

# Es 1)

Task periodici:	$T_i$	$C_i$
$A_1$	9	3
$A_2$	6	2
$A_3$	4	1

$$\Rightarrow U = \frac{3}{9} + \frac{2}{6} + \frac{1}{4} = \frac{12+12+9}{36} = \frac{33}{36}$$

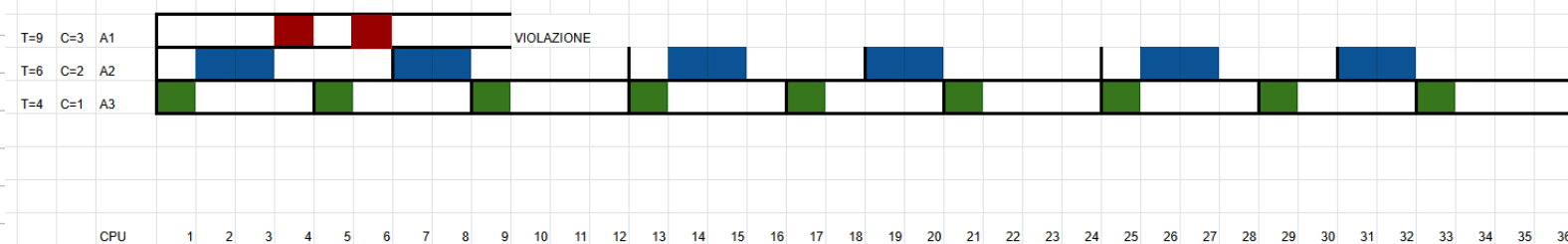
Task aperiodico:  $a_4 = 2$   $d_4 = 30$   $c_4 = 3$

Essendo  $U < 1$ , sicuramente i task sono schedulabili.

Con RMPO sono certamente schedulabili se

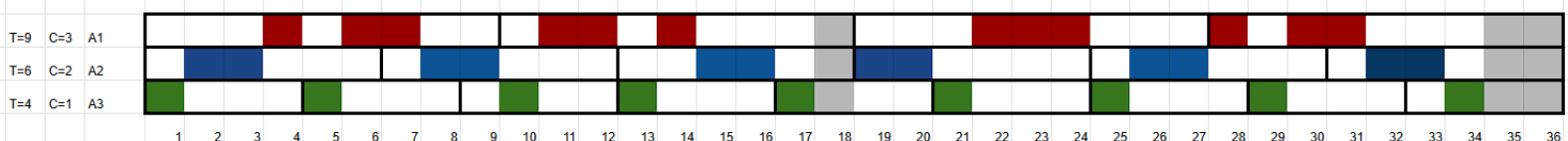
- relazioni armoniche: NO
- $U \leq \ln(2)$ : NO
- $U \leq 3 \cdot (2^{1/3} - 1) \approx 0.779$ : NO

È necessario tracciare la trama:



RMPO non risolve i task hard real time.

Si prova EDF:



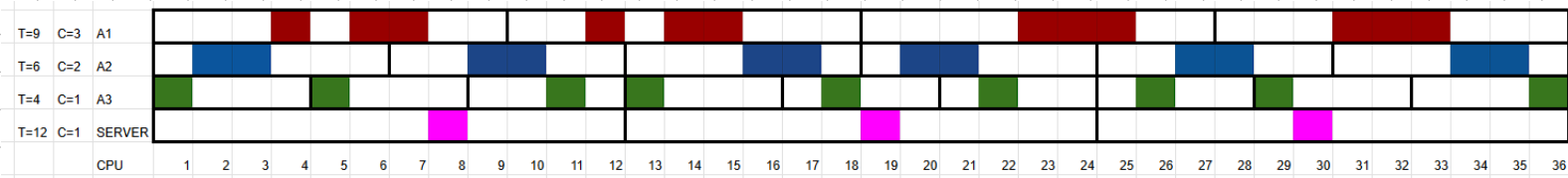
EDF lo schedula, e come atteso, per 3 t.u.

la CPU è libera. Il task soft real time

non viene eseguito entro la deadline, si

applica deferring server con  $T_s=12$  e  $C_s=1$

$$U = \frac{33}{36} + \frac{1}{12} = \frac{33+3}{36} = 1 \quad \text{EDF lo schedula:}$$



Il task aperiodico rispetta il vincolo!

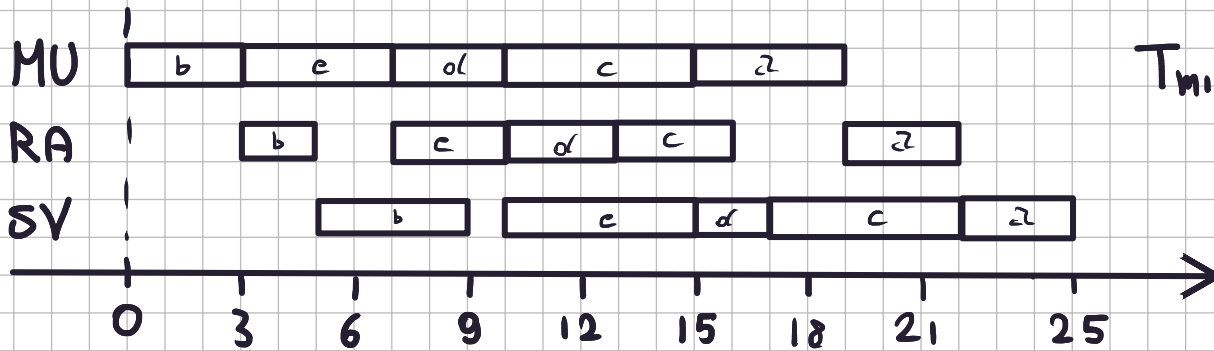
Es 2)

Tabella equivalente:

	a	b	c	d	e
OP1	7	5	8	6	7
OP2	6	6	8	5	8

PIV' RAPIDE SU OP1  $S_1 = \{b\}$

PIV' RAPIDE SU OP2  $S_2 = \{a, c, d, e\}$  Seq =  $b \rightarrow e \rightarrow d \rightarrow c \rightarrow a$



$T_{min} = 25$  minuti

Es 3)

La PN mostrata e' un Marked Graph.

La matrice di incidenza e'

$$C = \begin{matrix} & t_1 & t_2 & t_3 & t_4 & t_5 \\ \begin{matrix} p_1 \\ p_2 \\ p_3 \\ p_4 \\ p_5 \\ p_6 \\ p_7 \end{matrix} & \begin{bmatrix} -1 & 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 1 & 0 \\ 1 & -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1 \\ 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & 1 & -1 & 0 \end{bmatrix} \end{matrix}$$

La trasposta è  $C^T = \begin{bmatrix} -1 & -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & -1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 1 & -1 \\ 1 & 0 & 0 & -1 & 0 & 0 & 0 \end{bmatrix}$  pongo  $\gamma$

$$\gamma C^T = 0 \Rightarrow \begin{cases} -\gamma_1 - \gamma_2 + \gamma_3 = 0 \\ -\gamma_3 + \gamma_4 + \gamma_5 = 0 \\ -\gamma_5 - \gamma_6 + \gamma_7 = 0 \\ \gamma_2 + \gamma_6 - \gamma_7 = 0 \\ \gamma_1 - \gamma_4 = 0 \end{cases} \Rightarrow \begin{cases} \gamma_1 = \gamma_3 - \gamma_2 \\ \gamma_3 = \gamma_4 + \gamma_5 \\ \gamma_5 = \gamma_7 - \gamma_6 \\ \gamma_2 = \gamma_7 - \gamma_6 \\ \gamma_1 = \gamma_4 \end{cases} \Rightarrow \begin{cases} \gamma_1 = \gamma_4 + \gamma_5 - \gamma_2 \\ \gamma_3 = \gamma_4 + \gamma_5 \\ \gamma_2 = \gamma_5 = \gamma_7 - \gamma_6 \\ \gamma_2 = \gamma_5 \\ \gamma_1 = \gamma_4 \end{cases}$$

$$\begin{aligned} \gamma_1 &= \gamma_4 \\ \Rightarrow \gamma_2 &= \gamma_5 = \gamma_7 - \gamma_6 \\ \gamma_3 &= \gamma_1 + \gamma_2 \\ \gamma_7 &= \gamma_6 + \gamma_2 \end{aligned} \Rightarrow \gamma = \begin{bmatrix} a \\ b \\ a+b \\ a \\ b \\ c \\ b+c \end{bmatrix} \quad a, b, c \in \mathbb{N}$$

P-invarianti canonici ed a supporto minimo sono:

$$a=1 \quad b=c=0$$

$$a=c=0 \quad b=1$$

$$a=b=0 \quad c=1$$

$$\gamma^T = [1 \ 0 \ 1 \ 1 \ 0 \ 0 \ 0]$$

$$\dot{\gamma}^T = [0 \ 1 \ 1 \ 0 \ 1 \ 0 \ 1]$$

$$\ddot{\gamma}^T = [0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 1]$$

Ora studio i T-invarianti:

$$C\bar{\eta} = 0 \Rightarrow \begin{cases} \eta_1 = \eta_5 \\ \eta_1 = \eta_4 \\ \eta_1 = \eta_2 \\ \eta_2 = \eta_5 \\ \eta_2 = \eta_3 \\ \vdots \end{cases} \Rightarrow \eta = \begin{bmatrix} b \\ b \\ b \\ b \\ b \\ b \\ b \end{bmatrix} \quad \begin{array}{l} \text{uno a} \\ \text{supporto} \\ \text{minimo e'} \end{array} \quad \eta = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$$

$b \in \mathbb{N}$

essendo il supporto dei 3 P invarianti:

$\|x\| \cup \|x\| \cup \|x\| = P \Rightarrow$  La rete e' limitata

Es 4)

STATI:

$x_{1A}$  : PIANO 1 PORTE APERTE

$x_{TA}$  : PIANO TERRA PORTE APERTE

$x_{1T}$  : SCENDENDO, PORTE CHIUSE

$x_{T1}$  : SALENDI, PORTE CHIUSE

INPUT:

$u_{P1}$  : Pressione tasto P1 dalla cabina

$u_{PT}$  : Pressione tasto PT dalla cabina

$u_{\Delta}$  : Pressione tasto chiamata da PT

$u_{\nabla}$  : Pressione tasto chiamata da P1

$u_{s1}$  : rilevato ascensore piano P1

$u_{ST}$  : rilevato ascensore piano PT

OUTPUT:

$\gamma_{AP}$  : Apertura porte

$\gamma_{CH}$  : chiusura porte

$\gamma_{\uparrow}$  : salita

$\gamma_{\downarrow}$  : discesa

