Computational Cost Analysis of Block Processing

Let:

- n : Number of state operations per block (each block h consumes a constant amount of gas) so n is constant.
- L_h : Average number of nodes accessed per state operation (intermediate + leaf node).

Per operation:

- Reading time : $T_r = L_r.R \to T_h operation = L_h(R + N)$
- Writing time : $T_w = L_h.W \to T_h = n.T_h operation = n.L_h(R + W)$

More data means mode nodes accessed per operations with lead to: $L_h \approx k. \log_{16}(D_h)$ (assuming MPT is balanced)
k: Constant
Which lead to:

$$\boxed{T_h = n.k. \log_{16}(D_h).(R + W)}$$

- The processing time for the block h: $T_h = n.k. \log_{16}(D_h).(R + W)$
- The processing time for the previous block (h-1):

  $T_{h-1} = n.k. \log_{16}(D_{h-1}).(R + W)$
- Relation between T_h and T_{h-1}:

  $\dfrac{T_h}{T_{h-1}} = \dfrac{n.k. \log_{16}(D_h).(R + W)}{n.k. \log_{16}(D_{h-1}).(R + W)}$

  $\Rightarrow \dfrac{T_h}{T_{h-1}} = \dfrac{\log_{16}(D_h)}{\log_{16}(D_{h-1})}$

$$\boxed{\mathrm{T}_h = \frac{\log_{16}(D_h)}{\log_{16}(D_{h-1})}.T_{h-1}}$$