CS5229

2010/2011 Semester 1

HW1

(80 points)

Due: Sep 9, 2010 (submit hardcopy in class)

Note:

1. **Late submission will have a 10% penalty.**
2. **Latest submission by 23:59, Sep 10.**

Week 1

1) (10pt) Read New Times Headlines: Google and Verizon Near Deal on Web Pay Tiers.
    a. What is net neutrality?
    b. Do you think net neutrality is a good thing? Explain your point of view.

Week 2

For Questions 2 to 4, assume arrival is Poisson and service time is exponentially distributed.

2) (10pt) For a M/M/1 server, let λ=4/s.
    a. What is the minimum service rate if expected delay should be less than 3s.
    b. Let μ = 5/s. What is the 99 percentile of expected delay? This is the delay where 99% of all customer delays are either smaller than or equal to.

3) (10pt) There are 2 servers, each with service rate of 10 per second. The system can buffer 5 customers, including those being served. If the target blocking rate is 1%, what is largest load supported in terms of average customer arrival rate?

4) (10pt) Consider a M/M/2/5 system with modification and where λ=4/s and μ=5 /s. In order to save energy, a server will work only if there are at least 2 customers in the system. Nevertheless, once service starts, the server will serve a custom to completion. Compare to the "original" M/M/2/5 system,
    a. compute the increase in "idle" time where no server is active. This value indicates the energy saved;
    b. compute the change in blocking rate and expected delay. Briefly discuss the result.

Week 3

5) (20pt) The average service time of the M/G/1 system is given as $T = 1/\mu + \lambda E(x_2) / 2(1-\rho)$. There are 2 traffic flows and the service rate is 50kbps, where $E(x) = 1/\mu$

   • Packet arrival for flow 1 is exponentially distributed with mean 10 packets per second and the packet size distribution is 80% 40 bytes and 20% 1500 bytes.

   • Packet arrival for flow 2 is exponentially distributed with rate 40 packets per second and the packet size is always 50 bytes.

   a. (5pt) Compute the average service time E(x).
   b. (5pt) Compute the average waiting time (T) if the 2 flows share a single FIFO schedule.
   c. (5pt) Compute the average waiting time (T) for flow 2 if it is served by a single server serving at 20kbps. (Flow 1 is served by a single server with rate 30kbps.)
   d. (5pt) Explain the pros and cons of using the approach in part (b) and (c), therefore using FIFO or two separate servers.

Week 4 (20pt)

6) (16pt) Based on the analysis by Chiu and Jain, what are the problems with a
   a. (8pt) multiplicative increase and multiplicative decrease algorithm
   b. (8pt) multiplicative increase and additive decrease algorithm

7) (4pt) Compute the max-min fair allocation for sources A,B,C,D and E with demands 2, 3, 4, 4, 5 respectively. The resource size is 15.