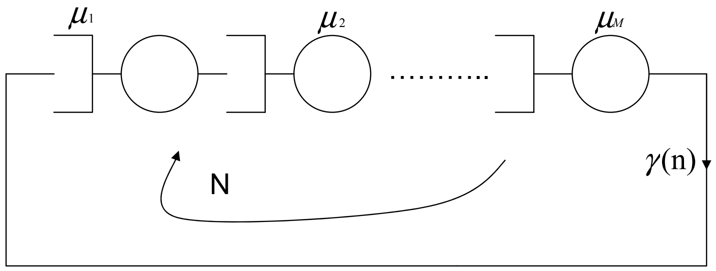
ECE 642
Lecture 13 - Excerpts

Mean value analysis



- $1/\mu_i$: service time at queue i.
- $\overline{t_i}$: average delay at queue i.

$$\overline{t_i} = 1/\mu_i + 1/\mu_i(\text{average number of packets on arrival})$$

- $\mu_i\overline{t_i}$(N) = average number of packets waiting at queue i, when N packets are in the network.
- $\overline{n_i}$(N) = average number of packets in queue i when N packets in network.

Procedures to get the mean values:

1. Set $\overline{n_i}(0) = 0$ for $\forall i \epsilon [1, M]$.
2. Set $\mu_i\overline{t_i}(N) = 1 + \overline{n_i}(N-1)$ for $\forall i \epsilon [1, M]$.
3. $\gamma(N) = \frac{N}{\sum_{i=1}^{M} \overline{t_i}(N)}$
4. $\overline{n_i}(N) = \gamma(N)\overline{t_i}(N)$

For example, $\mu_1 = \mu_2 = \mu_3 = ... = \mu_M = \mu$, calculate the mean value for different N.

For N=1:

1.
$$\mu\overline{t_i}(1) = 1 + \overline{n_i}(0) = 1$$
$$\Rightarrow \quad \overline{t_i}(1) = 1/\mu$$

2.

$$\gamma(1) = \frac{1}{\sum_{i=1}^{M} \overline{t_i}(1)} = \frac{\mu}{M}$$

$$\Rightarrow \quad \overline{t_i}(1) = \frac{1}{M}$$

3.

$$\overline{n_i}(1) = [\gamma(1)/\mu]\mu\overline{t_i}(1) = \frac{1}{M}$$

For N=2

1.

$$\mu\overline{t_i}(2) = 1 + \overline{n_i}(1) = 1 + \frac{1}{M} = \frac{M+1}{M}$$

2.

$$\gamma(2) = \frac{2}{\sum_{i=1}^{M} \overline{t_i}(2)} = \frac{2\mu}{M+1}$$

3.

$$\overline{n_i}(2) = [\gamma(2)/\mu]\mu\overline{t_i}(2) = \frac{2}{M}$$

So for N=N,

$$\overline{n_i}(N) = \frac{N}{M}$$

$$\gamma(N) = \frac{N\mu}{M-1+N}$$