

Sustavi za rad u stvarnom vremenu

Primjeri raspoređivanja mjerom ponavljanja,
prema krajnjim trenucima završetaka
te primjer općeg raspoređivanja

Primer: opći kriterij

$$\tau_1: T_1 = 10 \text{ ms} \quad C_1 = 3 \text{ ms}$$

$$\tau_2: T_2 = 15 \text{ ms} \quad C_2 = 5 \text{ ms}$$

$$\tau_3: T_3 = 20 \text{ ms} \quad C_3 = 2 \text{ ms}$$

$$\tau_4: T_4 = 30 \text{ ms} \quad C_4 = 5 \text{ ms}$$

3° Opći kriterij

za zadatke τ_j

$$\text{ujet } \sum_{i=1}^j \left\lceil \frac{D_j}{T_i} \right\rceil \cdot C_i \leq D_j$$

$$\text{za } \tau_1: D_1 \in \{10\}$$

$$\sum_{i=1}^1 \frac{D_1}{T_i} \cdot C_i \leq D_1$$

$$\frac{D_1}{T_1} \cdot C_1 \leq D_1$$

$$D_1 = T_1 \Rightarrow C_1 \leq T_1 \checkmark$$

$$\text{za } \tau_2: D_2 \in \{10, 15\}$$

$$\text{za } D_2 = 10$$

$$\left\lceil \frac{10}{10} \right\rceil \cdot C_1 + \left\lceil \frac{10}{15} \right\rceil \cdot C_2 =$$

$$= C_1 + C_2 = 8 \leq 10 \checkmark$$

$$\text{za } D_2 = 15$$

$$\left\lceil \frac{15}{10} \right\rceil \cdot 3 + \left\lceil \frac{15}{15} \right\rceil \cdot 5 = 2 \cdot 3 + 5 = 11 \leq 15 \checkmark$$

$$\text{za } \tau_3: D_3 \in \{10, 15, 20\}$$

$$\text{npr. za } D_3 = 15$$

$$\left\lceil \frac{15}{10} \right\rceil \cdot 3 + \left\lceil \frac{15}{15} \right\rceil \cdot 5 + \left\lceil \frac{15}{20} \right\rceil \cdot 2 =$$

$$= 2 \cdot 3 + 1 \cdot 5 + 1 \cdot 2 = 13 \leq 15 \checkmark$$

$$\text{za } \tau_4: D_4 \in \{10, 15, 20, 30\}$$

$$\text{npr. za } D_4 = 20$$

$$\left\lceil \frac{20}{10} \right\rceil \cdot 3 + \left\lceil \frac{20}{15} \right\rceil \cdot 5 + \left\lceil \frac{20}{20} \right\rceil \cdot 2 + \left\lceil \frac{20}{30} \right\rceil \cdot 5 =$$

$$= 2 \cdot 3 + 2 \cdot 5 + 1 \cdot 2 + 1 \cdot 5 =$$

$$= 23 > 20 \Rightarrow \text{nije ispr. za ovaj } D_4$$

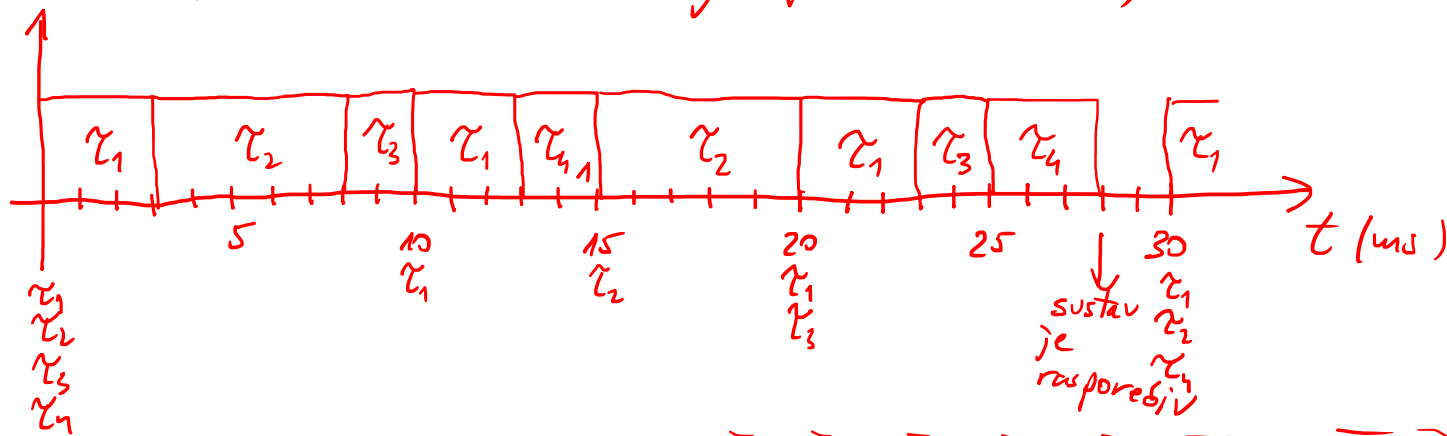
$$\text{za } D_4 = 30$$

$$\left\lceil \frac{30}{10} \right\rceil \cdot 3 + \left\lceil \frac{30}{15} \right\rceil \cdot 5 + \left\lceil \frac{30}{20} \right\rceil \cdot 2 + \left\lceil \frac{30}{30} \right\rceil \cdot 5 =$$
$$3 \cdot 3 + 2 \cdot 5 + 2 \cdot 2 + 1 \cdot 5 = 28 \leq 30 \checkmark$$

$$1^\circ \text{ Nužni uvjet } U_s \leq 1 \text{ (ne traži se)}$$

$$U_s = \sum_i \frac{C_i}{T_i} = \frac{3}{10} + \frac{5}{15} + \frac{2}{20} + \frac{5}{30} = \frac{9+10+3+5}{30} = \frac{27}{30} = \frac{9}{10} = 0,9$$

$$2^\circ \text{ simulacija u kritičnom slučaju (ne traži se...)}$$



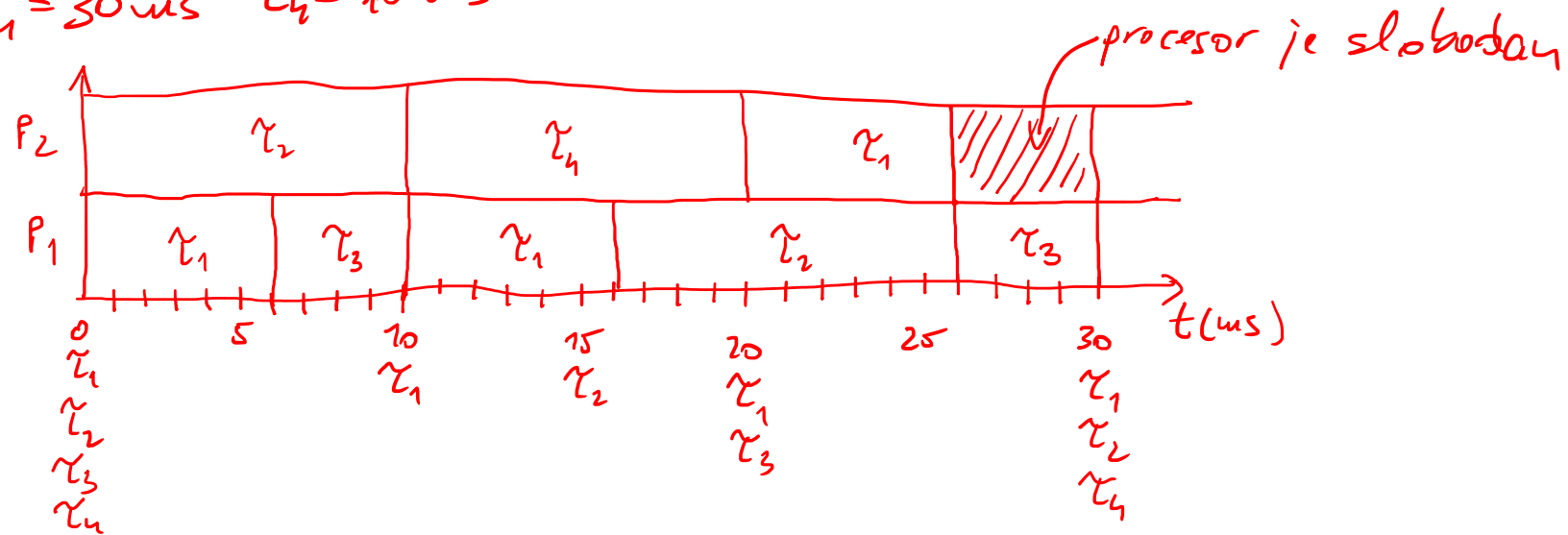
Rasporedivanje prema krajnjim terminima završetka na dvoprocesorskom računalu

$$\tau_1: T_1 = 10 \text{ ms} \quad C_1 = 6 \text{ ms}$$

$$\tau_2: T_2 = 15 \text{ ms} \quad C_2 = 10 \text{ ms}$$

$$\tau_3: T_3 = 20 \text{ ms} \quad C_3 = 4 \text{ ms}$$

$$\tau_4: T_4 = 30 \text{ ms} \quad C_4 = 10 \text{ ms}$$



$t = 0$

$$\begin{aligned} d_1 &= 10 \leftarrow \text{najmanji} \\ d_2 &= 15 \leftarrow \text{isti najmanji} \\ d_3 &= 20 \\ d_4 &= 30 \end{aligned}$$

$t = 5$

$$\begin{aligned} d_2 &= 15 \leftarrow \text{najmanji} \\ d_3 &= 20 \leftarrow \text{isti najmanji} \\ d_4 &= 30 \end{aligned}$$

$t = 10$

$$\begin{aligned} d_1 &= 20 \\ d_4 &= 30 \end{aligned}$$

$t = 15$

$$\begin{aligned} d_1 &= 20 \\ d_2 &= 30 \\ d_4 &= 30 \end{aligned} \quad \begin{aligned} &\parallel \\ &\text{isti!} \\ &\text{treba} \\ &\text{dodatni} \\ &\text{kriterij} \end{aligned}$$

$t = 16$

$$\begin{aligned} d_2 &= 30 \\ d_4 &= 30 \end{aligned}$$

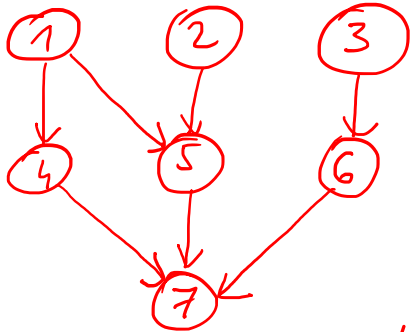
$t = 20$

$$\begin{aligned} d_1 &= 30 \\ d_2 &= 30 \\ d_3 &= 40 \end{aligned}$$

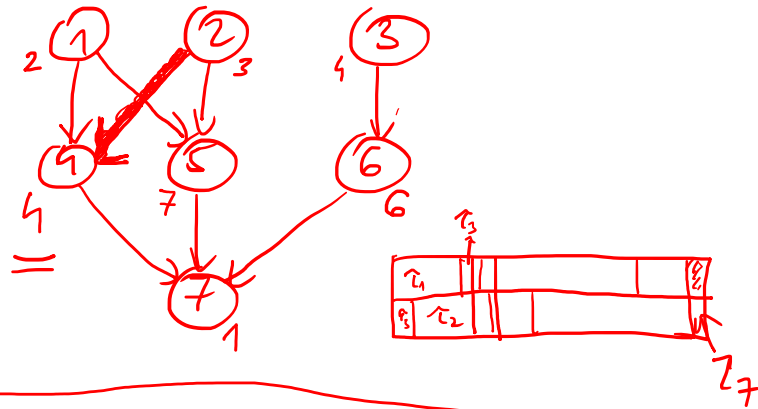
$t = 26$

$$d_3 = \underline{\underline{40}}$$

Opće raspoređivanje (2 procesora)



- nije redukovano!



$$\Delta t'' = \frac{c_4 + c_5}{\alpha_{\sigma_1}} = \frac{4 + 7}{\frac{16}{13}} = \frac{11 \cdot 13}{16}$$

$$\alpha_4 = \frac{4}{\frac{11 \cdot 13}{16}} = \frac{64}{143}$$

$$\alpha_5 = \frac{7}{\frac{11 \cdot 13}{16}} = \frac{112}{143}$$

$$x = \frac{52}{10} - \frac{65}{16}$$

$$x \cdot \alpha_4 \Rightarrow \tau_4$$

$$x \cdot \alpha_5 \Rightarrow \tau_5$$

$$t = 0$$

$$\tau_{\sigma_1} = \{\tau_1, \tau_2, \tau_4, \tau_5\}$$

$$\tau_{\sigma_2} = \{\tau_3, \tau_6\}$$

$$c_{\sigma_1} = 16$$

$$c_{\sigma_2} = 10$$

$$\Delta t = \frac{c_{\sigma_1} + c_{\sigma_2}}{\text{br. pro.}} = \frac{16 + 10}{2} = \underline{\underline{13}}$$

$$\alpha_{\sigma_1} = \frac{c_{\sigma_1}}{\Delta t} = \frac{16}{13} > 1 \text{ ali to je OK jer imamo } 2 \times 2 \text{ zad!}$$

$$\alpha_{\sigma_2} = \frac{c_{\sigma_2}}{\Delta t} = \frac{10}{13} < 1 \text{ u}$$

kreću τ_1, τ_2 i τ_3

$$\alpha_3 = \alpha_{\sigma_3} = \frac{10}{13}$$

$$t_{23} = 0 + \frac{c_3}{\alpha_3} = \frac{4}{\frac{10}{13}} = \frac{52}{10} = 5 \frac{2}{5} = 5,2$$

$$\Delta t' = \frac{c_1 + c_2}{\alpha_{\sigma_1}} = \frac{2 + 3}{\frac{16}{13}} = \frac{65}{16} = 4 \frac{1}{16}$$

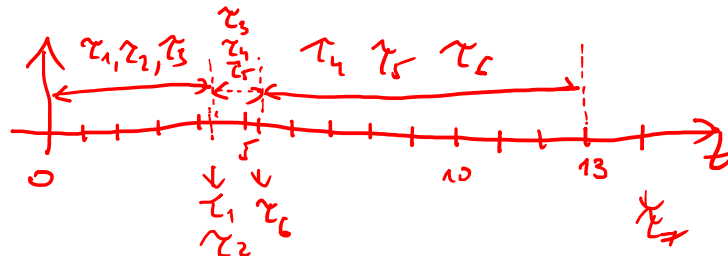
$$\alpha_1 = \frac{c_1}{\Delta t'} = \frac{2}{\frac{65}{16}} = \frac{32}{65}$$

$$\alpha_2 = \frac{c_2}{\Delta t'} = \frac{3}{\frac{65}{16}} = \frac{48}{65}$$

$$t_{21} = 0 + \Delta t' = 4 \frac{1}{16} \text{ u}$$

$$= 0 + \frac{c_1}{\alpha_1} = \frac{2}{\frac{32}{65}} = \frac{65}{16}$$

$$t_{22} = 0 + \Delta t' = 4 \frac{1}{16}$$



$$t = 4 \frac{1}{16} \tau_4, \tau_5, \tau_6$$

$$0 - 4 \frac{1}{16} \tau_3 : \alpha_3 = \frac{10}{13}$$

$$4 \frac{1}{16} \cdot \frac{10}{13} = \frac{5}{16} \cdot \frac{10}{13} = \frac{50}{208} = 3 \frac{1}{8}$$