College of Computer Science
Northeastern University
COM 1722: Freshman Honors Seminar

Winter 2003
Handout 8
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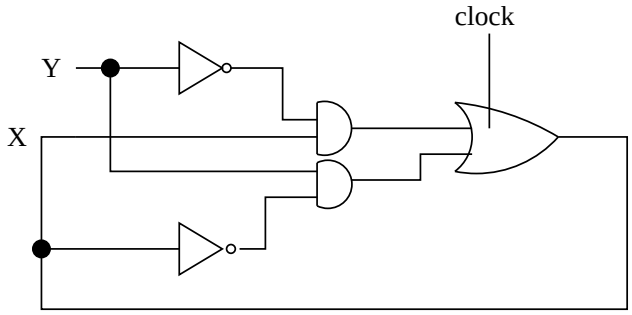
Sample Solution to Quiz 2

1. What does the following clocked circuit implement?



Answer: We can write $X_{t+1} = Y_t \cdot \overline{X_t} + \overline{Y_t} \cdot X_t$. Thus the signal x toggles whenever Y is 1 at the clock tick. (One can also view it as $X_{t+1} = X_t \oplus Y_t$.)

2. Scheduling

Recall that the shortest remaining processing time algorithm (SRPT) schedules, at each time step, the job that has the smallest remaining processing time.

Suppose we have the following instance of job arrivals. Two jobs, one of size 4 (time units) and another of size 1 arrive at time 0. Thereafter, jobs of size 2 arrive every 2 time units (that is, at times 2, 4, 8, ...) until time 10 when the last job arrives. If we choose SRPT as our scheduling policy, when will the job of size 4 complete. What is the average response time of SRPT for this instance? (Recall that the size of a job is its processing time and the response time for a job is the time the job spends in the system – from the time it arrives until the time it gets completed.)

Had we chosen a round-robin scheduling policy, would the completion time of the job of size 4 increase? Would the average response time decrease? (You need not compute the complete round-robin schedule.)

Answer: SRPT will execute the job of size 1 first, then 1 unit of the job of size 4. At time 2, we will have a stream of 5 jobs, each of size 2, coming every 2 units. SRPT will give priority to all the shorter jobs. Thus, until time 12, SRPT will be working on the size 2 jobs. Then, SRPT will complete the remaining 3 units of the size 4 job. The response time for the job of size 1 is 1, for each job of size 2 is 2. The response time for the job of size 4 is 15 since that is when it gets completed. So the average response time is $(1 + 2 \times 5 + 15)/7 = 26/7$.

Yes, the completion time of the job of size 4 will decrease in a round-robin schedule since it will be allocated some time units when the size 2 jobs are coming. The average response time will *increase*, however, because completing the job of size 4 earlier increases the response time for *every* job of size 2. SRPT always gives the schedule with the least average response time; round-robin does not.