Real-Time Systems Spring 2006

Exercise 2/7 (Tue 21.3.2006)

1) Three logical processes P, Q, and S have following attributes: P (2, 1), Q (6, 2), and S (18, 5).
   a) Can these tasks be scheduled by RM scheduler? If they are schedulable give schedule and if not give counter example.
   b) Can these tasks be scheduled by EDF scheduler? If they are schedulable give schedule and if not give counter example.

2) Consider a system that has five periodic tasks A,B,C,D, and E; and three processors P1, P2, P3. The periods of A, B, and C are 2 and their execution times are equal to 1. The periods of D and E are 8 and their execution times are 6. The phase of every task is 0, that is, the first job of the task is released at time 0. The relative deadline of every task is equal to its period.
   a) Show that if the tasks are scheduled dynamically on three processors according to the LST algorithm, some jobs in the system cannot meet their deadlines.
   b) Find a feasible schedule of the five tasks on three processors.
   c) Parts (a) and (b) allow us to conclude that the LST algorithm is not optimal for scheduling on more than one processor. However, when all the jobs have the same release time or when they have the same deadline, the LST algorithm is optimal. Prove this statement.

(Liu 4.4)

3) Each of the following systems of periodic tasks is scheduled and executed according to a cyclic schedule. For each system, choose an appropriate frame size. Preemptions are allowed, but the number of preemptions should be kept small. The tasks are defined by (p,e) or (p,e,d) or (ϕ,p,e,d), where ϕ is phase, p ie period, e is execution time and d is deadline.
   a) (6, 1), (10, 2) and (18, 2)
   b) (8, 1), (15, 3), (20, 4) and (22, 6)
   c) (9, 5.1, 1, 5.1), (8, 1), (13, 3) and (0.5, 22, 7, 22)

(Liu 5.1)

4) Which of the following systems of periodic tasks are schedulable by the rate-monotonic algorithm? By the earliest-deadline-first algorithm? Explain your answer.
   a) T = { (8,3), (9,3), (15,3) }
   b) T = { (8,4), (12,4), (20,4) }
   c) T = { (8,4), (10,2), (12,3) }

(Liu 6.5)

ESSAY: Write a one or two page essay or report. Return it on paper at the latest on the weekly meeting. If you cannot participate, you may send it (in pdf format) via email to the lecturer. It is also possible to submit on paper by giving it to the janitors in the first floor. Then you need to address it to Tiina Niklander.

Submitted essays will give you one additional point for the course. There will be one essay for each exercise session to write.

For this weeks essay, please read the articles

- Thiele, Lothar and Wilhelm, Reinhard: Design for Timing Predictability. Real-Time Systems, 28, 157-177, 2004. ja
- Moslehi, Khosrow et.al.: Distributed Autonomous Real-Time Systems for Power System Operations – A Conceptual Overview. Proceedings of Power System Conference and Exposition. IEEE PES. 10-13 Oct. 2004. pp.27-34 vol.1, 2004

Write a short (one or two pages) report or essay to discuss the question, how (well) do the ideas about the time predictability of the first paper appear in the second paper. Please create your own title depending on the approach you choose and the content of your essay.

To give some ideas, here are some suggestions for the title. Please remember that these are just suggestions, and that you should concider creating your own title.

”The effect of timing predictability in the usage of control agents in power system operations”
”Timing related threads, how to handle then in the design of power system operations”
”Timing predictability in distributed real-time systems, using power system as an example”
”The effects of layering in timing predictaibilily”