



$$S = 1 \times 0 + 2 \times 1 + 2^2 \times 2 + \dots + 2^{h-2} \times (h-2) + 2^{h-1} \times (h-1)$$

\hookrightarrow zero

$$S = 2^{h-1} (h-1) + 2^{h-2} (h-2) + 2^{h-3} (h-3) + \dots + 2^3 \times 3 + 2^2 \times 2 + 2^1 \times 1$$

$$\textcircled{1} S = 2^{h-1} \left(h-1 + \frac{h-2}{2} + \frac{h-3}{2^2} + \dots + \frac{3}{2^{h-4}} + \frac{2}{2^{h-3}} + \frac{1}{2^{h-2}} \right)$$

$$\textcircled{1} -2S = 2^{h-1} \left(2(h-1) + (h-2) + \frac{h-3}{2} + \dots + \frac{3}{2^{h-5}} + \frac{2}{2^{h-4}} + \frac{1}{2^{h-3}} \right)$$

$$\textcircled{1} - \textcircled{1}$$

$$S = 2^{h-1} \left(2(h-1) + (h-2) - (h-1) \right) + \left(\frac{h-3}{2} - \frac{(h-2)}{2} \right) + \dots + \left(\frac{2}{2^{h-4}} - \frac{3}{2^{h-5}} \right) + \left(\frac{1}{2^{h-3}} - \frac{2}{2^{h-4}} \right) - \frac{1}{2^{h-2}}$$

$$S = 2^{h-1} (2h-2 + (-1)) + \left(-\frac{1}{2} \right) + \dots + \left(-\frac{1}{2^{h-4}} \right) + \left(-\frac{1}{2^{h-3}} \right) + \left(-\frac{1}{2^{h-2}} \right)$$

$$S = 2^{h-1} \left(2h-2 - \left(1 + \frac{1}{2} + \frac{1}{2^2} + \dots + \frac{1}{2^{h-4}} + \frac{1}{2^{h-3}} + \frac{1}{2^{h-2}} \right) \right)$$

$$S = 2^{h-1} \left(2h-2 - \left(1 \times \frac{1 - \left(\frac{1}{2} \right)^{h-1}}{1 - \frac{1}{2}} \right) \right)$$

$$S = 2^{h-1} \left(2h-2 - \left(\frac{\frac{2^{h-1}}{2^{h-1}} - 1}{\frac{1}{2}} \right) \right)$$

$$S = 2^{h-1} \left(2h-2 - \left(\frac{2^{h-1} - 1}{2^{h-1}} \times 2 \right) \right)$$

$$S = 2h \times 2^{h-1} - 2^h - (2^{h-1} - 1) \times 2$$

$$S = h \times 2^h - 2^h - 2^h + 2$$

$$S = \log_2 n \times 2^{\log_2 n} - 2^{\log_2 n} - 2^{\log_2 n} + 2$$

$$S = n \log_2 n - n - n + 2$$

$$\underline{\underline{O(n \log_2 n)}}$$