Preview

Scheduling

Exercise class 2

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Based on the lecture of:
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Gliederung

Exercise sheet 2

TT Cyclic Executive Scheduling

Why scheduling?

- In many embedded systems, correct timing is a matter of **correctness**, not performance.
- Hard real-time systems can be often found in safety-critical applications. If an answer arrives too late within such a system, the consequences can be a **catastrophe**.
- We want to analyse our systems under a worst case assumption. We need to prove that our system can meet certain deadlines **reliably** and **without** statistical arguments.
- Given tasks and their deadlines, we now want to find a suitable arrangement of these periodic tasks such that the system can process them while keeping all their constraints in mind. (Or if not possible, we want to find out why not!)

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Recap: Definitions

- Γ : set of all periodic tasks
- τ_i : one particular periodic task (the i-th)
- $\tau_{i,j}$: the jth instance of task i
- $r_{i,j}$: release time of jth instance of task i
- $d_{i,j}$: absolute deadline of the jth instance of task i
- Φ_i : phase of task i
- D_i : relative deadline of task i

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Recap: Definitions

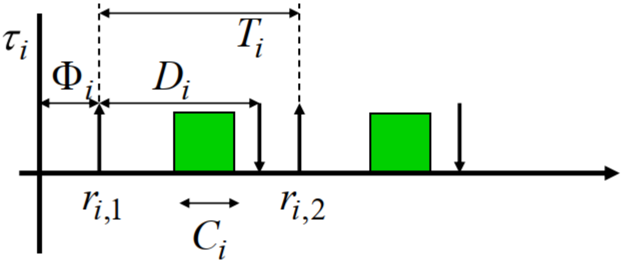

Figure 1: View on a single task

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Recap: Three assumptions

1. The instances of a periodic task are regularly activated at a constant rate. The interval between two consecutive activations is called period. The release times satisfy $r_{i,j} = \Phi_i + (j-1)T_i$
2. All instances have the same worst case execution time C_i (also written as $WCET(i)$)
3. All instances of a periodic task have the same relative deadline D_i. Therefore the absolute deadlines satisfy $d_{i,j} = \Phi_i + (j-1)T_i + D_i$

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Example Schedule

Given $P = 12$ and $f = 4$. Given the table below, find a possible frame assignment

Γ	T_i	Φ_i	D_i	C_i	frame
τ_1	12	2	8	2.8	
τ_2	12	3	9	3	
τ_3	4	0	4	1	

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Example Schedule

Γ	T_i	Φ_i	D_i	C_i	frame
τ_1	12	2	8	2.8	2
τ_2	12	3	9	3	3
τ_3	4	0	4	1	1, 2, 3

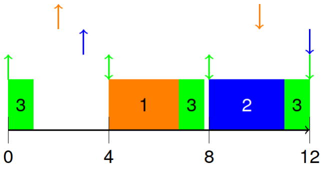

Figure 2: Solution

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Exercise 1: Correctness of a Schedule

In exercise 1 of sheet 2 you are asked to determine the feasability of a given schedule. For this, you need to consider the several questions raised in the lecture:

1. Is P a multiple of all periods T_i? Is P a multiple of f?
2. Is the frame sufficiently long? $\sum_{\{i \mid f_{ij}=k\}} C_i \leq f \qquad \forall 1 \leq k \leq \frac{P}{f}$
3. Determine offsets such that instances of tasks start after their release time:
   $\Phi_i = \min_{1 \leq j \leq P/T_i} \{(f_{ij} - 1)f - (j-1)T_i\} \qquad \forall tasks\ \tau_i$
4. Are deadlines respected? $(j-1)T_i + \Phi_i + D_i \geq f_{ij} f \quad \forall tasks\ \tau_i,\ 1 \leq j \leq P/T_i$

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Exercise 2: Finding a Schedule

In exercise 2 of sheet 2 you are asked to determine a feasible schedule. For this, you need to determine P and f given all the constraints as shown in the lecture to fill every frame. Exercise 3 is the same task and meant as a bonus exercise for those that want more practice.