Real-Time Systems Spring 2006

Exercise 4/6 (Tue 4.4.2006)

1) A system contains the five jobs. There are three resources X, Y and Z. The resource requirements of the jobs are listed below. The priority Ji is higher than the priority of Jj for I<j. What are the maximum blocking times of the jobs under the nonpreemptable critical-section protocol (NPCS) and under the priority-ceiling protocol?
J1: [X;2]; J2: none; J3: [Y;1]; J4: [X;3 [Z;1]]; J5: [Y;4 [Z;2]]

(Liu 8.1)

2) A fixed-priority system contains five tasks. There are two kinds of resources X and Y. The resource X has 3 units and Y has 2 units. The resource requirements of the tasks are as follows. The priority of Ti is higher than the priority of Tk if i<k.
T1: [X,1; 3]; T2: [Y,1; 4]; T3: [Y,1; 4 [X,3; 2]]; T4: [X,1; 4][Y,2; 2]; T5: [Y,1; 3]
   a) Suppose that the system uses the stack-based priority-ceiling protocol. What are the maximum blocking times of the jobs?
   b) Suppose that these periodic tasks have the following parameters: T1=(40,5,20), T2=(30,5,25), T3=(35,5,30), T4=(60,6,40), and T5=(55,5,50). Are these tasks schedulable? Explain your answer.

(Liu 8.6)

3) A system contains the following four periodic tasks T1=(6,3,[X;2]), T2=(20,5,[Y;1]), T3=(200,5,[X;3[Z;1]]), and T4=(210,6,[Z;5[Y;4]]). Compare the schedulability of the system when the priority-ceiling protocol is used versus the NPCS protocol.

(Liu 8.7)

4) Given a system consisting of the following tasks, whose periods, execution times, and resource requirements are:

T1=(2, 0.4, [X,3; 0.3])
T2=(3, 0.75, [X,1; 0.3][Y,1; 0.4])
T3=(6, 1.0, [Y,1; 0.4][Z,1; 0.5 [X,1; 0.4]])
T4=(8, 1.0, [X,1; 0.5][Y,2; 0.1][Z,1; 0.4])

There are 3 units of X, 2 units of Y, and 1 unit of Z. The tasks are scheduled by the EDF algorithm and the stack-based priority-ceiling protocol.
   a) Find the preemption ceiling of each resource and the maximum blocking time for each task.
   b) Are the tasks schedulable according to the earliest-deadline-first algorithm? Why?

(Liu 8.10)

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 two articles 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:

a) Kihwal Lee and Lui Sha: *Process resurrection: a fast recovery mechanism for real-time embedded systems*. In Proc. of Real Time and Embedded Technology and Applications Symposium, 2005. RTAS 2005. 11th IEEE 7-10 March 2005 Page(s):292 – 301. Digital Object Identifier 10.1109/RTAS.2005.42

   The article discusses about fast recovery (or restart) of processes. The restart is so fast that a failed process might be able to redo its task before the actual deadline. Discuss the articles approach in your essay for example from the viewpoint of a single programmer. Alternative you could discuss the approach from a more general viewpoint.

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b) Botaschanjan, J., Kof, L., Kühnel, C., and Spichkova, M. 2005. *Towards verified automotive software*. In Proceedings of the Second international Workshop on Software Engineering For Automotive Systems (St. Louis, Missouri, May 21 - 21, 2005). SEAS '05. ACM Press, New York, NY, 1-6. DOI= http://doi.acm.org/10.1145/1083190.1083199.

   The articles lists briefly all kinds of features related to the safety and reliability of the new computer-based systems for automobiles. The Verisoft project has published several other articles. You can change the article to one of the others if you want. Write essay based on the ideas, notions, views that came to your mind while reading the article. How do you see the feasibility of the approach, would you trust the car using such a system, etc.