

SPRINTS RTOS COURSE
Scheduling and Types of schedulers
Task Report

Prepared By :

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- **Task: Schedule the following task set using rate-monotonic: T1 {P: 5, E: 2.5, D: 5}, T2 {P: 15, E: 4.5, D: 15}, T3 {P: 20, E: 3.5, D: 20}**

1- Calculate the Urm

Task:

→ schedule the following task set using rate-monotonic:

T1 {P: 5, E: 2.5, D: 5}

T2 {P: 15, E: 4.5, D: 15}

T3 {P: 20, E: 3.5, D: 20}

1) Calculate the urm

$$\text{cpu load} = \sum_{i=1}^n \frac{C_i}{P_i}$$

$n \rightarrow$ number of tasks

$C \rightarrow$ execution time

$P \rightarrow$ periodicity

$$= \left(\frac{2.5}{5}\right) + \left(\frac{4.5}{15}\right) + \left(\frac{3.5}{20}\right) = 0.975 = 97.5\%$$

$$\text{utilization bound} = n \left(2^{\frac{1}{n}} - 1\right)$$

$$= 3 \left(2^{\frac{1}{3}} - 1\right) = 0.799 = 79.9\%$$

→ $\text{cpu load} > \text{utilization bound}$

→ System not schedulable

2- Calculate the time-demand analysis

For T1 :

② Calculate the time demand analysis

→ T₁ → highest priority ②

T₂ → priority ①

T₃ → priority ③ lowest priority

→ Calculate time demand for Task₁ (T₁)

$$W_i(t) = e_i + \sum_{k=1}^{i-1} \left[\frac{t}{P_k} \right] e_k$$

$$\text{for } 0 < t < P_i \sum_{k=1}^n \frac{t}{P_k} = 0$$

$$W(1) = 2.5 + 0 = 2.5 = 2.5 \cdot 0 = \left(\frac{2.5}{2.5} \right) + \left(\frac{2.5}{2.5} \right) + \left(\frac{2.5}{2.5} \right) =$$

$$W(2) = 2.5 + 0 = 2.5$$

$$W(3) = 2.5 + 0 = 2.5$$

$$W(4) = 2.5 + 0 = 2.5$$

$$W(5) = 2.5 + 0 = 2.5 \cdot 0.5 = 0.5 \cdot 0 = \left(1 - \frac{1}{2} \right) 2.5 =$$

$$\rightarrow W(5) < \text{Deadline}$$

$$2.5 < 5$$

→ T₁ is schedulable

For T2 :

→ Calculate the time demand for T2

$$w(1) = 4.5 + \left(\frac{1}{5}\right) \times 2.5 = 7.01 = 2.P + \left(\frac{1}{21}\right)$$

$$w(2) = 4.5 + \left(\frac{2}{5}\right) \times 2.5 = 7.201 = 2.P + \left(\frac{2}{21}\right)$$

$$w(3) = 4.5 + \left(\frac{3}{5}\right) \times 2.5 = 7.201 = 2.P + \left(\frac{3}{21}\right)$$

$$w(4) = 4.5 + \left(\frac{4}{5}\right) \times 2.5 = 7.201 = 2.P + \left(\frac{4}{21}\right)$$

$$w(5) = 4.5 + \left(\frac{5}{5}\right) \times 2.5 = 7.201 = 2.P + \left(\frac{5}{21}\right)$$

$$w(6) = 4.5 + \left(\frac{6}{5}\right) \times 2.5 = 9.5 \text{ El} = 2.P + \left(\frac{6}{21}\right)$$

$$w(7) = 4.5 + \left(\frac{7}{5}\right) \times 2.5 = 9.5 \text{ El} = 2.P + \left(\frac{7}{21}\right)$$

$$w(8) = 4.5 + \left(\frac{8}{5}\right) \times 2.5 = 9.5 \text{ El} = 2.P + \left(\frac{8}{21}\right)$$

$$w(9) = 4.5 + \left(\frac{9}{5}\right) \times 2.5 = 9.51 = 2.P + \left(\frac{9}{21}\right)$$

$$w(10) = 4.5 + \left(\frac{10}{5}\right) \times 2.5 = 9.51 = 2.P + \left(\frac{10}{21}\right)$$

$$w(11) = 4.5 + \left(\frac{11}{5}\right) \times 2.5 = 121 = 2.P + \left(\frac{11}{21}\right)$$

$$w(12) = 4.5 + \left(\frac{12}{5}\right) \times 2.5 = 121 = 2.P + \left(\frac{12}{21}\right)$$

$$w(13) = 4.5 + \left(\frac{13}{5}\right) \times 2.5 = 12 = 2.P + \left(\frac{13}{21}\right)$$

$$w(14) = 4.5 + \left(\frac{14}{5}\right) \times 2.5 = 12 = 2.P + \left(\frac{14}{21}\right)$$

$$w(15) = 4.5 + \left(\frac{15}{5}\right) \times 2.5 = 12 = 2.P + \left(\frac{15}{21}\right)$$

$$2.15 = 2.P + \left(\frac{15}{21}\right)$$

$$\rightarrow w(15) < \text{Deadline} \left(\frac{15}{21}\right)$$

$$12 < 15 \quad 2.P + \left(\frac{15}{21}\right)$$

$$2.15 = 2.P + \left(\frac{15}{21}\right)$$

→ T2 is schedulable

For T3 :

→ Calculate time demand for T3

$$w(1) = 3.5 + \left(\frac{1}{5}\right) \times 2.5 + \left(\frac{1}{15}\right) \times 4.5 = 10.5 \quad \text{ST of bar}$$

$$w(2) = 3.5 + \left(\frac{2}{5}\right) \times 2.5 + \left(\frac{2}{15}\right) \times 4.5 = 10.5 \quad \Sigma = 2$$

$$w(3) = 3.5 + \left(\frac{3}{5}\right) \times 2.5 + \left(\frac{3}{15}\right) \times 4.5 = 10.5 \quad \Sigma = 2$$

$$w(4) = 3.5 + \left(\frac{4}{5}\right) \times 2.5 + \left(\frac{4}{15}\right) \times 4.5 = 10.5 \quad \Sigma = 2$$

$$w(5) = 3.5 + \left(\frac{5}{5}\right) \times 2.5 + \left(\frac{5}{15}\right) \times 4.5 = 10.5 \quad \Sigma = 2$$

$$w(6) = 3.5 + \left(\frac{6}{5}\right) \times 2.5 + \left(\frac{6}{15}\right) \times 4.5 = 13 \quad \text{2.P} = 2$$

$$w(7) = 3.5 + \left(\frac{7}{5}\right) \times 2.5 + \left(\frac{7}{15}\right) \times 4.5 = 13 \quad \text{2.P} = 2$$

$$w(8) = 3.5 + \left(\frac{8}{5}\right) \times 2.5 + \left(\frac{8}{15}\right) \times 4.5 = 13 \quad \text{2.P} = 2$$

$$w(9) = 3.5 + \left(\frac{9}{5}\right) \times 2.5 + \left(\frac{9}{15}\right) \times 4.5 = 13 \quad \text{2.P} = 2.5$$

$$w(10) = 3.5 + \left(\frac{10}{5}\right) \times 2.5 + \left(\frac{10}{15}\right) \times 4.5 = 13 \quad \text{2.P} = 2.5$$

$$w(11) = 3.5 + \left(\frac{11}{5}\right) \times 2.5 + \left(\frac{11}{15}\right) \times 4.5 = 15.5 \quad \text{2.5}$$

$$w(12) = 3.5 + \left(\frac{12}{5}\right) \times 2.5 + \left(\frac{12}{15}\right) \times 4.5 = 15.5 \quad \text{2.5}$$

$$w(13) = 3.5 + \left(\frac{13}{5}\right) \times 2.5 + \left(\frac{13}{15}\right) \times 4.5 = 15.5 \quad \text{2.5}$$

$$w(14) = 3.5 + \left(\frac{14}{5}\right) \times 2.5 + \left(\frac{14}{15}\right) \times 4.5 = 15.5 \quad \text{2.5}$$

$$w(15) = 3.5 + \left(\frac{15}{5}\right) \times 2.5 + \left(\frac{15}{15}\right) \times 4.5 = 15.5 \quad \text{2.5}$$

$$w(16) = 3.5 + \left(\frac{16}{5}\right) \times 2.5 + \left(\frac{16}{15}\right) \times 4.5 = 21.5$$

$$w(17) = 3.5 + \left(\frac{17}{5}\right) \times 2.5 + \left(\frac{17}{15}\right) \times 4.5 = 21.5 \quad (21)$$

$$w(18) = 3.5 + \left(\frac{18}{5}\right) \times 2.5 + \left(\frac{18}{15}\right) \times 4.5 = 21.5 \quad 5/$$

$$w(19) = 3.5 + \left(\frac{19}{5}\right) \times 2.5 + \left(\frac{19}{15}\right) \times 4.5 = 21.5$$

$$w(20) = 3.5 + \left(\frac{20}{5}\right) \times 2.5 + \left(\frac{20}{15}\right) \times 4.5 = 21.5 \quad \text{ST}$$

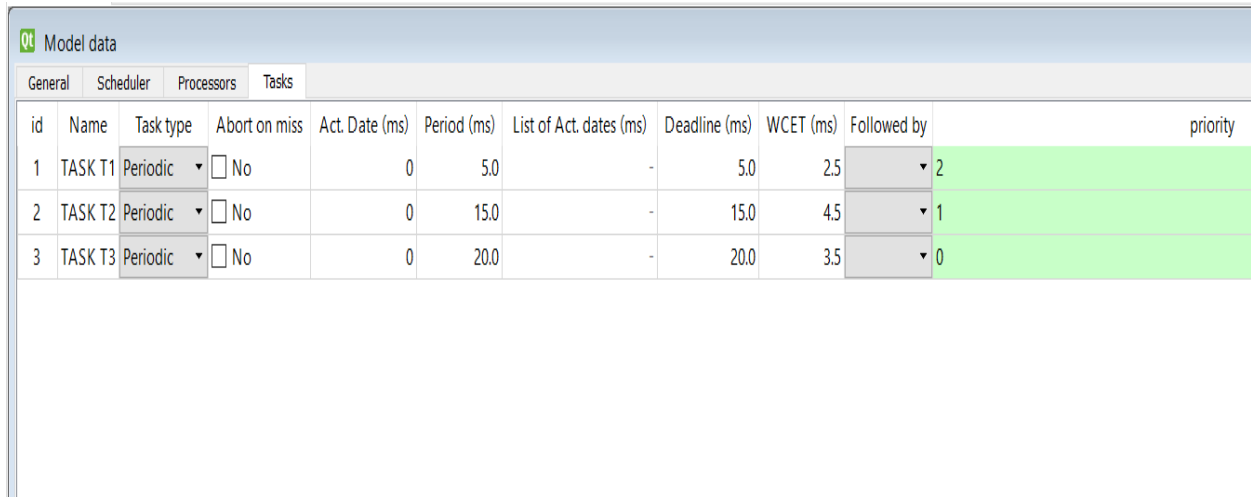
$$w(20) > \text{Deadline}$$

$$21.5 > 20$$

→ T3 is not schedulable

3- Model the task set using Simso

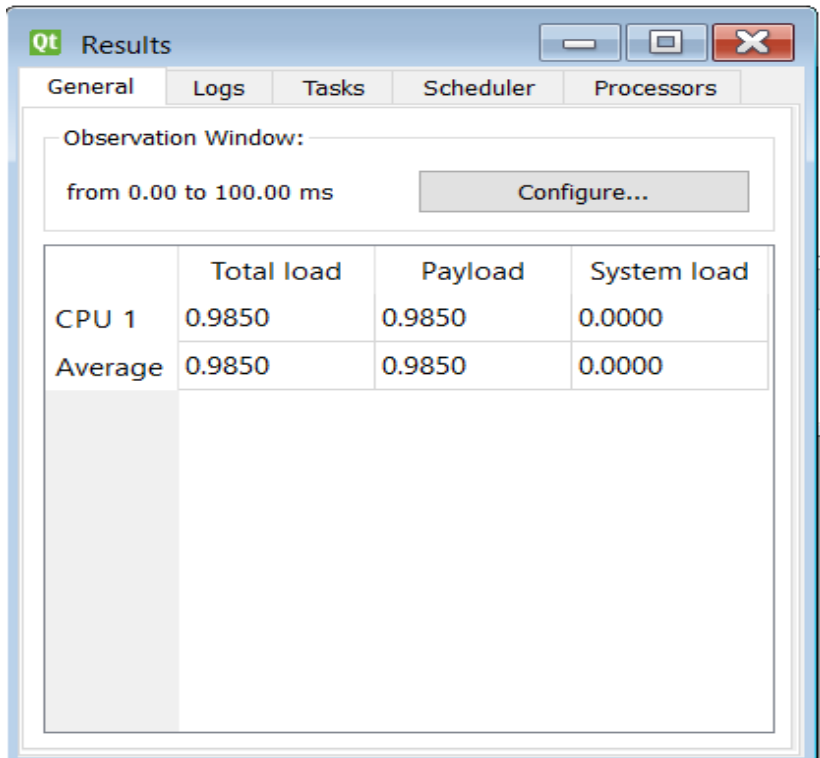
List Tasks :



The image shows a screenshot of the 'Qt Model data' window. It has a tabbed interface with 'General', 'Scheduler', 'Processors', and 'Tasks' tabs. The 'Tasks' tab is active, displaying a table with task configuration details. The table has columns for id, Name, Task type, Abort on miss, Act. Date (ms), Period (ms), List of Act. dates (ms), Deadline (ms), WCET (ms), Followed by, and priority. Three tasks are listed: TASK T1, TASK T2, and TASK T3. Each task is periodic with an abort on miss set to 'No'. TASK T1 has a period of 5.0 ms, deadline of 5.0 ms, and WCET of 2.5 ms. TASK T2 has a period of 15.0 ms, deadline of 15.0 ms, and WCET of 4.5 ms. TASK T3 has a period of 20.0 ms, deadline of 20.0 ms, and WCET of 3.5 ms. The 'Followed by' column shows TASK T1 followed by TASK T2, TASK T2 followed by TASK T1, and TASK T3 followed by no task. The priority column shows priorities of 2, 1, and 0 respectively.

id	Name	Task type	Abort on miss	Act. Date (ms)	Period (ms)	List of Act. dates (ms)	Deadline (ms)	WCET (ms)	Followed by	priority
1	TASK T1	Periodic	<input type="checkbox"/> No	0	5.0	-	5.0	2.5	2	
2	TASK T2	Periodic	<input type="checkbox"/> No	0	15.0	-	15.0	4.5	1	
3	TASK T3	Periodic	<input type="checkbox"/> No	0	20.0	-	20.0	3.5	0	

Cpu Load :



The image shows a screenshot of the 'Qt Results' window. It has a tabbed interface with 'General', 'Logs', 'Tasks', 'Scheduler', and 'Processors' tabs. The 'General' tab is active, displaying an 'Observation Window' from 0.00 to 100.00 ms. Below this, there is a table showing CPU load statistics for CPU 1 and the average. The table has columns for Total load, Payload, and System load. The values for CPU 1 and the average are all 0.9850 for Total load and Payload, and 0.0000 for System load.

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

Gantt Chart:



**Task3 Miss Its Deadline, so
System Guaranteed Not Schedulable**