TECHNISCHE UNIVERSITÄT DRESDEN

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Networked Embedded Systems Group

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Exercise 1: Real-time Scheduling

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Task 1: Scheduling Function and Parameters of Real-time Tasks

A real-time system needs to execute four tasks J_1, J_2, J_3, and J_4. Their arrival times a_i and absolute deadlines d_i are listed in Table 1. The scheduling function $\sigma(t)$ is shown in Figure 1.

Table 1: Task set for Task 1.

	J_1	J_2	J_3	J_4
arrival time a_i	0	6	4	2
absolute deadline d_i	9	18	22	7

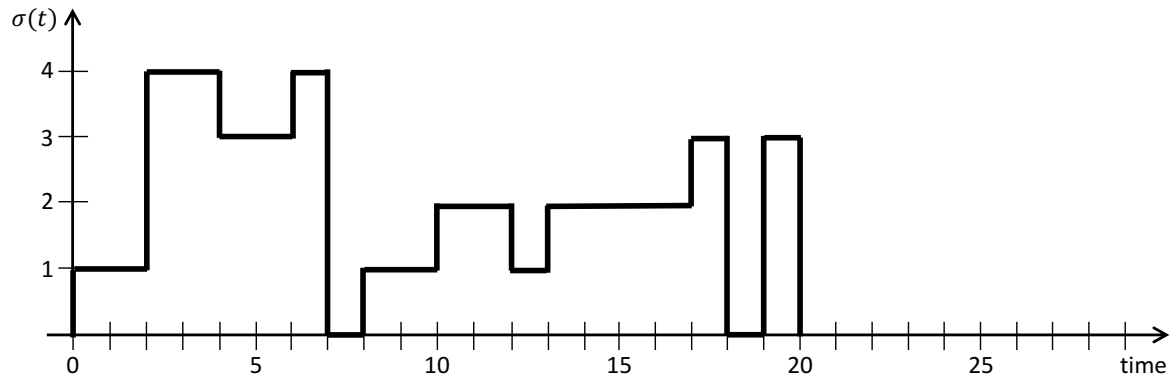

Figure 1: Scheduling function $\sigma(t)$ for Task 1.

(a) Determine the maximum lateness when tasks are executed according to the given scheduling function.

(b) Determine the laxity of each task.

(c) Compute the processor utilization U for the interval between time $t = 0$ and time $t = 20$.

(d) Is this schedule feasible? If not, modify the scheduling function so that the task set is schedulable.

Task 2: Earliest Deadline Due (EDD)

Check whether the Earliest Deadline Due (EDD) algorithm produces a feasible schedule for the task set in Table 2. The tasks are independent and arrive synchronously at time $t = 0$. Determine the schedule.

Table 2: Task set for Task 2.

	J_1	J_2	J_3	J_4
execution time C_i	6	2	4	3
relative deadline D_i	16	7	5	12

Task 3: Earliest Deadline First (EDF)

Given is a set of five tasks as shown in Table 3.

Table 3: Task set for Task 3.

	J_1	J_2	J_3	J_4	J_5
arrival time a_i	0	13	3	0	9
execution time C_i	3	4	2	5	2
absolute deadline d_i	17	19	6	8	15

(a) Determine the Earliest Deadline First (EDF) schedule. Is the schedule feasible?

(b) At time $t = 2$, a new task J_n arrives with execution time $C_n = 3$ and absolute deadline $d_n = 11$. Is the new task set (including J_n) still schedulable or do you need to reject the newly arrived task?

Task 4: Fixed-priority Scheduling: Rate Monotonic (RM)

Consider the set of periodic tasks given in Table 4; assume that the first instance of each task arrives at time $t = 0$ (i.e., the phases Φ_i are 0) and that relative deadlines are equal to periods (i.e., $D_i = T_i$).

Table 4: Task set for Task 4.

	τ_1	τ_2	τ_3
execution time C_i	1	2	3
period T_i	4	6	8

(a) Use the sufficient test to check if the task set is schedulable under Rate-monotonic (RM) scheduling.

(b) Construct the schedule using RM for the interval $[0, 20]$. Identify deadline misses if they exist.

Task 5: Dynamic-priority Scheduling: Earliest Deadline First (EDF)

(a) Check if the task set from Task 4 in Table 4 is schedulable under EDF scheduling.

(b) Construct the schedule using EDF for the interval $[0, 20]$. Identify deadline misses if they exist.

(c) Assume the necessary and sufficient EDF schedulability test fails for a task set with given execution times C_i and periods $T_i = D_i$, so there are definitely deadline misses expected when scheduling this task set using EDF. Does this imply that always the same task(s) will miss their deadline?