Tutorial-1

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Sec:- A

Master Theorem:-

Ans 1:- ~~$f(n) = \theta(n^{\log_b a - \epsilon}), \epsilon > 0$~~

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

$T(n) = aT(n/b) + f(n^2)$

→ $a = 3$, $b = 2$, $f(n) = n^2$

→ $c = \log_2 3 = 1.58$

→ $n^c = n^1$

$\therefore f(n) > n^c$

ToC = $\theta(n^2)$

Ans 2:- $T(n) = 4T(n/2) + n^2$

→ $a = 4$, $b = 2$, $f(n) = n^2$

→ $c = \log_2 4 = 2$

$\therefore n^2 = f(n)$

→ **ToC = $O(n^2 \log n)$**

Ans 3:- $T(n) = T(n/2) + 2^n$

$a = 1$, $b = 2$

→ $c = \log_2 1 = 0$

$\therefore f(n) > n^c$

T.C = $\theta(2^n)$

Ans 4:- $T(n) = 2^n T(n/2) + n^n$

$\rightarrow a = 2^n, b = 2, f(n) = n^n$

$\rightarrow c = \log_2 2^n = n$

$\therefore f(n) > c$

$\therefore$ T.C = $\theta(n^n)$

Ans 5:- $T(n) = 16T(n/4) + n$

$\rightarrow a = 16, b = 4, f(n) = n$

$\rightarrow c = \log_4 16 = 2$

$\therefore n^2 > f(n)$

$\therefore T(n) = \theta(n^2)$

Ans 6:- $T(n) = 2T(n/2) + n\log n$

$\rightarrow a = 2, b = 2, f(n) = n\log n$

$\rightarrow c = \log_2 2 = 1$

$\therefore n^c < f(n)$

T.C = $O(n\log n)$

Ans 7:- $T(n) = 2T(n/2) + n/\log n$

Does not apply.

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

$a = 2, b = 4$

$\rightarrow c = \log_4 2$

$\therefore f(n) > n^c$

T.C = $\theta(n^{0.51})$

Ans 9:- $T(n) = 0.5T(n/2) + 1/n$

$a \geq 1$

but $a = 0.5$ which is less than 1.

$\therefore$ Not apply.

Ans 10:- $T(n) = 16T(n/4) + n!$

$a = 16, b = 4$

$c = \log_4 16 = 2$

$\therefore f(n) > n^c$

T.C = $\theta(n!)$

Ans 11:- $T(n) = 4T(n/2) + \log n$

$a = 4, b = 2$

$c = \log_2 4 = 2$

$\therefore f(n) < n^2$

T.C = $\theta(n^2)$

Ans 12:- $T(n) = \text{sqrt}(n)\,T(n/2) + \log n$

Does not apply.

Ans13:- $T(n) = 3T(n/2) + n$

$a = 3, b = 2, f(n) = n$

$\therefore c = \log_2 3 = 1.58$

$\therefore n^c > f(n)$

$T.C = \theta(n^{\log 3})$

Ans14:- $T(n) = 3T(n/3) + sqrt(n)$

$a = 3, b = 3, f(n) = sqrt(n)$

$\therefore c = \log_3 3 = 1$

$\therefore n > f(n)$

$\therefore T.C = \theta(n)$

Ans15:- $T(n) = 4T(n/2) + cn$

$a = 4, b = 2, f(n) = cn$

$\therefore c = \log_2 4 = 2$

$\therefore n^2 > f(n)$

$\rightarrow T.C = \theta(n^2)$

Ans16:- $T(n) = 3T(n/4) + n\log n$

$a = 3, b = 4, f(n) = n\log n$

$\rightarrow c = \log_4 3$

$\therefore f(n) > n^c$

$\therefore T.C = \theta(n\log n)$

Ans17:- $T(n) = 3T(n/3) + n/2$

$a = 3, b = 3, f(n) = n/2$

$\rightarrow c = 1$

$\therefore n > f(n)$

$T.C = \theta(n)$

Ans18:- $T(n) = 6T(n/3) + n^2\log n$

$a = 6, b = 3, f(n) = n^2\log n$

$\therefore c = \log_3 6$

$\therefore f(n) > n^c$

$T.C = \theta(n^2\log n)$

Ans19:- $T(n) = 4T(n/2) + n/\log n$

$a = 4, b = 2, f(n) = n/\log n$

$\therefore c = \log_2 4 = 2$

$\rightarrow n^2 > f(n)$

$\therefore T.C = \theta(n^2)$

Ans20:- $T(n) = 64T(n/8) - n^2\log n$

Does not apply.

Ans21:- $T(n) = 7T(n/3) + n^2$

$a = 7, b = 3, f(n) = n^2$

$\therefore c = \log_3 7$

$\therefore n^c < f(n)$

$\therefore T.C = \theta(n^2)$

Ans22:- $T(n) = T(n/2) + n(2 - \cos n)$

Does not apply.