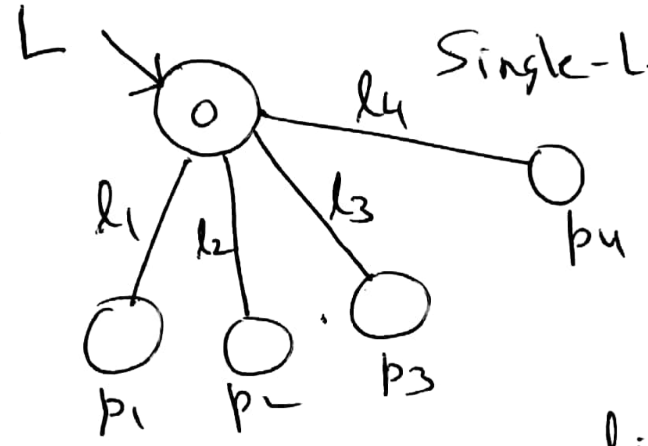
EE5903 RTS

Arbitrarily Divisible Loads Scheduling



Single-Level Tree Network

link l_i
proc p_i

link speed: z_i
proc. speed: w_i

Linear Model:

(L) can be arbitrarily divided

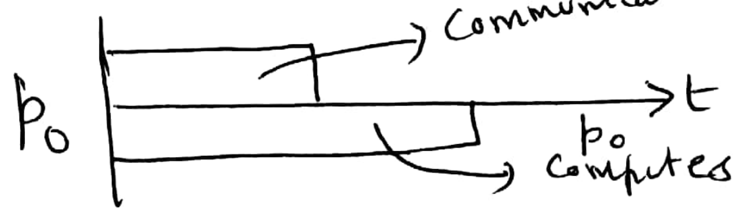
$\alpha_i \longrightarrow p_i$

$\Rightarrow$ communication time $= \alpha_i z_i$
Computation time $= \alpha_i w_i$

Root processor p_0

- → with front-end (FE)
- → without front-end

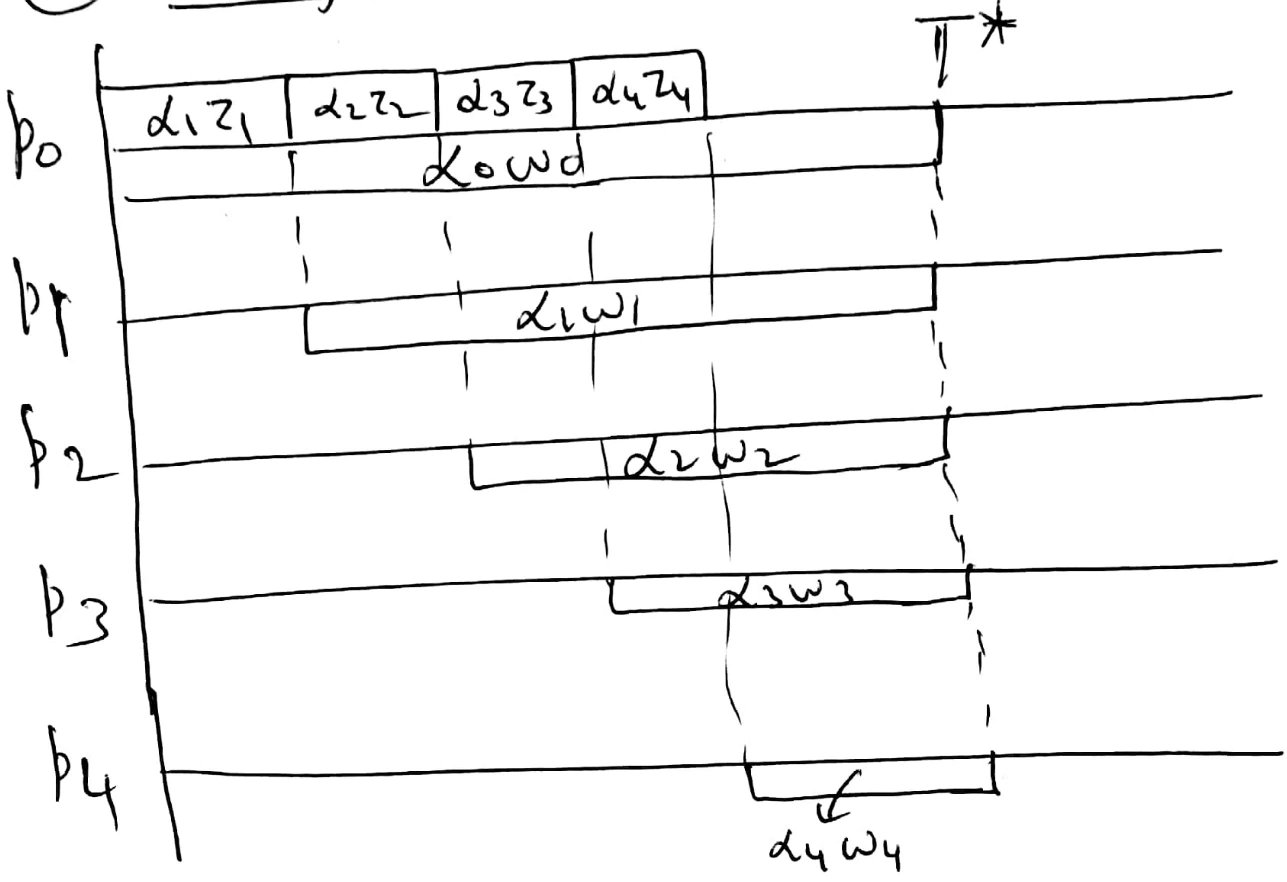
If p_0 is equipped with a FE, then it can compute & communicate concurrently.



→ communicate a chunk to other processor

→ p_0 computes its load.

② Ⓐ With front-end



$$\left.\begin{aligned} \alpha_3 w_3 &= \alpha_4 (w_4 + z_4) \\ \alpha_2 w_2 &= \alpha_3 (w_3 + z_3) \\ \alpha_1 w_1 &= \alpha_2 (w_2 + z_2) \\ \alpha_0 w_0 &= \alpha_1 (w_1 + z_1) \end{aligned}\right\} + \sum_{i=0}^{4} \alpha_i = L$$

$$\Rightarrow \alpha_3 = \alpha_4 \left(\frac{w_4 + z_4}{w_3}\right) = \alpha_4 \sigma_4, \quad \text{where } \sigma_4 = \frac{w_4 + z_4}{w_3}$$

$$\alpha_2 = \alpha_3 \sigma_3 = \alpha_4 \sigma_4 \cdot \sigma_3$$

$$\alpha_1 = \alpha_2 \cdot \sigma_2 = \alpha_4 \sigma_4 \cdot \sigma_3 \cdot \sigma_2$$

$$\alpha_0 = \alpha_1 \sigma_1 = \alpha_4 \sigma_4 \cdot \sigma_3 \cdot \sigma_2 \cdot \sigma_1$$

Using $\sum d_i = L$, we obtain,

$$d_4 = \left(\frac{L}{1 + \sum_{i=0}^{4} \prod_{j=i+1}^{4} \sigma_j} \right)$$

in general,

$$d_m = \left(\frac{L}{1 + \sum_{i=0}^{m} \prod_{j=i+1}^{m} \sigma_j} \right)$$

& Hence, $T^* = d_0 w_0$

$$\Rightarrow \boxed{T^* = \frac{\left(\prod_{k=1}^{m} \sigma_k \right) \cdot w_0 \cdot L}{1 + \sum_{i=0}^{m} \prod_{j=i+1}^{m} \sigma_j}}$$

Optimal proc. time.

B Solve for without FE case and p_0 participates.

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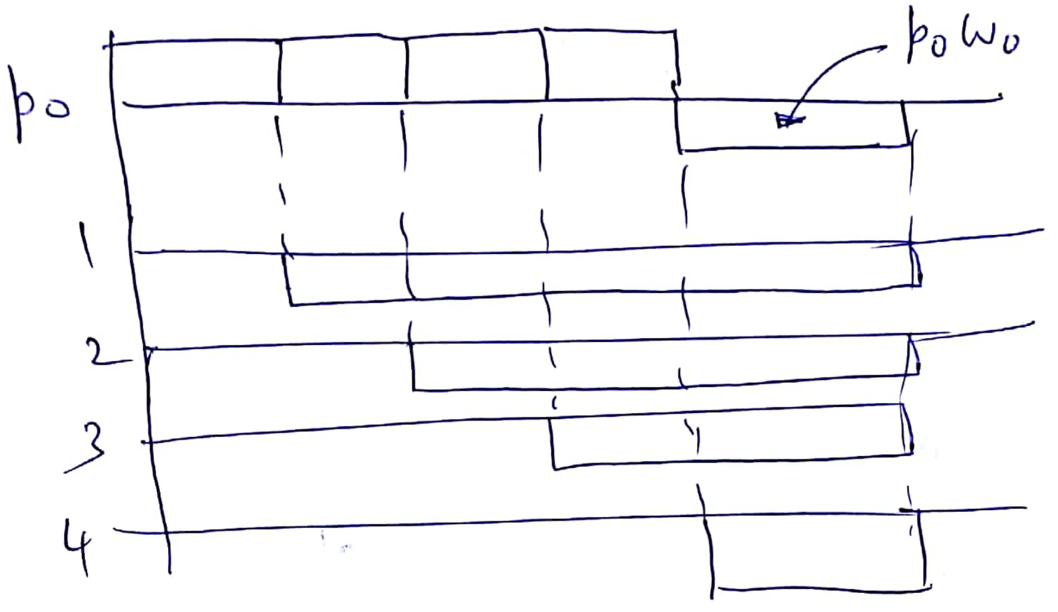
(4) For (B): the timing diagram would be similar to case (A) except:



Solve using the above method (A).

(c) Solve (A) & (B) using the following affine model:

$$\text{Comm. time} = \alpha_i z_i + \theta_{cm}$$

$$\text{Comp. time} = \alpha_i w_i + \theta_{cp}.$$

(*) Derive closed-form soln for $\underline{\underline{m=5}}$.

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