Free RTOS MasterClass

Week4 Task

Scheduling & Types Of Schedulers

By: Ahmed Abdelhamid Shokry

Task Table:

Task Number (n)	Periodicity (P)	Execution time (C)	Deadline (D)
1	5	2.5	5
2	15	4.5	15
3	20	3.5	20

Rate Monotonic Utilization Bound:

$$U_T = \sum_{i=1}^{n} \frac{C_i}{P_i} = \frac{2.5}{5} + \frac{4.5}{15} + \frac{3.5}{20} = 0.975$$

$$U_{rm} = n\left(2^{\frac{1}{n}} - 1\right) = 3\left(2^{\frac{1}{3}} - 1\right) = 0.779$$

Time Demand Analysis:

For Task1:

$w_{T1}(1)$ = 2.5 + 0 = 2.5

$w_{T1}(2)$ = 2.5 + 0 = 2.5

$w_{T1}(3)$ = 2.5 + 0 = 2.5

$w_{T1}(4)$ = 2.5 + 0 = 2.5

$w_{T1}(5)$ = 2.5 + 0 = 2.5

For Task2:

$w_{T2}(1) = 4.5 + \left\lceil \frac{1}{5} \right\rceil (2.5) = 7$

$w_{T2}(2) = 4.5 + \left\lceil \frac{2}{5} \right\rceil (2.5) = 7$

$w_{T2}(3) = 4.5 + \left\lceil \frac{3}{5} \right\rceil (2.5) = 7$

$w_{T2}(4) = 4.5 + \left\lceil \frac{4}{5} \right\rceil (2.5) = 7$

$w_{T2}(5) = 4.5 + \left\lceil \frac{5}{5} \right\rceil (2.5) = 7$

$w_{T2}(6) = 4.5 + \left\lceil \frac{6}{5} \right\rceil (2.5) = 9.5$

$w_{T2}(7) = 4.5 + \left\lceil \frac{7}{5} \right\rceil (2.5) = 9.5$

$w_{T2}(8) = 4.5 + \left\lceil \frac{8}{5} \right\rceil (2.5) = 9.5$

$w_{T2}(9) = 4.5 + \left\lceil \frac{9}{5} \right\rceil (2.5) = 9.5$

$w_{T2}(10) = 4.5 + \left\lceil \frac{10}{5} \right\rceil (2.5) = 9.5$

$w_{T2}(11) = 4.5 + \left\lceil \frac{11}{5} \right\rceil (2.5) = 12$

$w_{T2}(12) = 4.5 + \left\lceil \frac{12}{5} \right\rceil (2.5) = 12$

$w_{T2}(13) = 4.5 + \left\lceil \frac{13}{5} \right\rceil (2.5) = 12$

$w_{T2}(14) = 4.5 + \left\lceil \frac{14}{5} \right\rceil (2.5) = 12$

$w_{T2}(15) = 4.5 + \left\lceil \frac{15}{5} \right\rceil (2.5) = 12$

For Task3:

$w_{T3}(1) = 3.5 + \left\lceil \frac{1}{5} \right\rceil (2.5) + \left\lceil \frac{1}{15} \right\rceil (4.5) = 10.5$

$w_{T3}(2) = 3.5 + \left\lceil \frac{2}{5} \right\rceil (2.5) + \left\lceil \frac{2}{15} \right\rceil (4.5) = 10.5$

$w_{T3}(3) = 3.5 + \left\lceil \frac{3}{5} \right\rceil (2.5) + \left\lceil \frac{3}{15} \right\rceil (4.5) = 10.5$

$w_{T3}(4) = 3.5 + \left\lceil \frac{4}{5} \right\rceil (2.5) + \left\lceil \frac{4}{15} \right\rceil (4.5) = 10.5$

$w_{T3}(5) = 3.5 + \left\lceil \frac{5}{5} \right\rceil (2.5) + \left\lceil \frac{5}{15} \right\rceil (4.5) = 10.5$

$w_{T3}(6) = 3.5 + \left\lceil \frac{6}{5} \right\rceil (2.5) + \left\lceil \frac{6}{15} \right\rceil (4.5) = 13$

$w_{T3}(7) = 3.5 + \left\lceil \frac{7}{5} \right\rceil (2.5) + \left\lceil \frac{7}{15} \right\rceil (4.5) = 13$

$w_{T3}(8) = 3.5 + \left\lceil \frac{8}{5} \right\rceil (2.5) + \left\lceil \frac{8}{15} \right\rceil (4.5) = 13$

$w_{T3}(9) = 3.5 + \left\lceil \frac{9}{5} \right\rceil (2.5) + \left\lceil \frac{9}{15} \right\rceil (4.5) = 13$

$w_{T3}(10) = 3.5 + \left\lceil \frac{10}{5} \right\rceil (2.5) + \left\lceil \frac{10}{15} \right\rceil (4.5) = 13$

$w_{T3}(11) = 3.5 + \left\lceil \frac{11}{5} \right\rceil (2.5) + \left\lceil \frac{11}{15} \right\rceil (4.5) = 15.5$

$w_{T3}(12) = 3.5 + \left\lceil \frac{12}{5} \right\rceil (2.5) + \left\lceil \frac{12}{15} \right\rceil (4.5) = 15.5$

$w_{T3}(13) = 3.5 + \left\lceil \frac{13}{5} \right\rceil (2.5) + \left\lceil \frac{13}{15} \right\rceil (4.5) = 15.5$

$w_{T3}(14) = 3.5 + \left\lceil \frac{14}{5} \right\rceil (2.5) + \left\lceil \frac{14}{15} \right\rceil (4.5) = 15.5$

$w_{T3}(15) = 3.5 + \left\lceil \frac{15}{5} \right\rceil (2.5) + \left\lceil \frac{15}{15} \right\rceil (4.5) = 15.5$

$w_{T3}(16) = 3.5 + \left\lceil \frac{16}{5} \right\rceil (2.5) + \left\lceil \frac{16}{15} \right\rceil (4.5) = 22.5$

$w_{T3}(17) = 3.5 + \left\lceil \frac{17}{5} \right\rceil (2.5) + \left\lceil \frac{17}{15} \right\rceil (4.5) = 22.5$

$w_{T3}(18) = 3.5 + \left\lceil \frac{18}{5} \right\rceil (2.5) + \left\lceil \frac{18}{15} \right\rceil (4.5) = 22.5$

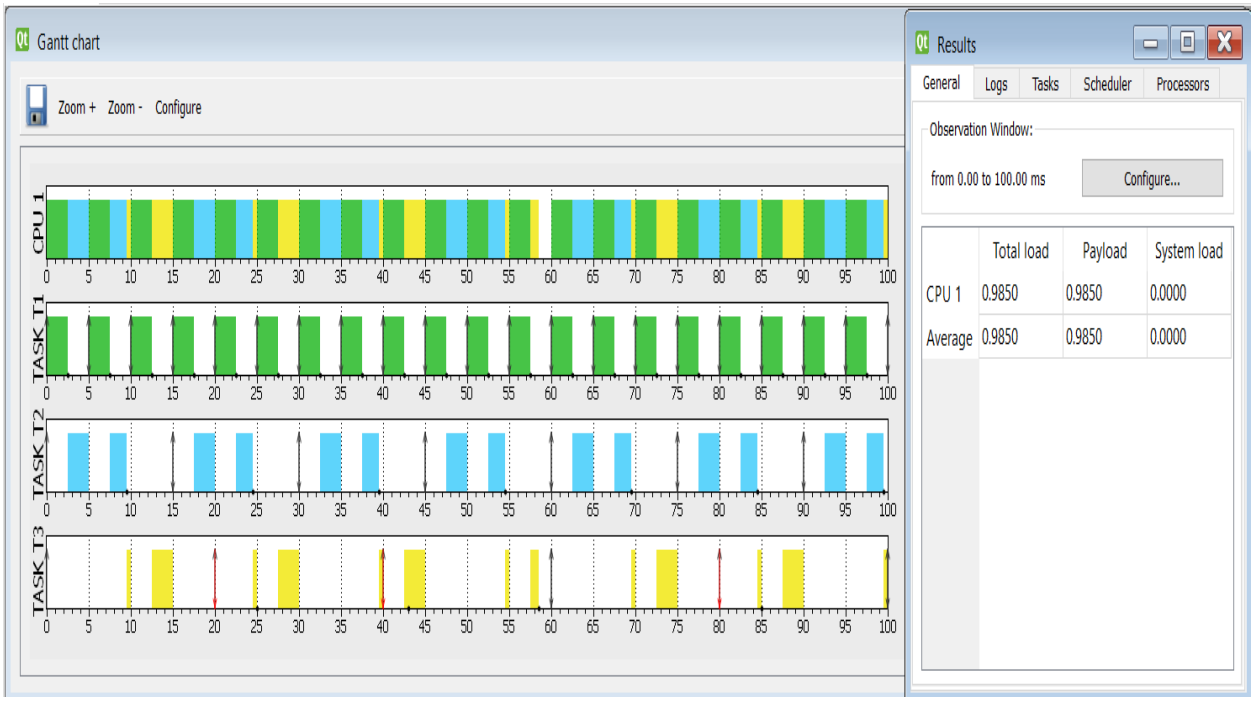
$w_{T3}(19) = 3.5 + \left\lceil \frac{19}{5} \right\rceil (2.5) + \left\lceil \frac{19}{15} \right\rceil (4.5) = 22.5$

$w_{T3}(20) = 3.5 + \left\lceil \frac{20}{5} \right\rceil (2.5) + \left\lceil \frac{20}{15} \right\rceil (4.5) = 22.5$

Comments on results:

- The Rate Monotonic Utilization bound test wasn't able to fully decide if the system is schedulable or not as $U_T > U_{rm}$ & $U_T < 1$
- Task 1 is schedulable as it is proved from the Time Demand Analysis ($w_{T1}(5) = 2.5 < D_1$)
- Task 2 is schedulable as it is proved from the Time Demand Analysis ($w_{T2}(15) = 12 < D_2$)
- Task 3 is not schedulable as it is proved from the Time Demand Analysis ($w_{T3}(20) = 22.5 > D_3$)
- The whole system is not schedulable as Task 3 misses its deadline

Simulation Results:



Comments on Simulation:

- The system is considered heavily loaded as the CPU load is 98.5%
- Task 3 missed its deadline as it was expected from the previous calculations
- The system is not schedulable