Selection Sort

$$\sum_{i=0}^{p-1}\left(c_1 + \sum_{k=i+1}^{p}(c_2)\right) + c$$

$$= \sum_{i=0}^{p-1}\left(c_1 + c_2(p-(i+1)+1)\right)$$

$$= \sum_{i=0}^{p-1}\left(c_1 + c_2(p-i)\right)$$

$$= \sum_{i=0}^{p-1}(c_1 + c_2 p - c_2 i)$$

$$= (c_1 + c_2 p)(n-1-0+1) - c_2 \sum_{i=0}^{p-1}$$

$$= (c_1 + c_2 p)p - c_2\left(\frac{(p-1)(p)}{2}\right)$$

$$= c_2 p^2 + \left(\frac{c_1 + c_2}{2}\right)p + c$$

$O(p^2)$

Merge Sort

$$\text{merge}() = c_1 + \sum_{0}^{mid} c + \sum_{mid}^{n} c$$

$$= cn$$

$$\text{mergeSort}() = T(n/2) + T(n/2) + cn$$

$$\Rightarrow 2T(n/2) + cn$$

$$\Rightarrow 4T(n/4) + 2cn$$

$$\Rightarrow 8T(n/8) + 3cn$$

$$\Rightarrow 2^k T(n/2^k) + kcn$$

$$\frac{n}{2^k} = 1 \Rightarrow 2^k = n$$

$$\Rightarrow k = \log_2 n$$

$$\Rightarrow 2^{\log_2 n} T(1) + (\log_2 n)cn$$

$$\Rightarrow nc' + cn\log_2 n \Rightarrow O(n \log n)$$

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