PEVA Cheat Sheet 1

Lecture 1 General

Amdahl's law: $T(n) = (1-\alpha) \cdot t + \alpha \cdot \frac{t}{n}$, $lim_{n \to \infty}\ S(n) = \frac{1}{1-\alpha}$
Kendall notation for queues:
arrivals | service | servers | buffersize | population | scheduling

`arrival`	Distribution of interarrival time
`service`	Distribution of service time
`servers`	Number of servers.
`buffer size`	Maximum number of customers in queueing station (including servers).
`population`	Number of customers in and outside the queueing station.
`scheduling`	Employed scheduling strategy.

Lecture 2 DTMCs

Limiting distribution: $\underline{v}(P-I) = \underline{0}$ and $\sum_j v_j = 1$

$$(P-I) = \begin{pmatrix} -0.1 & 0.1 \\ 0.4 & -0.4 \end{pmatrix} \implies \begin{aligned} -0.1v_0 + 0.4v_1 = 0 \\ 0.1v_0 - 0.4v_1 = 0 \end{aligned}$$

`recurrent`	A state is recurrent if we return to it with probability 1.
`transient`	A state is transient (or nonrecurrent) if there is a positive probability of not returning to this state.
`positive recurrent`	A state is positive recurrent (or recurrent non-null) if its mean recurrence time is finite.
`null recurrent`	A state is null recurrent if its mean recurrence time is infinite.
`absorbing`	A state i is absorbing if and only if pi,i = 1.
`period`	The period d_i of state i is the greatest common divisor of all the values n for which $p_{i,i}(n) > 0$.
`irreducible`	A DTMC is called irreducible if every state can be reached from every other state in a finite number of steps. In an irreducible DTMC, all states have the same period.
`Markov property`	Future evolution (next state) only depends on the current state, not on the past history!
`time-homogeneous`	DTMCs are time-homogeneous: the matrix **P** does not change over time.

Lecture 3 CTMCs

For each state i, introduce rate q_i for an exponentially distributed residence time; mean residence time is $1/q_i$.

Compute steady-state of CTMC by: **1.** GBEs or "fluxin, fluxout", **2.** Determine steady-state of embedded DTMC and renormalize $\underline{v}$ with $p_i = (\frac{v_i}{q_i})\ div\ (\sum_j \frac{v_j}{q_j})$, **3.** Generator Matrix **Q** with $q_{i,j} = q_i \cdot p_{i,j},\ i \neq j$ and $-q_i,\ i = j$. With **Q**, solve $\underline{p} \cdot \mathbf{Q} = \underline{0}$.

Lecture 4

`FCFS`	First come, first served.
`RR`	Round robin.
`PS`	Processor sharing.
`SJN`	Shortest job next.
`LCFS`	Last come, first served.
`IS`	Infinite server.
`PRIO`	priority scheduling.
`PASTA`	Poisson Arrivals See Time Averages.

What is the expected number of jobs in the system in steady state?
1. compute steady-state probabilities using GBEs or something else,
2. use steady-state probabilities to compute expectation.
$E[N] = \sum_{i=0}^{n} i \cdot p_i$.
If server is infinite (like with a M|M|1 queue), the expected number of customer:
In system, $E[N] = \frac{\rho}{1-\rho}$.
In queue, $E[N_q] = \frac{\rho^2}{1-\rho}$.
In server, $E[N_s] = \rho$.
Little's Law helps to go from **system-oriented** measures tot **user-oriented** measures.

Little's law for:	
`Full station`	$E[N] = \lambda \cdot E[R]$, with $E[R]$ as the expected response time, average time each customer spends in system.
`Queue only`	$E[N_q] = \lambda \cdot E[W]$, with $E[W]$ as average waiting time.
`Server only`	$\rho = \lambda \cdot E[S]$, with $E[S]$ as average service time.

For finite stations with one server:	
`Little's law`	$E[N] = X \cdot E[R]$, with $X = \mu$ if overloaded
`Loss prob p_{m}`	probability that an arriving job has to leave because the buer is full (PASTA)
`Throughput`	$X = \lambda \cdot (1-p_m) = \mu \cdot (1-p_0)$, number of jobs served per time unit
`Utilization`	$X \cdot E[S] = 1 - p_0$

For infinite stations with m server:	
`Utilization`	For each individual server $\rho = \frac{\lambda}{m \cdot \mu}$
`Expected busy servers`	For each individual server $m \cdot \rho = \frac{\lambda}{\mu}$

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Lecture 5

Lecture 6