RM

① (es. 2.1)

	τ_1	τ_2
Φ_i	0	1
C_i	2	2
T_i	15	3

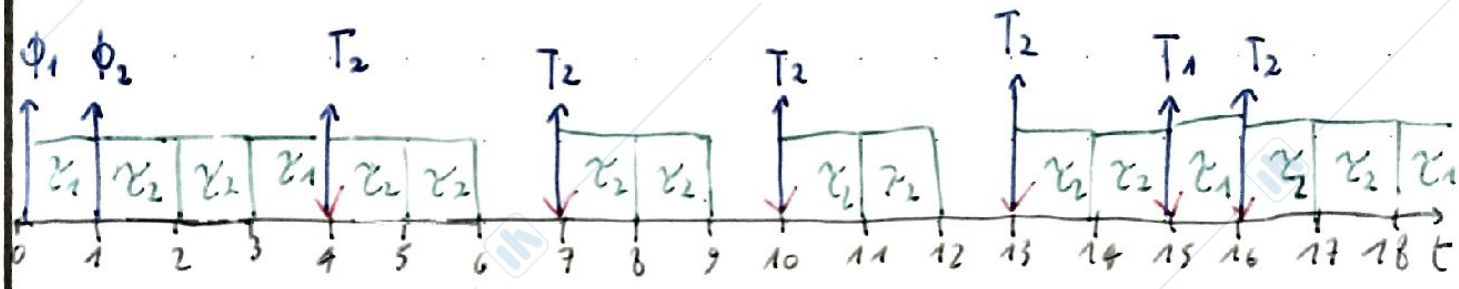
Proc. periodici

$\{\tau_1, \dots, \tau_n\}$ set proc. periodici

$\tau_{k,i}$ = k-esima istanza del processo i

D_i = deadline relativa

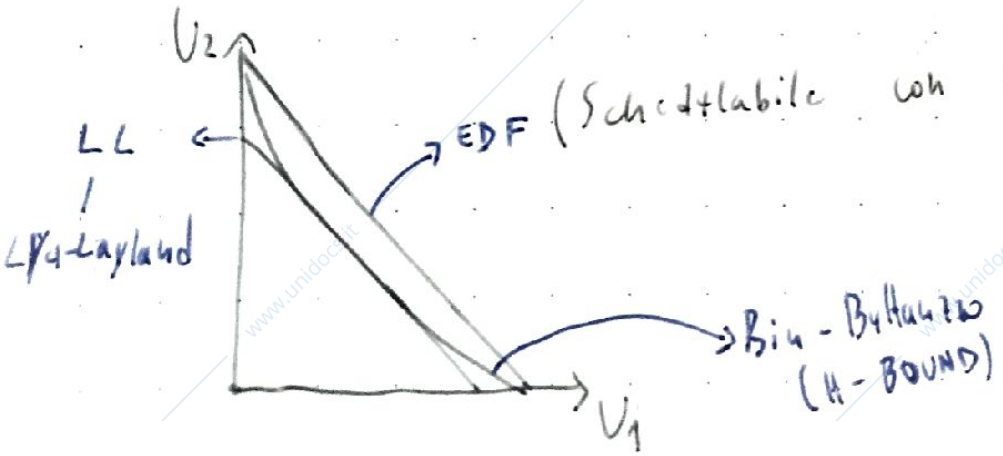
$U = \sum_{i=1}^{n} U_i = \sum_{i=1}^{n} \frac{C_i}{T_i}$



② (es. 2.2)

	τ_1	τ_2	τ_3	τ_4
Φ_i	2	0	2	0
C_i	1	1	2	1
T_i	3	5	13	15

Dire se è schedulabile con RM



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Lyd-Layland

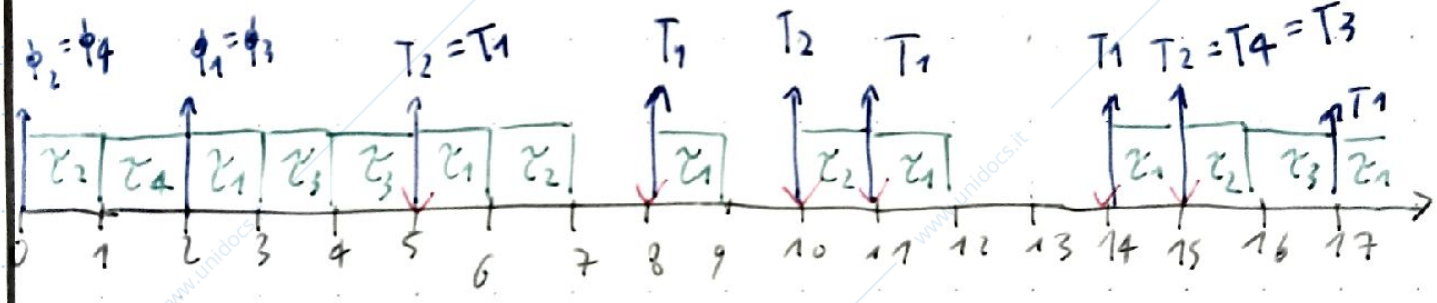
$$\bar{U}_{LUB} = n\left(2^{\frac{1}{n}} - 1\right)$$

se $U \leq \bar{U}_{LUB}$ → schedulabile

se $\bar{U}_{LUB} < U \leq 1$ (?)

$$\bar{U}_{LUB} = 4\left(\sqrt[4]{2} - 1\right) = 0{,}7568$$

$$U = \frac{1}{3} + \frac{1}{5} + \frac{2}{13} + \frac{1}{15} = 0{,}7538$$ → schedulabile con RM



(3) (05.2.3)

	τ_1	τ_2	τ_3	τ_4
ϕ_i	0	1	2	3
C_i	2	2	1	2
T_i	6	10	4	11

cond. sufficiente

LL (Lyd-Layland)

$\bar{U}_{LUB} = 0{,}7568$

$$U = \frac{1}{3} + \frac{1}{5} + \frac{1}{4} + \frac{2}{11} = 0{,}9652$$

$U < 1$ → ma non si sa

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Bound Bini & Butazzo — cond. suff.

$$U_{BB} = \prod_{i=1}^{n} (U_i + 1) \leq 2 \text{ sched}$$

$\rightarrow 2$ no garanzia

$$U_{BB} = \left(\frac{1}{3}+1\right)\left(\frac{1}{5}+1\right)\left(\frac{1}{4}+1\right)\left(\frac{2}{11}+1\right) = 2{,}3636 > 2$$

ho garanzie

RTA — cond. nec. e suff.

Ordino per Di crescente qui $D_i = T_i$

$\hookrightarrow \tau_3, \tau_1, \tau_2, \tau_4$

$$R_i^{(0)} = C_i, \quad I_i^k = \sum_{j}^{i-1} C_j \left\lceil \frac{R_i^k}{T_j} \right\rceil$$

Se ho 2 processi con lo stesso tempo devo ricordarmi l'ordine in cui ho scritto di metterli

$\dots R_i^{k+1} = C_i + I_i^k$, $\rightarrow$ STOP se $R_i^{k+1} = R_i^k$

Posso anche fare

$$R_1^0 = \sum_{j}^{i-1} C_j = C_3 + C_1$$

$$I_1^0 = C_3 \left\lceil \frac{R_1^0}{T_3} \right\rceil$$

con questo metodo mi porto avanti in cui ho scritto di metterli

R_1 sched

- $R_3^0 = 1$, $I_3^0 = 0 \rightarrow R_3 = 1 \leq 4 \rightarrow R_3$ sched.
- $R_1^0 = 2$, $I_1^0 = 1 \cdot \left\lceil \frac{2}{4} \right\rceil = 1$, $R_1^1 = 3$, $I_1^1 = 1 \cdot \left\lceil \frac{3}{4} \right\rceil = 1 \rightarrow R_1 = 3$
- $R_2^0 = 2$, $I_2^0 = 1 \cdot \left\lceil \frac{2}{4} \right\rceil + 2 \cdot \left\lceil \frac{2}{6} \right\rceil = 3$, $R_2^1 = 5$, $I_2^1 = 1 \cdot \left\lceil \frac{5}{4} \right\rceil + 2 \cdot \left\lceil \frac{5}{6} \right\rceil = 4$,
  $R_2^2 = 6$, $I_2^2 = 1 \cdot \left\lceil \frac{6}{4} \right\rceil + 2 \cdot \left\lceil \frac{6}{6} \right\rceil = 4 \rightarrow R_2 = 6$ ← R2 sched
- $R_4^0 = 2$, $I_4^0 = 1 \cdot \left\lceil \frac{2}{4} \right\rceil + 2 \left\lceil \frac{2}{6} \right\rceil + 2 \cdot \left\lceil \frac{2}{10} \right\rceil = 5$, $R_4^1 = 7$, $I_4^1 = 2+4+2 = 8$,
  $R_4^2 = 10$, $I_4^2 = 3+4+2 = 9$, $R_4^3 = 11$, $I_4^3 = 3+4+4 = 11$, $R_4^3 = 13$,

$I_4^4 = 4+6+4 = 14$, $R_4^5 = 16$, $I_4^5 = 4+6+4 = 14$, $\rightarrow R_4 = 16$

Ci fermiamo a $R_4^4 = 13$ ← R_4 non schedulabile

$\Rightarrow$ Problema non schedulabile con RM

Si riferisce al caso in cui le fasi siano tutte uguali $\longrightarrow$ ossia worst-case

4. (es. 2A)

	τ_1	τ_2	τ_3	τ_4
ϕ_i	0	0	0	0
C_i	2	3	1	C_4
T_i	8	12	5	20

1) Trovare C_4 massimo t.c. schedulabil. con LL

$$U \leq U_{LUB} = 4\left(\sqrt[4]{2} - 1\right) = 0,757$$

$$U = \frac{1}{4} + \frac{1}{4} + \frac{1}{5} + \frac{C_4}{20} = \frac{5+5+4+C_4}{20} = \frac{14+C_4}{20} \leq 0,757$$

$\hookrightarrow C_4 \leq 1,08 \longrightarrow C_4 = 1$

2) C_4^{max} t.c. sched. con BB

$$U_{BB} = \left(\frac{1}{4}+1\right)\left(\frac{1}{4}+1\right)\left(\frac{1}{5}+1\right)\left(\frac{C_4}{20}+1\right) = \frac{5}{4}\cdot\frac{5}{4}\cdot\frac{6}{5}\cdot\frac{C_4+20}{20} \leq 2$$

$\hookrightarrow C_4 \leq \frac{4}{3} \longrightarrow C_4 = 1$

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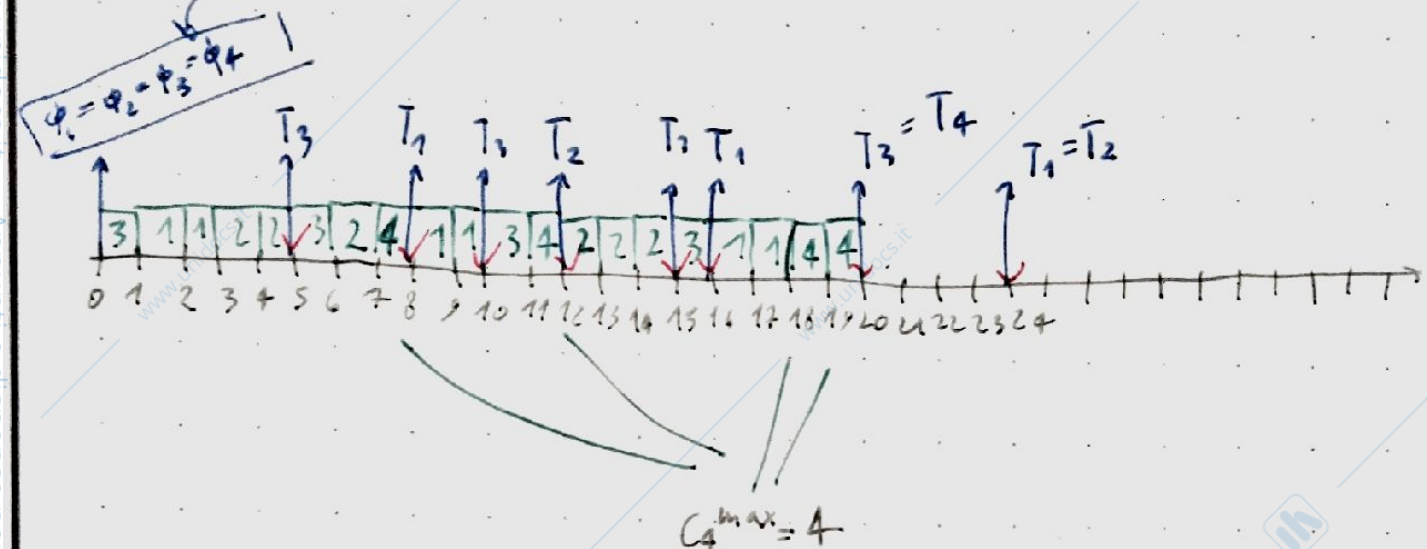
3) C_4^{max} t.c. i processi siano schedulabili in sezione critica → il tempo sarà quello lasciato dagli altri

↓ worst case



$C_4^{max} = 4$

↓

(5) (es. 2.6) EDF → tanto è con EDF

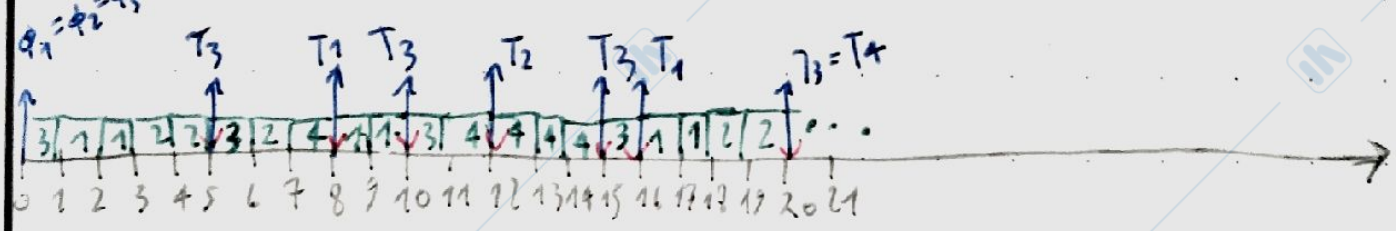
	τ_1	τ_2	τ_3	τ_4
ϕ_i	0	0	0	0
C_i	2	3	1	(5)
T_i	8	12	5	20

si considera la D_i assoluta

$$U = \frac{2}{8_4} + \frac{3}{12_4} + \frac{1}{5} + \frac{1}{4} = \frac{19}{20} < 1$$

↓

Schedulabile



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(6) (cs. 2.5) DM ($D_i < T_i$)

	τ_1	τ_2
ϕ_i	0	3
C_i	2	2
T_i	6	6
D_i	3	3

RTA

La deadline sono uguali scegliamo noi da dove partire

$R_2^0 = C_2 = 2,\ I_2^0 = 0,\ R_2^1 = 2 \rightarrow R_2 = 2 \leq 3$ ✓

$R_1^0 = 2,\ I_1^0 = 2 \cdot \lceil \frac{2}{6} \rceil = 2,\ R_1^1 = 4,\ I_1^1 = 2 \rightarrow R_1 = 4 > 3$ ✗

non schedulabile!

nel worst case

RTA