Exam in Real Time Systems

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Cover Sheet

Problem no.	Solution provided	Max	Your points
1		5	
2		8	
3		4	
4		4	
5		8	
6		4	
7		4	
8		11	
	Total:	33/44	

Name : .....

Pers.no. : .....

Exam Rubric

All answers should be written in English or Swedish (English is preferred). A mark of 50% is required for a G a mark of 85% is required for a VG. If you are registered on the 5 point version of this course you must answer all questions are your final mark will be calculated out of 44. If you are on the 4 point version of the course you do not need to answer question 8 and your final mark will be calculated out of 33.

Hjälpmedel:

Pen,pencil, ruler,rubber, dictionary.

Obs

Please indicate if you are registered for MN1 (5 points) or DV1 (4 points).

1. General Questions on Real-time systems.

   (a) What is the distinction between a hard and a soft real time system? Give at least one example of each. (**points 2**)

   (b) Discuss the following statement "A Real-time systems is a fast system". (**points 2**)

   (c) Why might a real-time programmer not use dynamic memory allocation in a real-time system. (**points 1**)

2. Types of Schedules.

   (a) What is a static schedule and what are the advantages and disadvantages of using a static schedule. To get all the points in this question you should give an example of a Static Schedule. (**points 4**)

   (b) What is the difference between a fixed priority schedule and an Earliest Deadline First (EDF) Schedule. Why might a fixed priority schedule be used over a fixed priority schedule? (**points 3**)

   (c) How and why can aperiodic processes be incorporated in fixed priority scheduling analysis? (**points 1**)

3. Consider the processes below. Determine if they are schedule when using a fixed priority rate-monotonic schedule (assuming independence, etc..)

Process	**Execution time**	**Period**
P_1	2	10
P_2	2	14
P_3	3	5
P_4	2	6
P_5	4	13

   (**points 4**)

4. Assume a (hard) real-time system with the three processes P_1, P_2, and P_4 executing on a CPU. The following system parameters are known:

Process	Period	Deadline	wcet
P_1	10	5	1
P_2	12	9	2
P_3	7	7	3

   (a) Which is the optimal priority order (and why?)? (**points 1**)

(b) Calculate the worst case response time for P_1, P_2, (**points 2**) and P_3.

(c) Are the processes schedulable? (**points 1**)

5. Assume a (hard) real-time system with the four processes P_1, P_2, P_3 and P_4 executing on a CPU. The processes share some resources guarded by the semaphores S_1, S_2 and S_3. The following system parameters are known:

Process	Period	Deadline	WCET	Max time in CS		
				S_1	S_2	S_3
P_1	12	10	3	–	–	1
P_2	7	4	2	1	–	0.1
P_3	20	19	1	1	2	0.5
P_4	5	5	1	0.2	0.3	–

Assume *deadline monotonic* priority order and that the immediate inheritance protocol is used.

(a) What is the priority order for the task set? (**points 1**)

(b) What is the blocking factor for each task? (**points 3**)

(c) What is the worst case response time for each task? (**points 3**)

(d) Is the task set schedulable? (**points 1**)

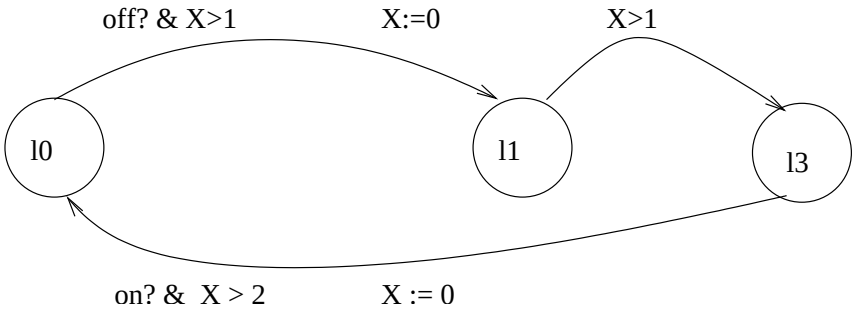
6. The CAN Bus.

(a) Briefly describe the CAN arbitration mechanism? (**points 2**)

(b) When doing scheduling on the CAN bus messages are non-preemptive describe what this means and how it affects the analysis. (**points 2**).

7. Timed Automata

(a) Given the following timed automata:



Which has one real-time clock X assuming that the automata starts in state $l0$ is it possible to be in location $l3$ with the clock X having value 4. You should justify your answer with a sequence of timed transitions. (**points 2**)

(b) What is the minimum and maximum time that the system has to wait in location $l3$? Justify your answer (**points 2**)

8. Consider the following task set:

Task	T_i	C_i	D_i
1	7	1	7
2	10	2	10
3	20	6	12

(a) What is the total CPU utilisation of the task set? (**points 1**)

(b) Assign priorities according to deadline monotonic. What is the priority order? (**points 1**)

(c) Calculate the response times. What are the response times and will all deadlines be met? (**points 2**)

(d) Now, lets assume the task set is to be scheduled by a *non-preemptive* scheduler. Derive the response-time equation to calculate response times in a non-preemptive system. (**points 5**)

(e) Calculate the response times for the tasks in a non-preemptive system. What are the response times and will all deadlines be met? (**points 2**)

Hint 1: You have seen analysis for non-preemptive systems when we studied analysis of the CAN bus.

Hint 2: Even if you cannot derive the response-time equation in this you may find the response-times by doing a manual critical instant simulation.

Good Luck