CPEN 432: Homework Assignment 6

Deadline: 11:59 PM, 18 April, 2022

Note: This is the sixth and the last homework assignment. We will consider the best five homework assignment grades out of six when grading.

1 Multiprocessor Scheduling [26 points]

Consider the following task set.

Task	C_i	D_i	T_i
τ_1	1	1	10,000
τ_2	2	2	10,000
τ_3	3	4	10,000
τ_4	2	4	10,000
τ_5	501	1,000	1,000
τ_6	5,001	10,000	10,000
τ_7	5,000	10,000	10,000

1.1 Partitioned Scheduling [10 points]

Show that the aforementioned taskset cannot be partitioned onto a two-processor system, *i.e.*, on a multiprocessor with $m = 2$.

1.2 Global Fixed-Priority Scheduling [16 points]

Show that the aforementioned taskset is not schedulable using global fixed-priority scheduling. Note that unlike on preemptive uniprocessors, rate monotonic (RM) priority assignment is no longer optimal for global scheduling upon multiprocessors. Hence, you need to show that no matter how the tasks are prioritized, the taskset can never be successfully scheduled. Hint: Synchronous arrivals may not be the worst-case scenario.

2 Event Arrivals with a Minimum Distance [24 points]

In Lecture 23, we discussed the "periodic with jitter" event model, which is modeled using time period T and jitter J. Based on the parameter values, one way to classify different types of arrival patterns is as follows.

- Strictly periodic (if $J = 0$)
- Periodic with jitter (if $0 < J < T$)
- Bursty patterns (if $J > T$)
- Sporadic (if $J = \infty$)

Since bursty patterns (*i.e.*, when $J > T$) can result in more than one arrivals at the same time, the "periodic with jitter" model is often enhanced with another parameter d_{min}, which denotes the minimum distance between two consecutive events.

2.1 Definitions [12 points]

Define the upper and lower event functions $\eta^u(\Delta t)$ and $\eta^l(\Delta t)$ (respectively) as well as the minimum and maximum distance functions $\delta^{min}(N \geq 2)$ and $\delta^{max}(N \geq 2)$ (respectively) as a function of time period T, jitter J, and minimum distance d_{min}. *Provide explanations for your definitions.*

2.2 Graphs [12 points]

Recall the event and distance function graphs for the bursty event stream $(T, J) = (30, 60)$ from Lecture 23. Plot similar event and distance function graphs but considering that the event arrivals are limited by a minimum distance of 10 time units, *i.e.*, for the event stream $(T, J, d_{min}) = (30, 60, 10)$.