1) Count number of nodes

$$\sum_{i=1}^{n} 1 + \sum_{i=1}^{l} 2$$

Where n: number of nodes

l: number of leaf nodes

2) quicksort

$C(n) = 2C(n/2) + n$ for $n > 1$, $C(1) = 0$

Master Theorem:

$T(n) = a\,T(n/b) + f(n)$

$a = 2, b = 2, f(n) = n$

$f(n) \in \Theta(n^d) = \Theta(n^1)$

$\therefore d = 1$

$a = b^d \because 2 = 2^1$

$\therefore T(n) \in \Theta(n \log n)$

$C(n) \in \Theta(n \log n)$

3) merge sort

$C(n) = 2C(n/2) + C_{merge}(n)$ for $n > 1$,

$C(1) = 0$

in the worst case, $C_{merge}(n) = n - 1$

$\therefore C_{worst}(n) = 2C_{worst}(n/2) + n-1$

Master Theorem:

$$T(n) = aT(n/b) + f(n)$$

$a = 2$, $b = 2$, $f(n) = n-1$

$f(n) \in \Theta(n^d) = \Theta(n^1)$

$\therefore d = 1$

$a = b^d \quad \because \quad 2 = 2^1$

$\therefore T(n) \in \Theta(n \log n)$

$C_{worst}(n) = \Theta(n \log n)$