Errata: A New Algorithm for Scheduling Periodic, Real-Time Tasks

Bala Kalyanasundaram *
Computer Science Department
University of Pittsburgh
kalyan@cs.pitt.edu

Kirk R. Pruhs *
Computer Science Department
University of Pittsburgh
kirk@cs.pitt.edu

Eric Torng †
Department of Computer Science and Engineering
Michigan State University
torng@cse.msu.edu

Two well known algorithms for real-time scheduling are the Least Laxity First (LLF) algorithm, and the Earliest Deadline First (EDF) algorithm. The EDF algorithm always runs the jobs with earliest deadline. The LLF algorithm always runs the jobs with least laxity; The laxity of a job is its deadline minus the sum of its remaining processing time and the current time. In the paper [1], it was claimed that every instance schedulable by EDF on m processors is also schedulable by LLF on m processors. We show that this claim is, in fact, incorrect. We give an instance $I = \{J_1, J_2, J_3, J_4, J_5, J_6\}$, such that EDF completes all jobs in I by their deadline on two processors, while LLF does not complete every job in I by its deadline on two processors.

We use the notation $J_i = (r_i, x_i, d_i)$ to denote that the arrival time of the job J_i is r_i, the length of the job J_i is x_i, and the deadline of the job J_i is d_i. The instance I is then:

$$J_1 = (0, 1, 5);\ J_2 = (0, 1, 5);\ J_3 = (0, 3, 6);\ J_4 = (1, 3, 9);\ J_5 = (4, 5, 9);\ J_6 = (4, 5, 9)$$

It is easy to observe that EDF completes all the jobs by their deadlines. Now consider LLF. During the interval $[0, 2]$, LLF schedules J_3 on one processor while J_1 and J_2 equally share the second processor. Observe that LLF ignores J_4 during the interval $[1, 2]$ since the laxity of J_4 is at least 4 while the laxity of jobs J_1, J_2, and J_3 are strictly less than 4. Now, during the interval $[2, 3]$, LLF runs J_3 on one processor, and J_4 on the other processor. The job J_3 is completed at time 3. The algorithm LLF runs J_4 on one processor during the interval $[3, 4]$, and idles the other processor. At time 4, LLF now has 11 remaining units of work that must be completed by time 9 (1 from J_4, 5 from job J_5, and 5 from J_6). However, LLF only has 10 units of processing time available by time 9. Thus, LLF cannot schedule all of the jobs by their deadlines.

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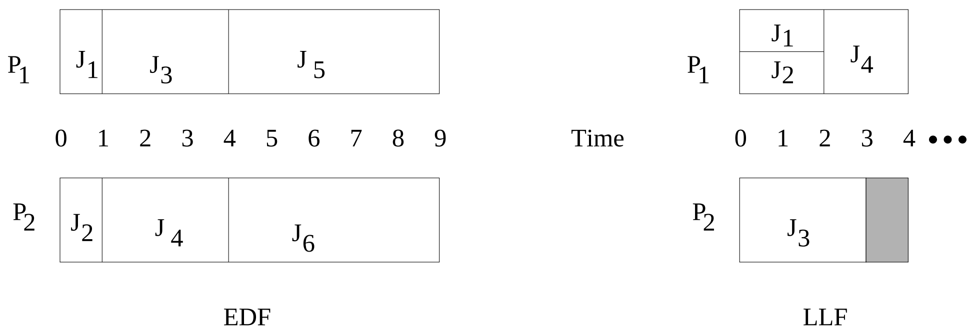

Figure 1: The Gantt charts

References

[1] J. Leung, A New Algorithm for Scheduling Periodic, Real-Time Tasks, *Algorithmica*, **4**, pp. 209–219, 1989.