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Tutorial-4

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

$a = 3, \; b = 2$

$n^{\log_b^a} = n^{\log_2^3}$

Comparing $n^{\log_2^3}$ & n^2

$n^{\log_2^3} < n^2$ (case 3)

$\therefore$ According to master theorem,

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

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

$a = 4, \; b = 2$

$n^{\log_2^4} = n^2 = f(n)$ (case 2)

$\therefore$ According to master theorem,

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

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

$a = 1, \; b = 2$

$n^{\log_2^1} = 2n^0 = 1$

$\therefore \; T(n) = \Theta(2^n)$

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

Master's theorem is not applicable.

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

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

$n^{\log_4 16} = n^2$

$n^2 > f(n)$

$\therefore \; T(n) = \Theta(n^2)$

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

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

$n^{\log_2 2} = n$

$f(n) > n$

$\therefore \; T(n) = \Theta(n\log n)$

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

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

$n^{\log_2 2} = n$

$n > f(n)$

$\therefore T(n) = \Theta(n)$

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

$a=2, b=4, f(n) = n^{0.51}$

$n^{\log_4 2} = n^{0.5}$

$\therefore T_n = \Theta(n^{0.51})$

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

Master's Theorem is not applicable as $a<1$.

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

$a=16, b=4, f(n) = n!$

$n \log_4 16 = n^2$

$\therefore T(n) = \Theta(n!)$

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

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

$n^{\log_2^4} = n^2$

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

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

Master's Theorem is not applicable.

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

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

$n^{\log_2^3} = n^{1.58}$

$T(n) = O(n^{\log_2^3})$

Ans 14 $T(n) = 3T(n/3) + \sqrt{n}$

$a = 3, b = 3, f(n) = \sqrt{n}$

$n^{\log_3^3} = n$

$T(n) = \Theta(n)$

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Ans 16 $T(n) = 3T(n/4) + n\log n$

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

$n^{\log_4^3} = n^{0.79}$

$T(n) = \Theta(n\log n)$

Ans 17 $T(n) = 3T(n/3) + n/2$

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

$n^{\log_3^3} = n$

$\Theta(n) = \Theta(n/2)$

$T(n) = \Theta(n\log n)$

Ans 18 $T(n) = 6T(n/3) + n^2\log n$

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

$n^{\log_3^6} = n^{1.63}$

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

Ans 19 $T(n) = 4T(n/2) + n/\log n$

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

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$n^{\log_2 4} = n^2$

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

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

Master's Theorem is not applicable.

Ans 21 $T(n) = 7\,T(n/3) + n^2$

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

$n^{\log_3 7} = n^{1.7}$

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

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

Master's Theorem is not applicable.