Übung Echtzeitsysteme WS 2014 / 2015

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Exercise 0 Rate-Monotonic Scheduling

Given a fixed number N of periodic tasks we want to implement a rate monotonic scheduler.

- Have a look at the `task.h` headerfile that contains the basic task structure and some utility functions.
- In order to schedule our tasks we need to find the hyper-period h of the tasks. The hyper-period is given by the least common multiple lcm() of the task periods p_i:

$$h = \text{lcm}(p_0, \ldots, p_{N-1}). \tag{1}$$

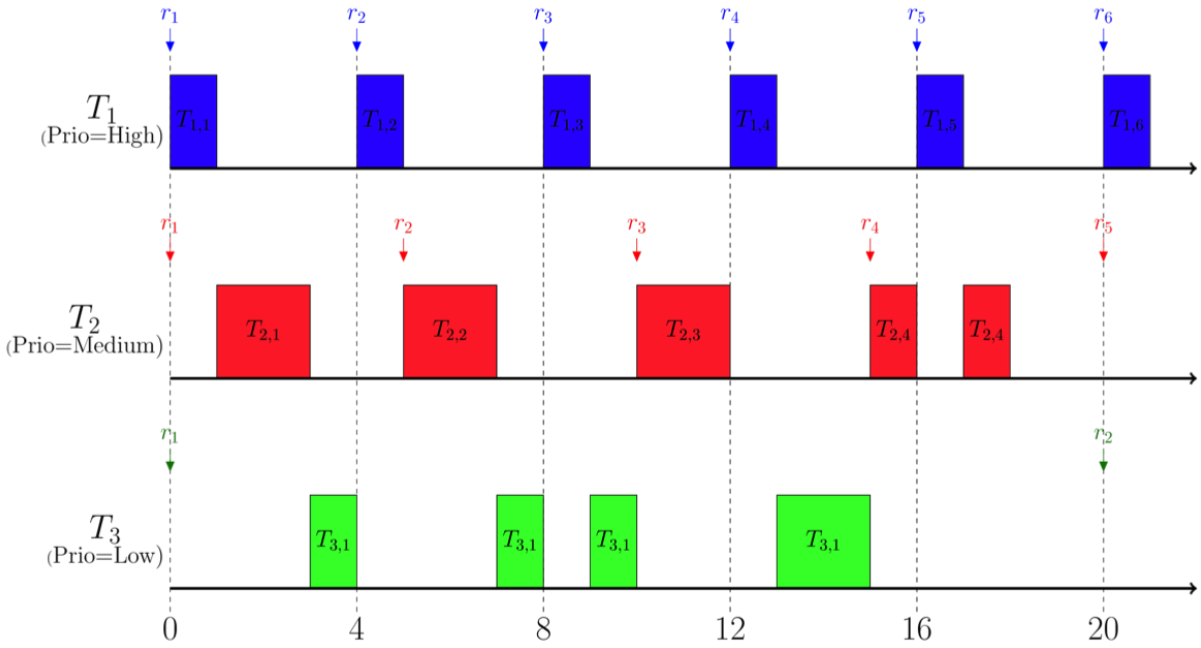
  The least common multiple of two positive numbers a, b can be calculated using the greatest common divisor gcd:

$$\text{lcm}(a, b) = \frac{a \cdot b}{\text{gcd}(a, b)}. \tag{2}$$

  In the header `util.h` an implementation of the gcd can be found. Implement a function `task_hyperperiod` that takes a task array (pointer) and the number of tasks and returns the hyperperiod. Use the following rules for the calculation of the lcm:

$$\text{lcm}(a) = a \tag{3}$$
$$\text{lcm}(a, b, c) = \text{lcm}(a, \text{lcm}(b, c)). \tag{4}$$

- Given the hyper-period h and the N tasks we can start implementing our rate monotonic scheduler for one hyperperiod. In the file `rmscheduler.h` you find some skeleton code and some hints for the implementation. The function `task_sort_rate` sorts the tasks according to the period in ascending order. Remember that for the rate monotonic scheduler always the task with the highest rate $r_i = \frac{1}{p_i}$ is selected. After a task has finished execution it can not be selected for scheduling until it becomes ready again at its period time. If a running task gets interrupted it still needs to execute for its remaining time at some point. Check if the schedule is feasible and the deadlines are met (here the deadline is the period).
- Use the following $N = 3$ tasks $T_1 = (4, 1)$, $T_2 = (5, 2)$, $T_3 = (20, 5)$ with a hyper-period of 20 to test your implementation together with the example schedule in the figure below.


r_1
r_2
r_3
r_4
r_5
r_6
T_1
(Prio=High)
$T_{1,1}$
$T_{1,2}$
$T_{1,3}$
$T_{1,4}$
$T_{1,5}$
$T_{1,6}$
r_1
r_2
r_3
r_4
r_5
T_2
(Prio=Medium)
$T_{2,1}$
$T_{2,2}$
$T_{2,3}$
$T_{2,4}$
$T_{2,4}$
r_1
r_2
T_3
(Prio=Low)
$T_{3,1}$
$T_{3,1}$
$T_{3,1}$
$T_{3,1}$
0
4
8
12
16
20