

## Exercise 3/7 (Tue 28.3.2006)

- 1) A system uses the cyclic EDF algorithm to schedule sporadic jobs. The cyclic schedule of periodic tasks in the system uses a frame size of 5, and a major cycle contains 6 frames. Suppose that the initial amounts of slack time in the frames are 1, 0.5, 0.5, 0.5, 1 and 1.
- Suppose that a sporadic job  $S_1$  (23,1) arrives in frame 1 before the beginning of frame 2, sporadic jobs  $S_2$  (16, 0.8) and  $S_3$  (20, 0.5) arrive in frame 2. In which frame are the accepted sporadic jobs scheduled?
  - Suppose that an aperiodic job with execution time 3 arrives at time 1. When will it be completed, if the system does not do slack stealing?

(Liu 5.2)

- 2) A system contains three periodic tasks. They are (2.5, 1), (4, 0.5), (5, 0.75), and their total utilization is 0.475.
- The system also contains a periodic server (2, 0.5). The Server is scheduled with the periodic tasks rate-monotonically.
    - Suppose that the periodic server is a sporadic server. What are the response times of the following two aperiodic jobs: one arrives at 3 and has execution time 0.75, and one arrives at 7.5 and has execution time 0.6.
    - Suppose that the period server is a deferrable server. What are the response times of the above two aperiodic jobs.
  - Note that the utilization of the periodic server in part a) is 0.25. We can give the server different periods while keeping its utilization fixed at 0.25. How will the answers to i) and ii) change if the period of the periodic server is 1.
  - Can we improve the response times by increasing the period of the periodic server?

(Liu 7.1)

- 3) Repeat the question 2 when the whole task set is scheduled using earliest-deadline-first algorithm?

- 4) Old exam: Is the task set described in the table schedulable with

- RM (Rate Monotonic) or
- EDF (Earliest Deadline First)?
- Is it possible to add one more task to the set? What are its parameters?

Justify your answers using suitable alternatives of the schedulability tests presented in the book (schedulable utilisation, time-demand analysis, creating the schedule by simulating algorithm). If the task set is not schedulable in a) or b), what modifications are needed to make it schedulable.

<i>Tehtävä</i>	<i>Saapumisaika</i>	<i>Laskennan kesto</i>	<i>Jakson pituus</i>
A	0	2	10
B	0	8	15
C	5	1	20
D	10	3	25
E	15	2	30

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.

This week you can choose one of following three article and write the essay based on the ideas that came to your mind when reading the article. Try not to write an abstract or summary of the article. It is more preferable to write more like a learning diary. What impact the article had to your thinking or learning or ...

Choose one of the following articles:

The Giotto article describes the whole engineering process for embedded systems. It is quite easy to read.

- a) Henzinger, T.A., Kirsch, C.M., Sanvido, M.A.A., and Pree, W., *From control models to real-time code using Giotto*. IEEE Control Systems Magazine. Volume 23, Issue 1, Feb. 2003 Page(s):50 – 64. Digital Object Identifier 10.1109/MCS.2003.1172829

Next article describes how we can add time-related information to an existing description (or design) tool called SDL and MSC. To follow the article may require some previous knowledge about the techniques.

- b) Wang, S., and Tsai, G. *Specification and Timing Analysis of Real-Time Systems*. Real-Time Systems, 28, 69-90, 2004.

Third article attacks the software engineering process from the view point of programming languages and compilers. The described language is based on c. So, previous knowledge of c may help the reading. If you choose this article, you could think how the presented restrictions influence the program writing.

- c) Kowshik, S., Dhurjati, D., and Adve, V. *Ensuring code safety without runtime checks for real-time control systems*. In Proceedings of the 2002 international Conference on Compilers, Architecture, and Synthesis For Embedded Systems (Grenoble, France, October 08 - 11, 2002). CASES '02. ACM Press, New York, NY, 288-297. 2002.  
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