



RTOS – Design

Rate-monotonic Scheduling



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Rate-monotonic analysis

Requirements

Schedule the following task set using rate-monotonic:

Task	Periodicity (ms)	Execution Time (ms)	Deadline (ms)
T1	5	2.5	5
T2	15	4.5	15
T3	20	3.5	20

Calculating U_{rm}

$$U_{rm} = \sum_{i=1}^n \frac{C_i}{P_i} \leq n \left(2^{\frac{1}{n}} - 1 \right)$$

Where:

U: total utilization

C: Execution time

P: Periodicity

N: Number of tasks

$$\therefore U_{rm} = \left(\frac{2.5}{5} + \frac{4.5}{15} + \frac{3.5}{20} \right) \leq (3 * (2^{\frac{1}{3}} - 1)) = 0.975 \leq \sim 0.779 = \text{False}$$

System needs more tests to verify schedulability as U_{rm} result is false.

Time demand analysis

Hyperperiod

$$\text{Hyperperiod} = LCM(P_i) = LCM(5, 15, 20) = 60ms$$

Calculations

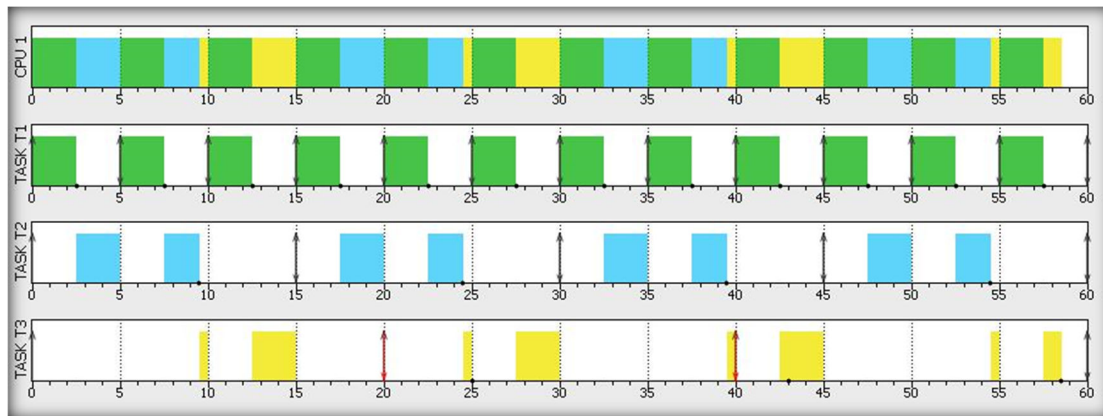
$$W_i(t) = e_i + \sum_{k=1}^{i-1} \left[\frac{t}{p_k} \right] e_k, \text{ for } 0 < t \leq p_i$$

Task	Deadline (T_p)	Time needed (W_i)	Schedulable? ($T_n \leq \text{deadline}$)
T1	5	2.5	<input checked="" type="checkbox"/>
T2	15	12	<input checked="" type="checkbox"/>
T3	20	22.5	<input checked="" type="checkbox"/>

Task 3 is not schedulable

SimSo Model

SimSo Results



CPU Load

Qt Results

General Logs Tasks Scheduler Processors

Observation Window:
from 0.00 to 120.00 ms Configure...

	Total load	Payload	System load
CPU 1	0.9750	0.9750	0.0000
Average	0.9750	0.9750	0.0000

Logs

Qt Results

General Logs Tasks Scheduler Processors

General	TASK T1	TASK T2	TASK T3			
Activation	Start	End	Deadline	Comp. time	Resp. time	CP
0.0000	0.0000	25.0000	20.0000	3.5000	25.0000	
20.0000	25.0000	43.0000	40.0000	3.5000	23.0000	
40.0000	43.0000	58.5000	60.0000	3.5000	18.5000	
60.0000	60.0000	85.0000	80.0000	3.5000	25.0000	
80.0000	85.0000	103.0000	100.0000	3.5000	23.0000	
100.0000	103.0000	118.5000	120.0000	3.5000	18.5000	
120.0000	120.0000		140.0000			

We can clearly notice that task 3 keeps missing its deadline.

SimSo RM Scheduler model complies with our Urm and Time demand calculations.