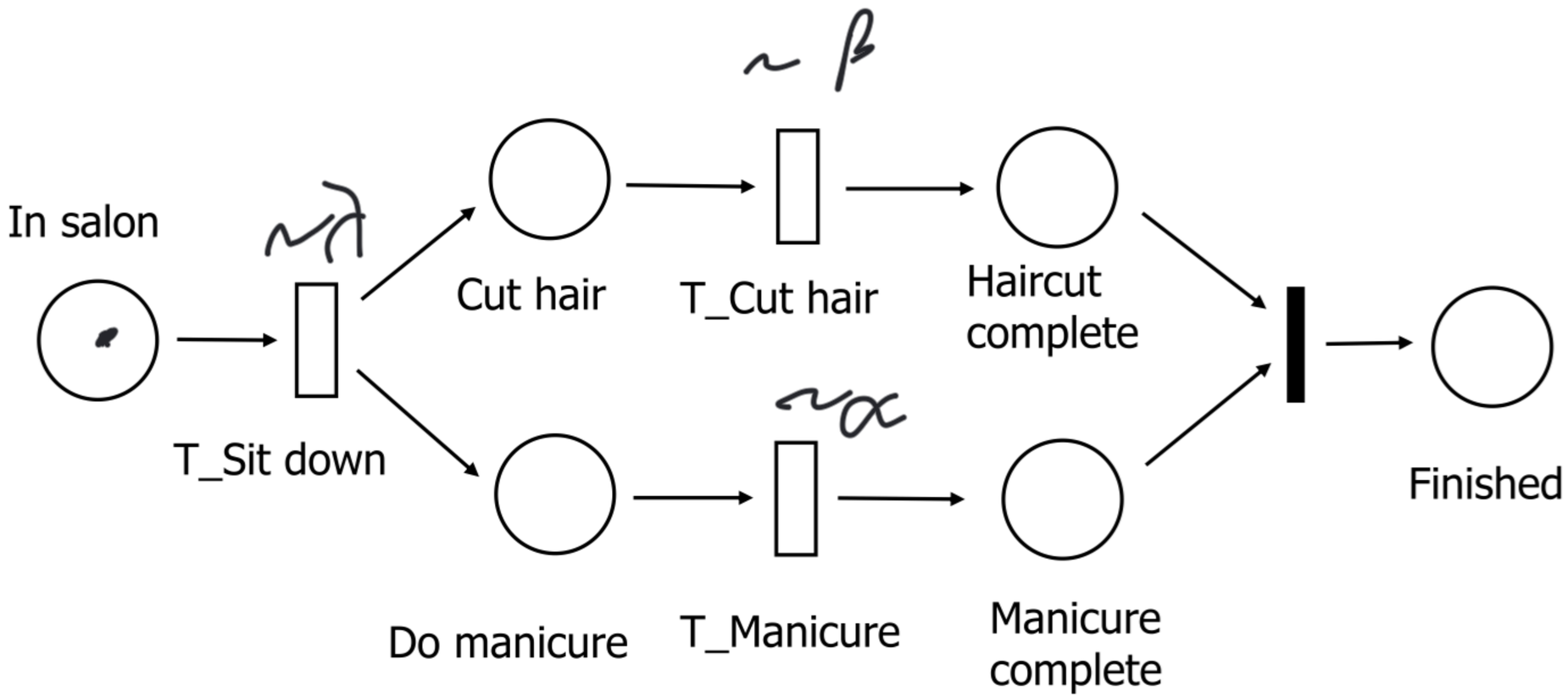
It takes a certain amount of time to be seated

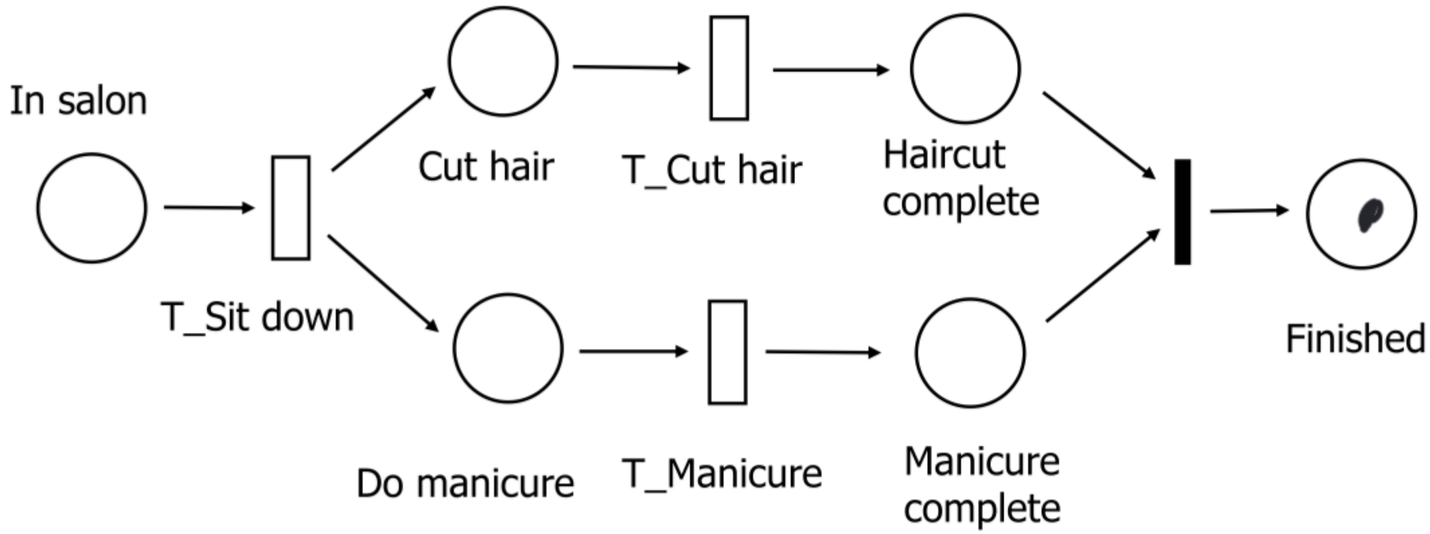
Then the manicure and haircut can start

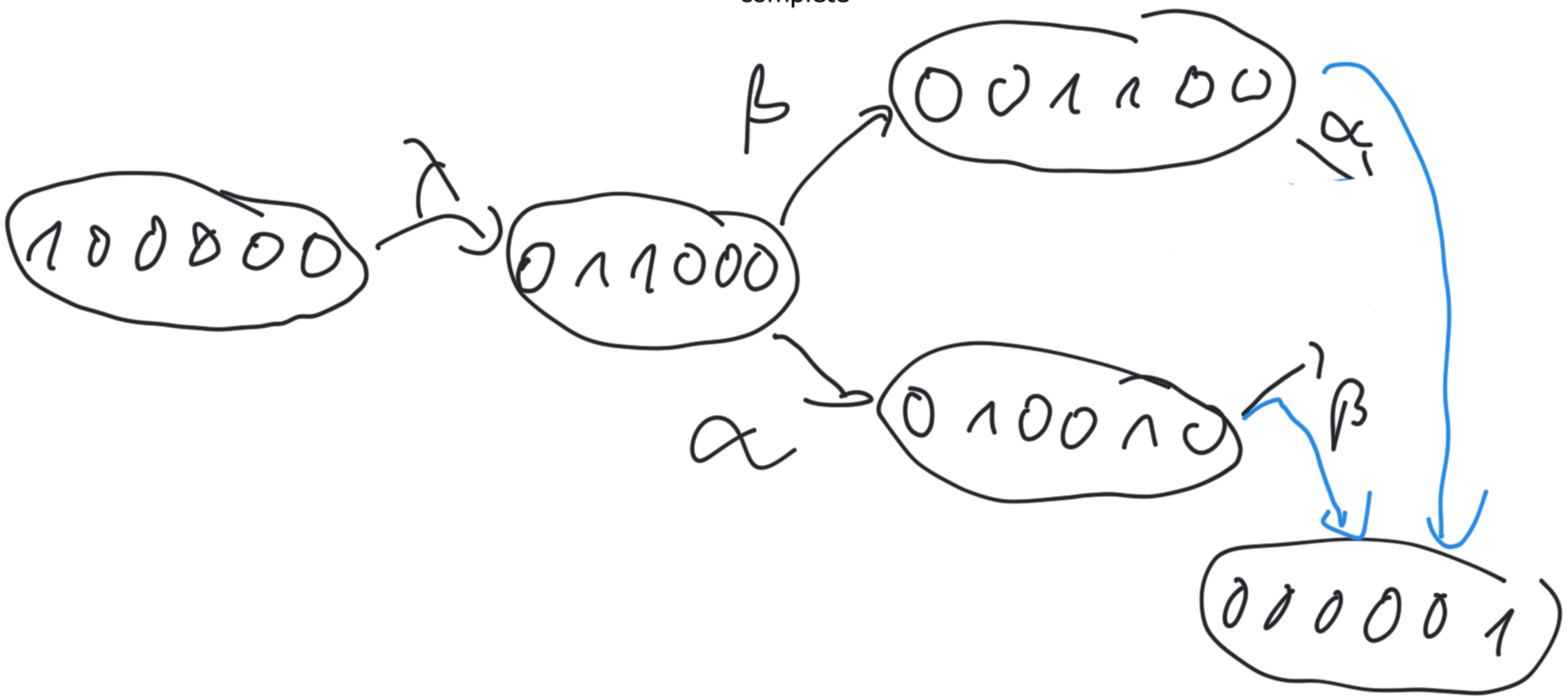
Both can happen at the same time and can have different durations

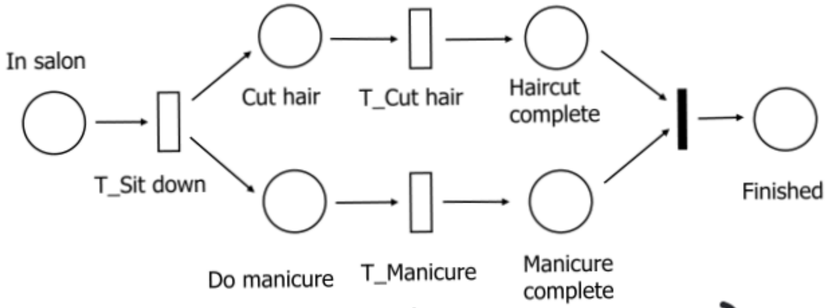
Only if both manicure and haircut are done, is the visit at the salon finished

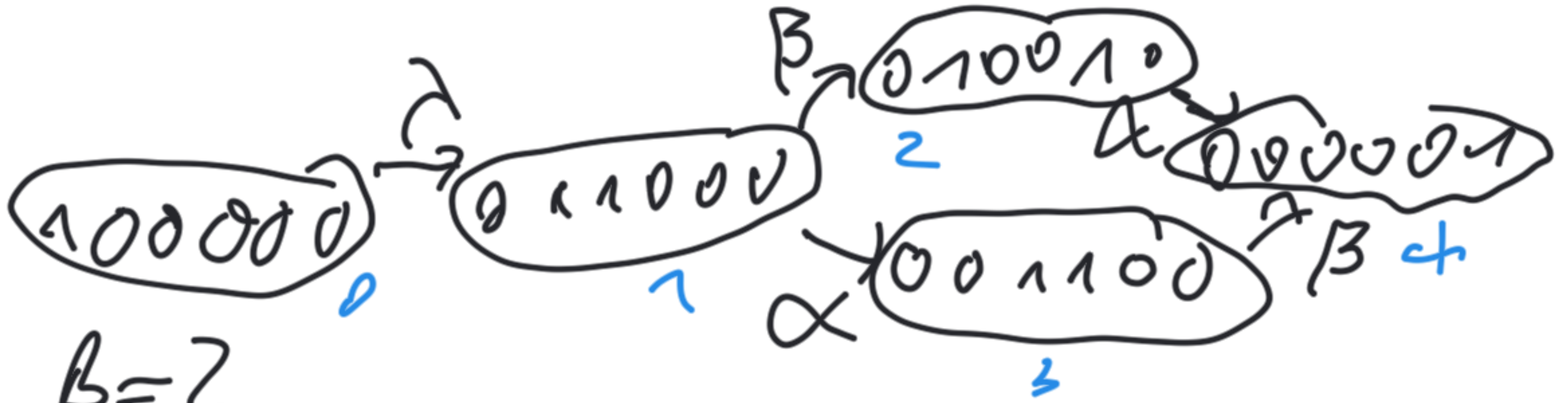
# Example: The Hairdresser




In salon
T_Sit down
Cut hair
T_Cut hair
Haircut complete
Do manicure
T_Manicure
Manicure complete
Finished


β
α
α
β



$\eta = 4 \quad \alpha = 3$

$\beta = 2$

$$\begin{bmatrix} -\lambda & \lambda & 0 & 0 & 0 \\ 0 & -\alpha-\beta & \beta & \alpha & 0 \\ 0 & 0 & -\eta & \eta & 0 \\ 0 & 0 & 0 & -\beta & \beta \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} -4 & 4 & 0 & 0 & 0 \\ 0 & -5 & 2 & 3 & 0 \\ 0 & 0 & -3 & 0 & 3 \\ 0 & 0 & 0 & -2 & 2 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$\Delta < \frac{1}{4}$

$\Delta = 1/20$

# Example: The Bar

3 people are sitting in a bar

The time until one of them orders their next drink is exponentially distributed $\sim \lambda$

If the barman is free, he can attend to the request

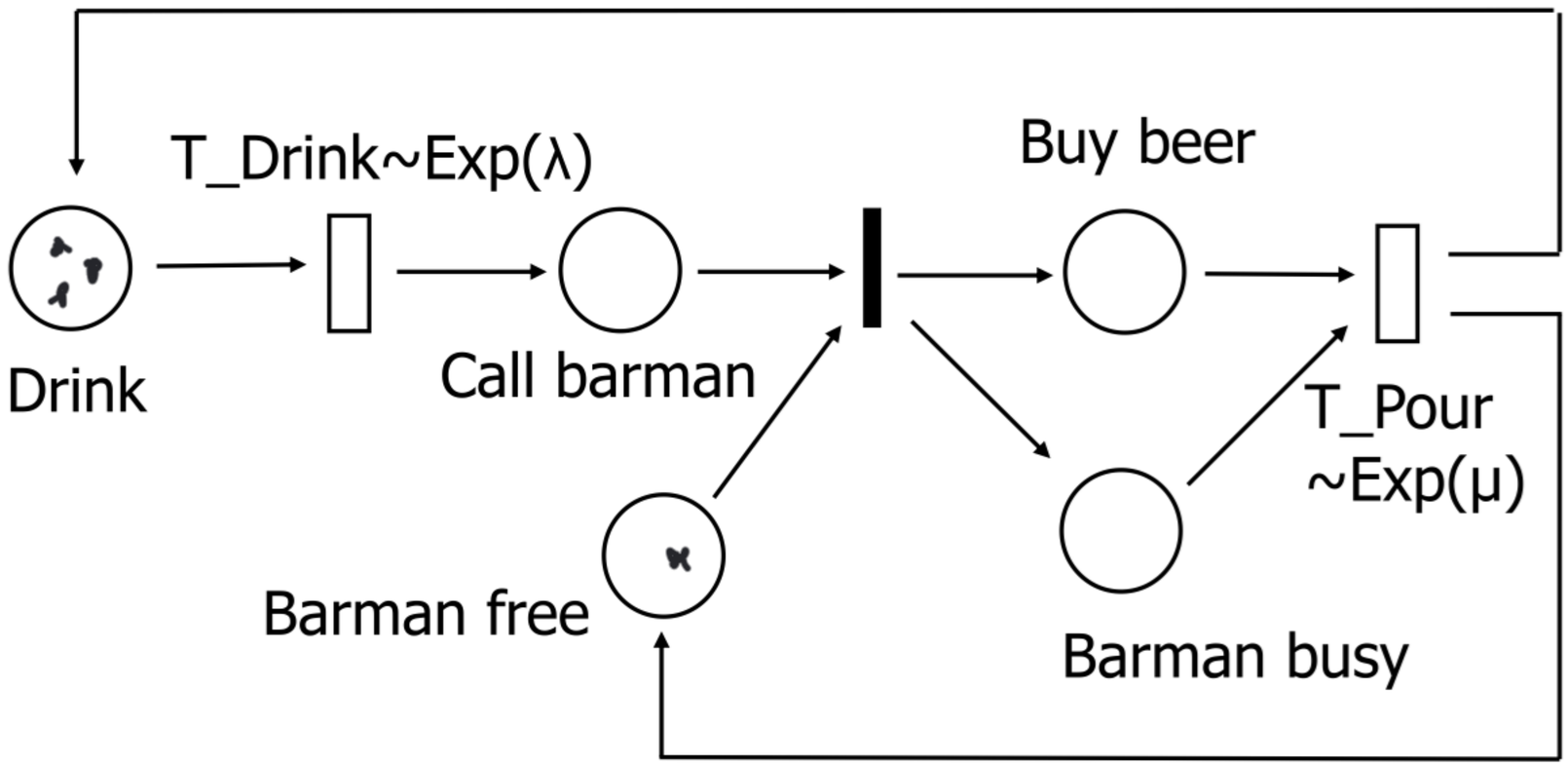
Preparing the drink and serving it takes an exponentially distributed amount of time $\sim \mu$

After that the customer is happy again, and the barman free

# Example: The Bar

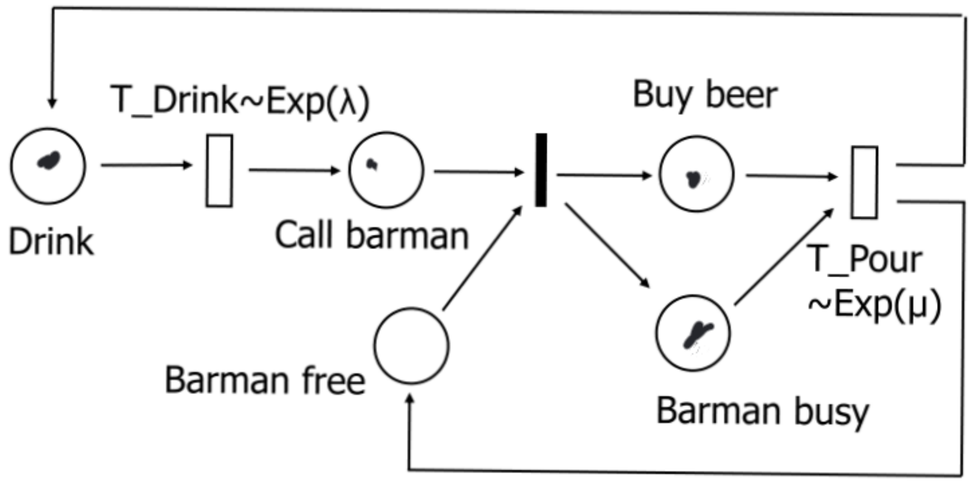
P (no customer is waiting)

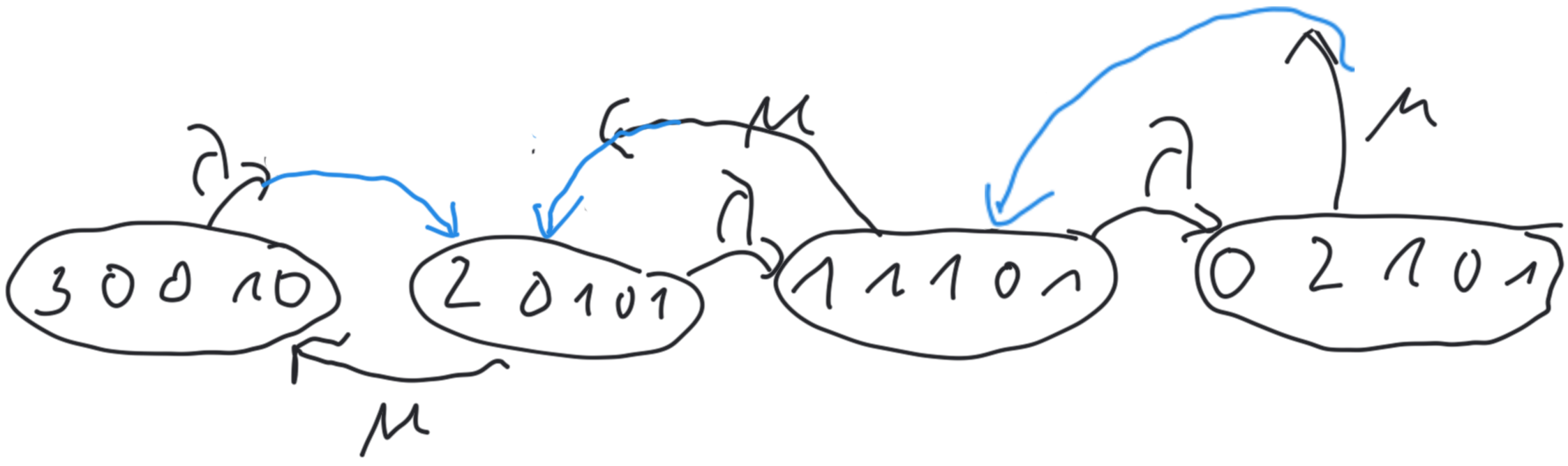
Average number of waiting customers?



P (no customer is waiting)

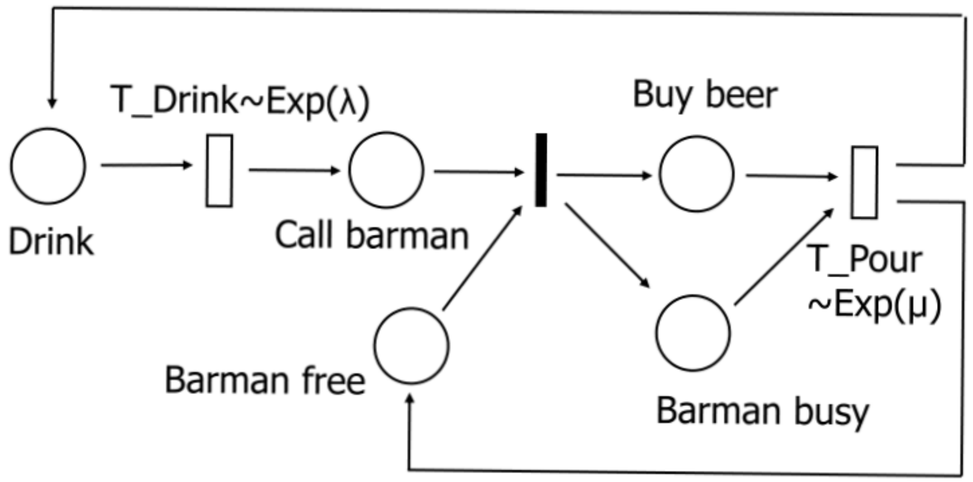
Average number of waiting customers?

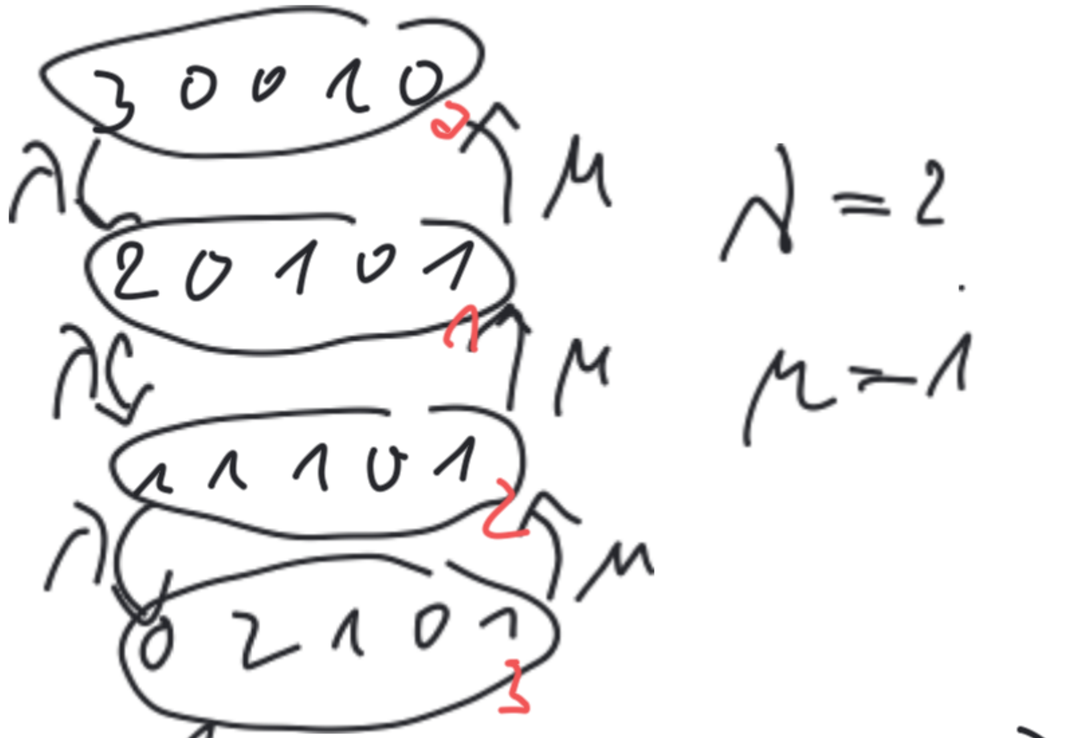


P (no customer is waiting)

Average number of waiting customers?




$$\begin{bmatrix} -2 & 2 & 0 & 0 \\ 1 & -3 & 2 & 0 \\ 0 & 1 & -3 & 2 \\ 0 & 0 & 1 & -1 \end{bmatrix}$$

$\Delta < \frac{1}{3}$ $(\pi_0\ \pi_1\ \pi_2\ \pi_3)$

$= 1/6$

$\pi_0 + \pi_1$

$\pi_2 \cdot 1 + \pi_3 \cdot 2$

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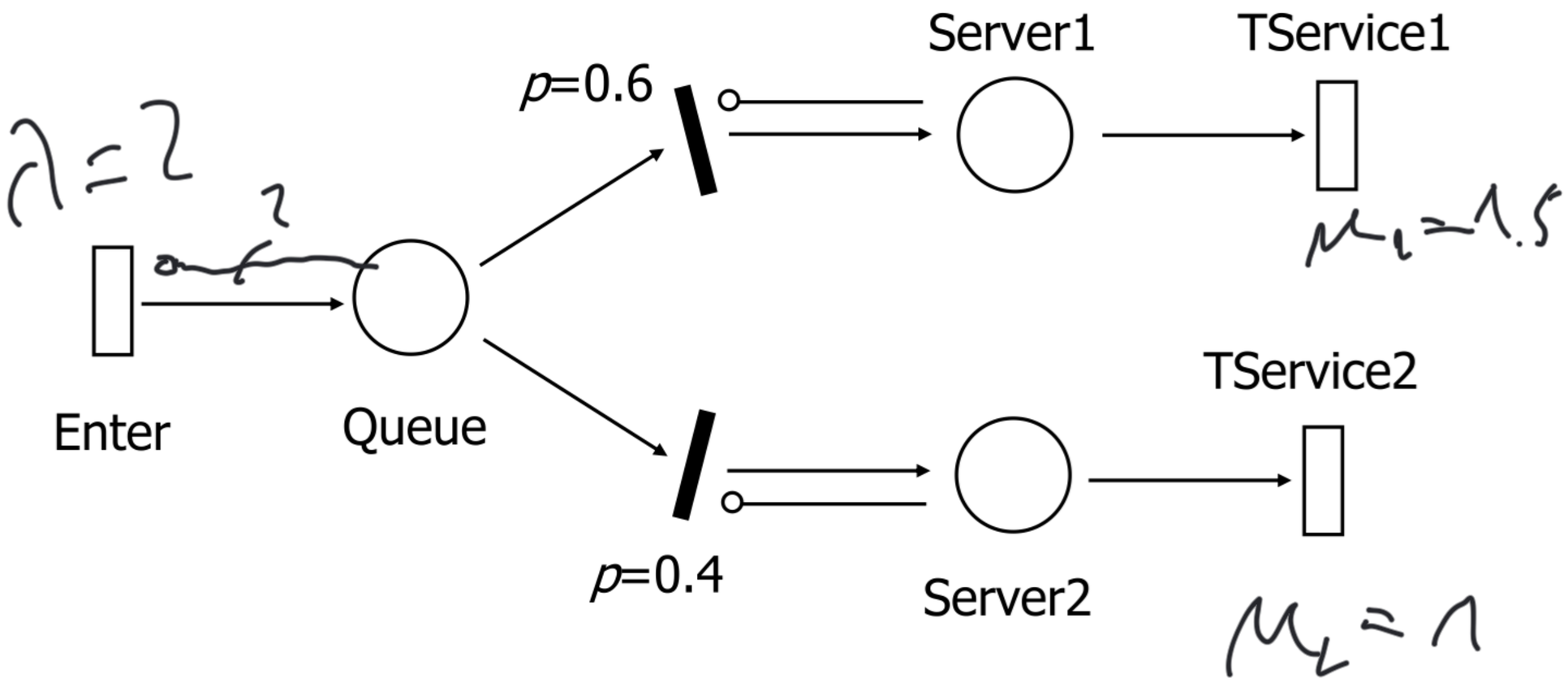
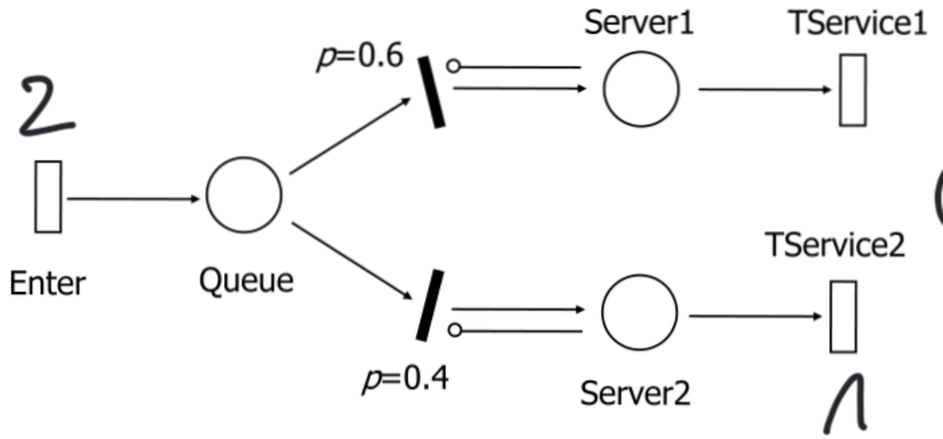
# Example: The Bank

## Utilization of Server 1/2?

## Throughput of the Bank



Utilization of Server 1/2?
Throughput of the Bank




$$\begin{bmatrix} -2 & 1.2 & 0.8 & 0 & 0 & 0 \\ 1.5 & -3.5 & 0 & 2 & 0 & 0 \\ 1 & 0 & -3 & 2 & 0 & 0 \\ 0 & 1 & 1.5 & -4.5 & 2 & 0 \\ 0 & 0 & 0 & 2.5 & -4.5 & 2 \\ 0 & 0 & 0 & 0 & 2.5 & -2.5 \end{bmatrix} \begin{matrix} \Pi_1 + \Pi_3 + \Pi_4 \\ + \Pi_5 \\ \Pi_2 + \Pi_1 + \Pi_4 + \\ \Pi_5 \\ u_1 \cdot \mu_1 \\ + u_2 \cdot \mu_2 \\ \Delta = 0.1 \end{matrix}$$