

**COMP SCI/SFWR ENG 4E03 — Questions for 9/30 Tutorial**

1. Consider a system with  $N$  users, a CPU and two disks. A request from the users first visits the CPU. After processing at the CPU, with probability 0.8 the request visits disk  $A$ , 0.16 it visits disk  $B$  and 0.04 it is completed and returns to the user. After processing at either disk, the request returns to the CPU. The average think time of each user is 5 seconds, the average processing times (per visit) at the CPU, disk  $A$ , and disk  $B$  are 30, 25 and 40 milliseconds, respectively.
  - (a) What is the bottleneck device?
  - (b) What is the maximum possible system throughput (measured at the users)?
  - (c) Plot an upper bound on the system throughput as a function of  $N$ .
  - (d) What is the maximum possible disk  $B$  utilization?
  
2. A server that is used for compilation jobs is monitored and reveals the following performance data (compilations are the only activity performed by the server):
  - Average number of active user logins: 230
  - Average time to generate a new compilation request: 300 seconds per user
  - Average server utilization: 48 percent
  - Average CPU processing demand: 0.63 seconds per compilation
  - (a) What is the system throughput (in compiles per second)?
  - (b) What is the average compilation time (from compilation submission by a user to completion)?
  
3. In a timesharing system, accounting log data produced the following profile for user programs
  - each program requires 5 seconds of CPU time, makes 80 I/O requests to disk  $A$  and 100 I/O requests to disk  $B$
  - average think-time of a user was 18 seconds
  - from the device specifications, it was determined that disk  $A$  takes 50 milliseconds to satisfy an I/O request and disk  $B$  takes 30 milliseconds per request
  - with 17 users, disk  $A$  throughput was observed to be 15.70 I/O requests per second

Find the system throughput and the utilizations of the CPU, disk  $A$  and disk  $B$ .