



$$S = \underbrace{2^{h-1} \times 0}_{\rightarrow \text{zero}} + 2^{h-2} \times 1 + 2^{h-3} \times 2 + \dots + 2^2 \times (h-3) + 2^1 \times (h-2) + 2^0 \times (h-1)$$

$$S = 2^{h-2} \times 1 + 2^{h-3} \times 2 + 2^{h-4} \times 3 + \dots + 2^2 (h-3) + 2^1 (h-2) + 2^0 (h-1)$$

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

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

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

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

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

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

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

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

$$= 2 \times 2^{h-2} + 2 \times 2^{h-2} - 2$$

$$= 2^{h-1} + 2^{h-1} - 2$$

$$= 2^h - 2$$

$$= n - 2$$

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