Answer to examples and exercises in lecture 07 - Schedulability part 2

Adrien Lapointe, Mojtaba Bagherzadeh

$$w_i^{n+1} = e_i + \sum_{j=1}^{k} \left\lceil \frac{w_i^n}{p_j} \right\rceil \cdot e_j$$

Example 1

$S = \{S_A = (40, 80), S_B = (10, 40), S_C = (5, 20)\}$

Calculating the response time for S_e:

$R_C = e_C$ Since there is no possible interference.

Calculating the response time for S_B:

$w_B^0 = e_B = 10$

$w_B^1 = 10 + \lceil \frac{10}{20} \rceil \cdot 5 = 15$

$w_B^2 = 10 + \lceil \frac{15}{20} \rceil \cdot 5 = 15$

$R_B = 15 < p_B = 40$ therefore S_B meets its deadline.

Calculating the response time for S_A:

$w_A^0 = e_A = 40$

$w_A^1 = 40 + \lceil \frac{40}{40} \rceil \cdot 10 + \lceil \frac{40}{20} \rceil \cdot 5 = 60$

$w_A^2 = 40 + \lceil \frac{60}{40} \rceil \cdot 10 + \lceil \frac{60}{20} \rceil \cdot 5 = 75$

$w_A^3 = 40 + \lceil \frac{75}{40} \rceil \cdot 10 + \lceil \frac{75}{20} \rceil \cdot 5 = 80$

$w_A^4 = 40 + \lceil \frac{80}{40} \rceil \cdot 10 + \lceil \frac{80}{20} \rceil \cdot 5 = 80$

$R_C = 80 = e_C = 80$ therefore S_A meets its deadline.

Since all the services/tasks meet their deadlines, they are schedulable.

Example 2

Task	e	p	D	P
1	3	20	5	1
2	3	15	7	2
3	4	10	10	3
4	3	30	20	4

Calculating the response time for $T1$:

$R_{T1} = e_{T1}$ Since there is no possible interference.

$R_{T1} = 3 < D_{T1} = 5$ therefore $T1$ meets its deadline.

Calculating the response time for $T2$:

$W^0_{T2} = e_{T2} = 3$

$W^1_{T2} = 3 + \lceil \frac{3}{20} \rceil \cdot 3 = 3 + 1 \cdot 3 = 6$

$W^2_{T2} = 3 + \lceil \frac{6}{20} \rceil \cdot 3 = 3 + 1 \cdot 3 = 6$

$R_{T2} = 6 < D_{T2} = 7$ therefore $T2$ meets its deadline.

Calculating the response time for $T3$:

$W^0_{T3} = e_{T2} = 4$

$W^1_{T3} = 4 + \lceil \frac{4}{15} \rceil \cdot 3 + \lceil \frac{4}{20} \rceil \cdot 3 = 4 + 3 + 3 = 10$

$W^2_{T3} = 4 + \lceil \frac{10}{15} \rceil \cdot 3 + \lceil \frac{10}{20} \rceil \cdot 3 = 4 + 3 + 3 = 10$

$R_{T3} = 10 = D_{T3} = 10$ therefore $T3$ meets its deadline.

Calculating the response time for $T4$:

$W^0_{T4} = e_{T2} = 3$

$W^1_{T4} = 3 + \lceil \frac{3}{10} \rceil \cdot 4 + \lceil \frac{3}{15} \rceil \cdot 3 + \lceil \frac{3}{20} \rceil \cdot 3 = 3 + 4 + 3 + 3 = 13$

$W^2_{T4} = 3 + \lceil \frac{13}{10} \rceil \cdot 4 + \lceil \frac{13}{15} \rceil \cdot 3 + \lceil \frac{13}{20} \rceil \cdot 3 = 3 + 8 + 3 + 3 = 17$

$W^2_{T4} = 3 + \lceil \frac{17}{10} \rceil \cdot 4 + \lceil \frac{17}{15} \rceil \cdot 3 + \lceil \frac{17}{20} \rceil \cdot 3 = 3 + 8 + 6 + 3 = 20$

$W^2_{T4} = 3 + \lceil \frac{20}{10} \rceil \cdot 4 + \lceil \frac{20}{15} \rceil \cdot 3 + \lceil \frac{20}{20} \rceil \cdot 3 = 3 + 8 + 6 + 3 = 20$

$R_{T4} = 20 = D_{T4} = 20$ therefore $T4$ meets its deadline.

Example 3

Task	e	p	D	P	U
1	3	7	7	1	0.42
2	3	12	12	2	0.25
3	5	20	18	3	0.25

RM utlization test fails since

$0.92 > 77$

Calculating the response time for $T1$:

$R_{T1} = e_{T1}$ Since there is no possible interference.

$R_{T1} = 3 < D_{T1} = 7$ therefore $T1$ meets its deadline.

Calculating the response time for $T2$:

$W^0_{T2} = e_{T2} = 3$

$W^1_{T2} = 3 + \lceil \frac{3}{7} \rceil \cdot 3 = 3 + 1 \cdot 3 = 6$

$W^2_{T2} = 3 + \lceil \frac{6}{7} \rceil \cdot 3 = 3 + 1 \cdot 3 = 6$

$R_{T2} = 6 < D_{T2} = 12$ therefore $T2$ meets its deadline.

Calculating the response time for $T3$:

$W^0_{T3} = e_{T2} = 5$

$W^1_{T3} = 5 + \lceil \frac{5}{12} \rceil \cdot 3 + \lceil \frac{5}{7} \rceil \cdot 3 = 5 + 3 + 3 = 11$

$W^2_{T3} = 5 + \lceil \frac{11}{12} \rceil \cdot 3 + \lceil \frac{11}{7} \rceil \cdot 3 = 5 + 3 + 6 = 14$

$W^3_{T3} = 5 + \lceil \frac{14}{12} \rceil \cdot 3 + \lceil \frac{14}{7} \rceil \cdot 3 = 5 + 6 + 6 = 17$

$W^4_{T3} = 5 + \lceil \frac{17}{12} \rceil \cdot 3 + \lceil \frac{17}{7} \rceil \cdot 3 = 5 + 6 + 9 = 20$

$W^4_{T3} = 20 > D_{T3} = 18$ therefore $T3$ does not meet its deadline.