

Rate-Monotonic Scheduling Task

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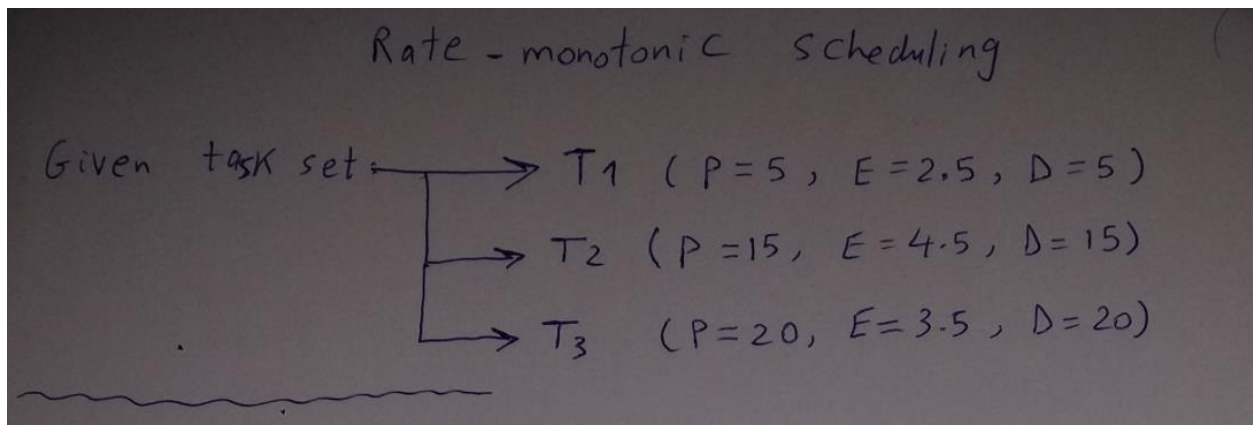
- Problem Statement:

- **Task:** Schedule the following task set using rate-monotonic:

$T_1 \{P: 5, E: 2.5, D: 5\}$, $T_2 \{P: 15, E: 4.5, D: 15\}$, $T_3 \{P: 20, E: 3.5, D: 20\}$

- Calculate the Urm.
- Calculate the time-demand analysis.
- Model the task set using Simso.
- **Provide a report with the above points using screenshots and comments on your results and analysis.**

- Breaking down tasks:



- Test1: Rate-Monotonic Utilization Bound

Test 1: Rate-Monotonic utilization bound ($n=3$) \rightarrow no. of tasks

$$U_{rm} = n(2^{\frac{1}{n}} - 1) = 3(2^{\frac{1}{3}} - 1) \approx 0.77976$$

$$U = \sum_{i=1}^3 \frac{C_i}{P_i} = \frac{2.5}{5} + \frac{4.5}{15} + \frac{3.5}{20} = 0.5 + 0.3 + 0.175 = 0.975$$

$\therefore U > U_{rm} \rightarrow \therefore$ system is not schedulable (Test 1 failed)

- Test2: Time Demand Analysis:

Test 2: Time Demand Analysis $\rightarrow W_i(t) = e_i + \sum_{k=1}^{i-1} \left\lceil \frac{t}{P_k} \right\rceil e_k$

1) Tasks order in critical instant (from high priority to low priority):
 T_1, T_2, T_3

2) Time demand for T_1 : $\overset{D_1}{W_1(5)} = e_1 + 0 = 2.5 + 0 = 2.5$

$\therefore W_1 < D_1 \rightarrow \therefore$ Task 1 is schedulable

Time demand for T_2 : $W_2(15) = e_2 + \left\lceil \frac{15}{P_1} \right\rceil e_1 = 4.5 + \frac{15}{5} \times 2.5$
 $= 4.5 + 7.5 = 12$

$\therefore W_2 < D_2 \rightarrow \therefore$ Task 2 is schedulable

3) Time demand for T_3 : $W_3(20) = e_3 + \left\lceil \frac{20}{P_1} \right\rceil e_1 + \left\lceil \frac{20}{P_2} \right\rceil e_2$
 $= 3.5 + \left\lceil \frac{20}{5} \right\rceil 2.5 + \left\lceil \frac{20}{15} \right\rceil 4.5$
 $= 3.5 + 4 \times 2.5 + 2 \times 4.5 = 3.5 + 10 + 9$
 $= 22.5$

$\therefore W_3 > D_3 \rightarrow \therefore$ Task 3 is not schedulable
 \therefore system is not schedulable (Test 2 failed)

- Modeling the system on simso and verifying schedulability:

System:

The Qt Model data window displays the configuration for three tasks. The 'Tasks' tab is selected, showing a table with columns: id, Name, Task type, Abort on miss, Act. Date (ms), Period (ms), List of Act. dates (ms), Deadline (ms), WCET (ms), and Followed by. Below the table are buttons for 'Edit data fields...', 'Remove selected task(s)', 'Add task', and 'Generate Task Set'.

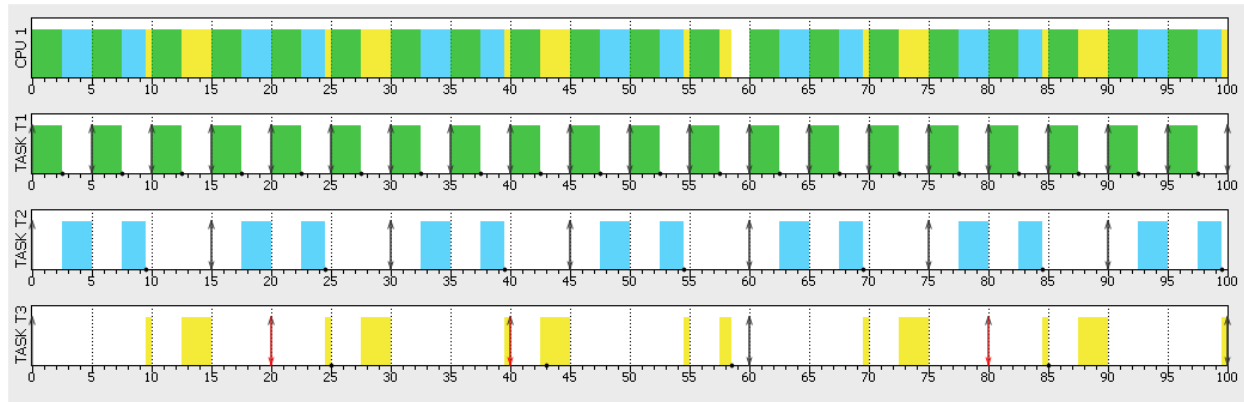
id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	List of Act. dates (ms)	Deadline (ms)	WCET (ms)	Followed by
1	TASK T1	Periodic	<input type="checkbox"/> No	0	5	-	5	2.5	
2	TASK T2	Periodic	<input type="checkbox"/> No	0	15	-	15	4.5	
3	TASK T3	Periodic	<input type="checkbox"/> No	0	20	-	20	3.5	

Result:

The Qt Results window displays the 'Results' tab, showing system load metrics. The 'Observation Window' is set from 0.00 to 100.00 ms. Below this is a table with columns: CPU, Total load, Payload, and System load. The table shows data for CPU 1 and an Average row.

	Total load	Payload	System load
CPU 1	0.9850	0.9850	0.0000
Average	0.9850	0.9850	0.0000

Gantt:



- Final comments:

System is not schedulable both analytically and graphically using simso and both results match:

- CPU load on simso (0.985) > Urm (0.779) which is proven in Test 1**
- Task 3 on simso misses its deadline which is proven in Test 2**