Exercise: Rate Monotonic Scheduling (ca. 1-2h)

1. Introduction

In the lecture a first scheduling approach for tasks was presented that is able to guarantee that the deadlines of all tasks are met – if certain criteria are fulfilled: Rate Monotinic Scheduling (RMS).

In order to get a better intuition for this scheduling approach, in this exercise we want to experiment with RMS!

2. Write a RMS simulator

Write a RMS simulator such that the user can enter how many number of periodic tasks he wants to simulate. The user shall than enter the execution and the period time for each task to be simulated. Restart a new instance of each task when a new period starts!

Use your simulator to test the following two task sets and check whether RMS can meet all the deadlines! If RMS cannot schedule the tasks such that all their deadlines are met: at which time point can you observe the first deadline violation?

note: Ti = (computation time, period time)

Task set #1:
T1 = (10,30), T2 = (20,60) and T3 = (30,90) (task set as in the example run above)

Task set #2:
T1 = (10,100), T2 = (20,60) and T3 = (30,90)

3. Example program output

The output of your RMS simulator could look similar to this one:

```
scheduler base class constructor called.
            Rate Monotonic Scheduler (RMS) generated.

            Please enter number of tasks to schedule: 3

                    Enter execution time for task 0 in ms : 10
                    Enter period for task 0 in ms : 30

                    Enter execution time for task 1 in ms : 20
                    Enter period for task 1 in ms : 60

                    Enter execution time for task 2 in ms : 30
                    Enter period for task 2 in ms : 90

            Press a key to start the simulation!
```

```
Simulation time : 0
Quantum = 10
Periodic task #0 : exec_time=10 ms, period=30 ms
Periodic task #1 : exec_time=20 ms, period=60 ms
Periodic task #2 : exec_time=30 ms, period=90 ms
------------------------------------

added task with id=0 that will have to compute for 10 msecs. Period time: 30 ms
added task with id=1 that will have to compute for 20 msecs. Period time: 60 ms
added task with id=2 that will have to compute for 30 msecs. Period time: 90 ms

*** Scheduler choosed task #0 ***

There are 3 tasks that have not yet finished their computation.
        Task #0 : Time computed=10, Time needed: 10
        Task #1 : Time computed=0, Time needed: 20
        Task #2 : Time computed=0, Time needed: 30
Task #0 has now finished its computation!

Time 0 : choosed task #0 (tasks that waited were: 0 1 2 )




Simulation time : 10
Quantum = 10
Periodic task #0 : exec_time=10 ms, period=30 ms
Periodic task #1 : exec_time=20 ms, period=60 ms
Periodic task #2 : exec_time=30 ms, period=90 ms
------------------------------------


*** Scheduler choosed task #1 ***

There are 2 tasks that have not yet finished their computation.
        Task #1 : Time computed=10, Time needed: 20
        Task #2 : Time computed=0, Time needed: 30

Time 0 : choosed task #0 (tasks that waited were: 0 1 2 )
Time 10 : choosed task #1 (tasks that waited were: 1 2 )




Simulation time : 20
Quantum = 10
Periodic task #0 : exec_time=10 ms, period=30 ms
Periodic task #1 : exec_time=20 ms, period=60 ms
Periodic task #2 : exec_time=30 ms, period=90 ms
------------------------------------


*** Scheduler choosed task #1 ***

There are 2 tasks that have not yet finished their computation.
        Task #1 : Time computed=20, Time needed: 20
        Task #2 : Time computed=0, Time needed: 30
Task #1 has now finished its computation!

Time 0 : choosed task #0 (tasks that waited were: 0 1 2 )
Time 10 : choosed task #1 (tasks that waited were: 1 2 )
Time 20 : choosed task #1 (tasks that waited were: 1 2 )




Simulation time : 30
Quantum = 10
Periodic task #0 : exec_time=10 ms, period=30 ms
Periodic task #1 : exec_time=20 ms, period=60 ms
Periodic task #2 : exec_time=30 ms, period=90 ms
```

```
------------------------------------

added task with id=0 that will have to compute for 10 msecs. Period time: 30 ms

*** Scheduler choosed task #0 ***

There are 2 tasks that have not yet finished their computation.
        Task #2 : Time computed=0, Time needed: 30
        Task #0 : Time computed=10, Time needed: 10
Task #0 has now finished its computation!

Time 0 : choosed task #0 (tasks that waited were: 0 1 2 )
Time 10 : choosed task #1 (tasks that waited were: 1 2 )
Time 20 : choosed task #1 (tasks that waited were: 1 2 )
Time 30 : choosed task #0 (tasks that waited were: 2 0 )





Simulation time : 40
Quantum = 10
Periodic task #0 : exec_time=10 ms, period=30 ms
Periodic task #1 : exec_time=20 ms, period=60 ms
Periodic task #2 : exec_time=30 ms, period=90 ms
------------------------------------


*** Scheduler choosed task #2 ***

There are 1 tasks that have not yet finished their computation.
        Task #2 : Time computed=10, Time needed: 30

Time 0 : choosed task #0 (tasks that waited were: 0 1 2 )
Time 10 : choosed task #1 (tasks that waited were: 1 2 )
Time 20 : choosed task #1 (tasks that waited were: 1 2 )
Time 30 : choosed task #0 (tasks that waited were: 2 0 )
Time 40 : choosed task #2 (tasks that waited were: 2 )





Simulation time : 50
Quantum = 10
Periodic task #0 : exec_time=10 ms, period=30 ms
Periodic task #1 : exec_time=20 ms, period=60 ms
Periodic task #2 : exec_time=30 ms, period=90 ms
------------------------------------


*** Scheduler choosed task #2 ***

There are 1 tasks that have not yet finished their computation.
        Task #2 : Time computed=20, Time needed: 30

Time 0 : choosed task #0 (tasks that waited were: 0 1 2 )
Time 10 : choosed task #1 (tasks that waited were: 1 2 )
Time 20 : choosed task #1 (tasks that waited were: 1 2 )
Time 30 : choosed task #0 (tasks that waited were: 2 0 )
Time 40 : choosed task #2 (tasks that waited were: 2 )
Time 50 : choosed task #2 (tasks that waited were: 2 )





Simulation time : 60
Quantum = 10
Periodic task #0 : exec_time=10 ms, period=30 ms
Periodic task #1 : exec_time=20 ms, period=60 ms
Periodic task #2 : exec_time=30 ms, period=90 ms
------------------------------------

added task with id=0 that will have to compute for 10 msecs. Period time: 30 ms
added task with id=1 that will have to compute for 20 msecs. Period time: 60 ms
```

```
*** Scheduler choosed task #0 ***

There are 3 tasks that have not yet finished their computation.
        Task #2 : Time computed=20, Time needed: 30
        Task #0 : Time computed=10, Time needed: 10
        Task #1 : Time computed=0, Time needed: 20
Task #0 has now finished its computation!

Time 0 : choosed task #0 (tasks that waited were: 0 1 2 )
Time 10 : choosed task #1 (tasks that waited were: 1 2 )
Time 20 : choosed task #1 (tasks that waited were: 1 2 )
Time 30 : choosed task #0 (tasks that waited were: 2 0 )
Time 40 : choosed task #2 (tasks that waited were: 2 )
Time 50 : choosed task #2 (tasks that waited were: 2 )
Time 60 : choosed task #0 (tasks that waited were: 2 0 1 )
```