$T(n) = aT(\frac{n}{b}) + O(n^d)$ $\quad c = \log_b a$

$$T(n) \begin{cases} O(n^d) & \text{if } n^d < n^c \\ O(n^c \log n) & \text{if } n^d = n^c \\ O(n^d) & \text{if } n^d > n^c \end{cases}$$

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

   $a = 1,\ b = 2,\ d = 0,\ c = \log_2 1 = 0$

   Since $n^d = n^c$; $T(n) = O(n^c \log n)$

   $= O(\log n)$

2. $T(n) = 2T(\frac{n}{2}) + O(n^2)$

   $a = 2,\ b = 2,\ c = \log_2 2 = 1,\ d = 2$

   Since $n^d > n^c$; $T(n) = O(n^d)$

   $= O(n^2)$

3. $T(n) = 2T(\frac{n}{2}) + O(n)$

   $a = 2,\ b = 2,\ c = \log_2 2 = 1,\ d = 1$

   Since $2^d = 2^c$; $T(n) = O(n^c \log n)$

   $= O(n \log n)$

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

$a = 4,\ b = 2,\ c = \log_2 4,\ d = 0$

Since $n^d < n^c$; $T(n) = O(n^c)$

$= O(n^2)$

5. $T(n) = T(\frac{n}{3}) + O(1)$

$a = 1,\ b = 3,\ c = \log_3 1 = 0,\ d = 0$

Since $n^b = n^c$; $T(n) = O(n^c \log n)$

$= O(\log n)$

6. $T(n) = 8T(\frac{n}{2}) + O(n^2)$

$a = 8,\ b = 2,\ c = \log_2 8 = 3,\ d = 2$

Since $n^d < n^c$; $T(n) = O(n^c)$

$= O(n^3)$

7. $T(n) = 9T(\frac{n}{3}) + O(n)$

$a = 9,\ b = 3,\ c = \log_3 9 = 2,\ d = 1$

Since $n^d < n^c$; $T(n) = O(n^c)$

$= O(n^2)$

8. $T(n) = 9T(\frac{n}{3}) + O(1)$

$a = 9,\ b = 3,\ c = \log_3 9 = 2,\ d = 0$

Since $n^d < n^c$; $T(n) = O(n^c)$

$= O(n^2)$