INF

FAKULTÄT FÜR
INFORMATIK

Applied Discrete Modelling

CTMC - Examples

Queuing Systems

Kendall's Notation: A / B / c / k / m – Z

- A – Arrival process: M, MAP, G, PH
- B – Service Process: – " –
- c – Number Servers
- k – System Capacity
- m – Calling Population
- Z – Queuing Discipline: FIFO, …

Standard Queue: M/M/1

limited Space Queue : M/M/1/K

Call Center: M/M/S/K

Jet Plane

A commercial jet airplane has 4 engines, two on each wing

Each engine fails at a rate of λ while being used in flight

If a failure takes place in flight, there can be no repair!

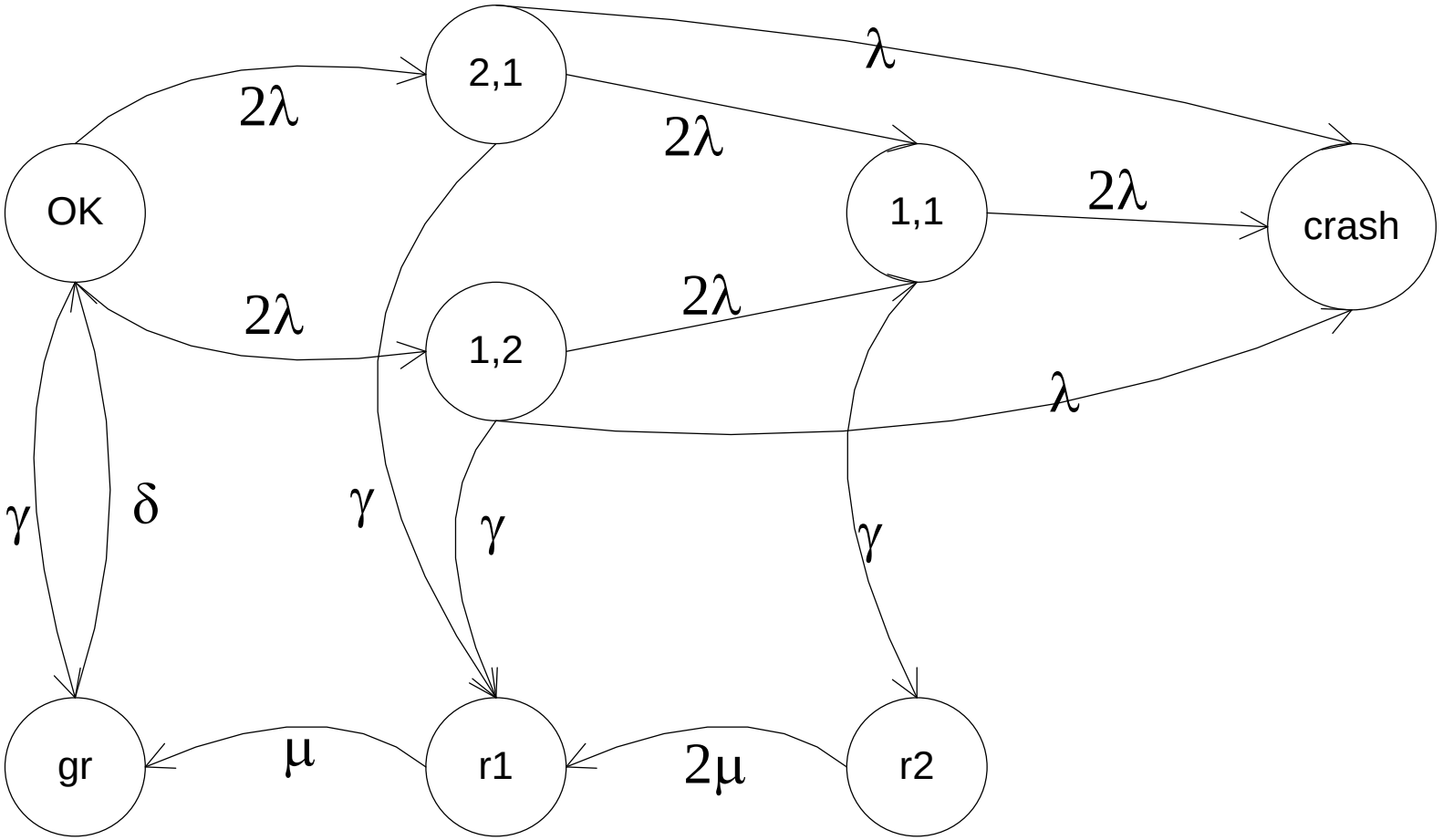
The airplane needs at least one engine on each wing to function properly

Once grounded, the engines need repair, that is finished at a rate of μ

Each flight ends with a rate of γ

Once it is repaired i.e. all 4 engines are functioning, the rate to start again is δ

Markov Chain



Generator Matrix

$$\pi = (\pi_{OK}, \pi_{2,1}, \pi_{1,2}, \pi_{1,1}, \pi_{crash}, \pi_{r2}, \pi_{r1}, \pi_{gr})$$

$$Q = \begin{bmatrix} -(\gamma+4\lambda) & 2\lambda & 2\lambda & 0 & 0 & 0 & 0 & \gamma \\ 0 & -(\gamma+3\lambda) & 0 & 2\lambda & \lambda & 0 & \gamma & 0 \\ 0 & 0 & -(\gamma+3\lambda) & 2\lambda & \lambda & 0 & \gamma & 0 \\ 0 & 0 & 0 & -(\gamma+2\lambda) & 2\lambda & \gamma & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -2\mu & 2\mu & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -\mu & \mu \\ \delta & 0 & 0 & 0 & 0 & 0 & 0 & -\delta \end{bmatrix}$$