Exam in Real Time Systems - TF/EIP omtenta

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2004-12-20 15-20.

Cover Sheet

This sheet should be handed in together with the exam.

Each problem must be solved on a separate sheet. Write your name on each sheet. Indicate below which questions you have answered.

Problem no.	Solution provided	Max	Your points
1		5	
2		3	
3		4	
4		3	
5		7	
6		6	
7		5	
8		7	
	Total:	28/40	

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 or a similar scheme for 3,4,5. If you are a TF student then you must only answer question 1-6 (other questions will not be marked). If you are doing the 5 point version you must answer all questions. If you are a distance student, you must do all the questions.

Hjälpmedel:

Pen,pencil, ruler,rubber, dictionary.

1. General Questions on Realtime systems.

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

   (b) What is the difference between static scheduling and dynamic scheduling? (**points 2**)

   (c) What sort of schedules are required for aperiodic tasks? (**points 1**)

2. Consider the processes below. Determine if they are schedulable when using rate-monotonic scheduling (assuming independence, etc..)

Process	**Execution time**	**Period**	
P_1	2	10	
P_2	4	30	(**points 3**)
P_3	1	20	
P_4	2	10	

3. Describe with example Earliest First Deadline (EDF) Scheduling. You should try to illustrate the difference between (EDF) Scheduling and fixed priority scheduling with your example. (**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	15	14	2
P_2	12	7	2
P_3	12	5	1

   (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.

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	15	10	3	–	–	1
P_2	8	4	2	1	–	0.1
P_3	20	20	5	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**)

6. The CAN Bus.

(a) Explain in detail (with examples) the CAN-bus arbitration mechanism. (**points 4**)

(b) Assume a CAN-like network using 5-bit identifiers and with a fixed frame/packet transmission time (including arbitration etc.) of 7ms. In the beginning of an arbitration cycle frames with the following identifiers enter arbitration from different nodes:

i. 11001
ii. 01101
iii. 01110
iv. 01010
v. 11100
vi. 00100

Assuming that no other frames will enter arbitration, after how long time will the transmission of frame with identifier 11001 be completed? (**points 2**)

Stop here if you are a TF Student!.

7. Consider the following task set with Jitter.

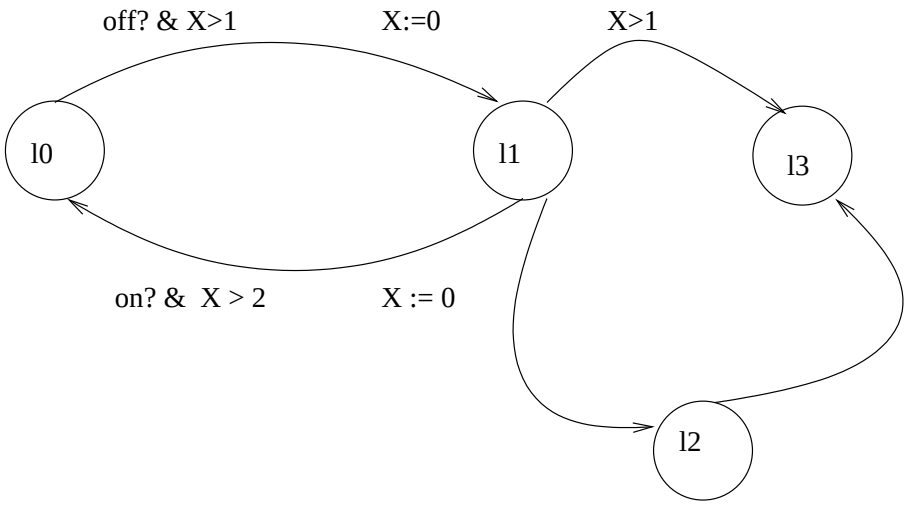
Task	T_i	C_i	D_i	$J_i^{smallest}$	$J_i^{biggest}$
1	6	2	5	1	1
2	5	1	3	1	2
3	20	5	15	2	3

(a) What is the optimal priority ordering? (**points 2**)

(b) What is the response-times for each task? (**points 3**)

8. Questions on Timed Automata.

   (a) Given the following timed automata:



   is it possible to reach the state $l3$ with the clock X equal to 0.5. Justify you answer with a sequence of timed transitions. (**points 2**)

   (b) You are to model a system using timed automata which is to act as a parental guard on a mobil phone. If the system is in the location `disabled` then the phone will not work. A mobil phone call can be upto 3 minutes after a phone call has been made the user must wait at least 5 minutes to use to the phone again. Model making the call with two events `startcall?` and `endcall?`. (**points 5**)