Scheduling analysis

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Task

- **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}
    - 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.**

task	periodicity	Execution time	Deadline
Task1	5 ms	2.5 ms	5 ms
Task2	15 ms	4.5 ms	15 ms
Task3	20 ms	3.5 ms	20 ms

Rate Monotonic Utilization Bound:

$$U = \sum_{i=1}^{n} \frac{C_i}{P_i} \leq n(2^{\frac{1}{n}} - 1)$$

U = Total Utilization
C = Execution time
P = Periodicity
N = Number of tasks

U = (2.5/5) + (4.5/15) + (3.5/20) = 0.975

Urm = 3 * (2 ^ (1/3) - 1) = 0.799

U > Urm   So, System not schedulable

Time Demand Analysis

Time demand analysis:

- Measures time required against time provided
- Guaranteed Schedulability test for any fixed priority preemptive scheduler at **critical instant**
- Assumes only periodic tasks are used
- D <= P
- Zero context switch time
- Equation:

W = Worst response time
E = Execution time
P = Periodicity
T = Time instance

$$w_i(t) = e_i + \sum_{k=1}^{i-1} \left\lceil \frac{t}{p_k} \right\rceil e_k \quad for\ 0 < t \le p_i$$

task	periodicity	Execution time	Deadline
Task1	5 ms	2.5 ms	5 ms
Task2	15 ms	4.5 ms	15 ms
Task3	20 ms	3.5 ms	20 ms

Time Demand Analysis:

● Time demand for T1 (priority = 3) -> Highest priority

  ➢ W (1) = 2.5 + 0 = 2.5
  ➢ 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

  W (5) < D = 2.5 < 5   So, T1 is schedulable

● Time demand for T2 (priority = 2)

  ➢ W (1) = 4.5 + (1/5) * 2.5 = 7
  ➢ W (2) = 4.5 + (2/5) * 2.5 = 7
  ➢ W (3) = 4.5 + (3/5) * 2.5 = 7
  ➢ W (4) = 4.5 + (4/5) * 2.5 = 7
  ➢ W (5) = 4.5 + (5/5) * 2.5 = 7
  ➢ W (6) = 4.5 + (6/5) * 2.5 = 9.5
  ➢ W (7) = 4.5 + (7/5) * 2.5 = 9.5
  ➢ W (8) = 4.5 + (8/5) * 2.5 = 9.5
  ➢ W (9) = 4.5 + (9/5) * 2.5 = 9.5
  ➢ W (10) = 4.5 + (10/5) * 2.5 = 9.5
  ➢ W (11) = 4.5 + (11/5) * 2.5 = 12
  ➢ W (12) = 4.5 + (12/5) * 2.5 = 12
  ➢ W (13) = 4.5 + (13/5) * 2.5 = 12
  ➢ W (14) = 4.5 + (14/5) * 2.5 = 12
  ➢ W (15) = 4.5 + (15/5) * 2.5 = 12

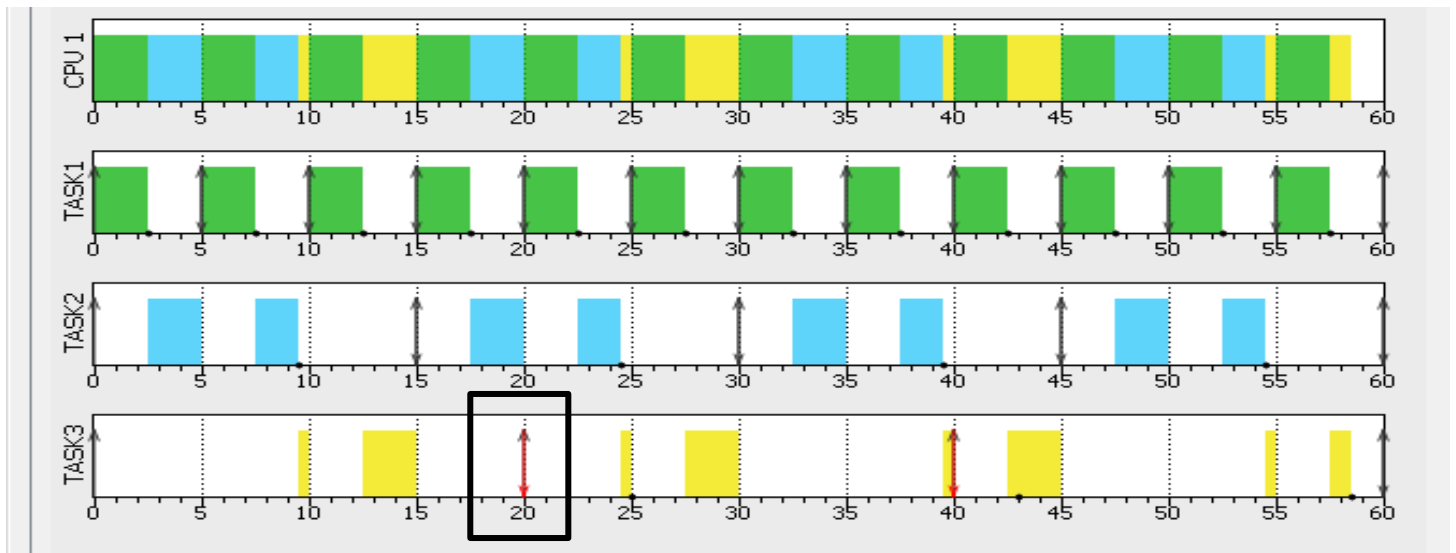 **W (15) < D = 12 < 15   So, T2 is schedulable**

● Time demand for T3 (priority = 1) -> Lowest priority

  ➢ W (20) = 3.5 + (20/15) *4.5 + (20/5) * 2.5 = 22.5

  W (20) < D = 22.5 > 20   So, T3 not schedulable

As we notice Task 3 is Not Schedulable, Missed Deadline

Conclusion:

➢ According to urm, Time Demand Analysis and simso results,

this system not Schedulable