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TCS 505

Tutorial

1 $T(n) = 3T(n/2) + n^2$

Here, $a = 3 \quad b = 2$

$c = \log_2 3 = 1.58$

$n^2 > n^{1.58}$

$\boxed{T.C = \Theta(n^2)}$

2 $T(n) = 4T(n/2) + n^2$

$c = \log_2 4 = 2$

$n^2 = n^2$

$\boxed{T.C. = \Theta(n^2 \log n)}$

3 $T(n) = T(n/2) + 2^n$

Since, 2^n is a polynomial

∴ Master's Theorem does not apply

4 $T(n) = 2^n T(n/2) + n^n$

∴ This relation can't be solved using master's method

5 $T(n) = 16\,T(n/4) + n$

$c = \log_4 16 = 2$

$n^2 > n$

$\boxed{TC = \Theta(n^2)}$

6 $T(n) = 2\,T(n/2) + n\log n$

By extended euclidean algorithm

$T(n) = aT(n/b) + \Theta(n^k \cdot \log^p n)$

$T(n) = \Theta(n^{\log_2 2} \log^2 n)$

$\boxed{T(n) = \Theta(n \log^2 n)}$

7 $T(n) = 2\,T(n/2) + n\log^7 n$

By extended eulidean algorithm

$T(n) = \Theta(n^{\log_2 2} \log \log n)$

$\boxed{T(n) = \Theta(n \log \log n)}$

8 $T(n) = 2T(n/4) + n^{0.51}$

$c = \log_4 2 = 0.5$

$n^{0.5} < n^{0.51}$

$\boxed{TC = \Theta(n^{0.51})}$

9 $T(n) = 0.5\ T(n/2) + n^{-1}$

since, $a < 1$

Master theorem does not apply here.

10 $T(n) = 16\ T(n/4) + n!$

$c = \log_4 16 = 2$

$n^2 < n!$

$\boxed{TC = \Theta(n!)}$

11 $T(n) = 4\ (T[n/2]) + \log n$

By extended Master theorem

$T(n) = a\ T(n/b) + O(n^c \log^b n)$

$T(n) = \Theta(n^{\log_2 4})$

$\boxed{T(n) = \Theta(n^2)}$

12 $T(n) = \sqrt{n}\ T(n/2) + \log n$

Master theorem does not apply here as 'a' here is not constant

13 $T(n) = 3\ T(n/2) + n$

$c = \log_2 3 = 1.58$

$\boxed{TC = \Theta(n^{1.58})}$

14

$T(n) = 3T(n/3) + \sqrt{n}$

$c = \log_3 3 = 1$

$n > f(n)$

$\boxed{T(n) = \Theta(n)}$

15

$T(n) = 4T(n/2) + cn$

$n^2 > n$

$\boxed{T(n) = \Theta(n^2)}$

16

$T(n) = 3T(n/4) + n \log n$

By extended master theorem

$T(n) = \Theta(n^c \log^p n)$

$\boxed{T(n) = \Theta(n \log n)}$

17

$T(n) = 3T(n/3) + n/2$

$c = \log_3 3 = 1$

$n^1 = n$

$\boxed{TC = \Theta(n \log n)}$

18

$T(n) = 6T(n/3) + n^2 \log n$

By extended master theorem

$T(n) = \Theta(n^c \log^p n)$

$= \Theta(n^2 \log n)$

19

$T(n) = 4T(n/2) + n\log^{-1} n$

By extended master theorem

$T(n) = aT(n/b) + \Theta(n^k \log^p n)$

$a=4 \quad b=2 \quad c=1$

$a > b^c$

$T(n) = \Theta(n^{\log_2 4})$

$\boxed{T(n) = \Theta(n^2)}$

20 $T(n) = 64T(n/8) - n^2 \log n$

Here, $f(n)$ is negative

∴ Master theorem is not applicable

21 $T(n) = 7T(n/2) + n^2$

$c = \log_3 7 = 1.77$

$f(n) > n^c$

∴ $\boxed{T(n) = \Theta(n^2)}$

22 $T(n) = T(n/2) + n(2 - \cos n)$

since,

$a f(n/b) \leq c f(n) \quad c < 1$

∴ Master theorem does not apply here