3) $T(n) = 2T\left(\frac{n}{2}\right) + 1, T(1) = 1$

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$T(n) = 2T(\frac{n}{2}) + 1, \quad T(1) = 1$

$T(n) = 2(2T(\frac{n}{4}) + 1) + 1$

$T(n) = 4T(\frac{n}{4}) + 2 + 1$

$T(n) = 4(2T(\frac{n}{8}) + 1) + 2 + 1$

$T(n) = 8T(\frac{n}{8}) + 4 + 2 + 1$

$T(n) = 8(2T(\frac{n}{16}) + 1) + 4 + 2 + 1$

$T(n) = 16T(\frac{n}{16}) + 8 + 4 + 2 + 1$

$T(n) = 2^k T(\frac{n}{2^k}) + \left(\sum_{i=0}^{k-1} 2^i\right)$

$\sum_{i=0}^{k-1} 2^i = 2^k - 1$

$\frac{n}{2^k} = 1, \quad n = 2^k, \quad k = \log_2 n$

$T(n) = 2^{\log_2 n}\left(T\left(\frac{n}{2^{\log_2 n}}\right)\right) + (2^{\log_2 n} - 1)$

$= n(T(1)) + (n - 1)$

$= n + n - 1$

$= 2n - 1$

$O(n)$

Substituting Equations

$n \rightarrow n/2$

$T(\frac{n}{2}) = 2T(\frac{n/2}{2}) + 1$

$T(\frac{n}{4}) = 2T(\frac{n/4}{2}) + 1$

$T(\frac{n}{8}) = 2T(\frac{n/8}{2}) + 1$