# Tutorial-4

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Q1 $T(n) = 3T(n/2) + n^2$

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

∵ a, b are constant & $f(n)$ is +ve functions ∴ Master Th. is applicable.

$c = \log_b a$

$\Rightarrow c = \log_b a \Rightarrow \log_2 3 = 1.58$

$n^c = n^{1.58}$

which is $n^2 > n^{1.58}$

Case 3 is applied here

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

Q2 $T(n) = 4T(n/2) + n^2$

$a = 4, b = 2, f(n) = n^2$.

∵ a & b are constant & $f(n)$ is +ve function.

∴ Master Th is applicable.

$c = \log_b a$

$\Rightarrow \log_2 a = \log_2 2^2 = 2 \log_2 2 = 2$

∴ $n^c = n^2 \Rightarrow n^c = f(n)$

Case 2 is applied.

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

Q3 $T(n) = T(n/2) + 2^n$

$a = 1, b = 2, f(n) = 2^n$

a & b are constant & $f(n)$ is +ve functions.

∴ Master's Th is applicable ; $c = \log_b a = \log_2 1$.

$n^c = n^0 = 1$ ; $f(n) > n^c$

Case 3 is applied $\Rightarrow T(n) = \Theta(2^n)$.

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

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

∵ a is not constant, its value depends on n.

∵ Masters Th is not applicable here.

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

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

∵ a & b are constant & $f(n)$ is +ve function

$c = \log_b a$.

$c \log_4 16 = c \log_4 4^2 = 2c \log_4 4 > 2$

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

Case 1 is applied here.

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

Q) $T(n) = 2T\left(\frac{n}{2}\right) + n \log n$.

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

∵ a, b are constant & $f(n)$ is +ve function $c = \log_b a$

$c \log_2 2 = 1$

$n^c = n^1 = n \Rightarrow \therefore f(n) > n^c$

Case 3 is applied.

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

Q) $T(n) = 0.5\,T(n/2) + 1/n$

$a = 0.5, b = 2, f(n) = 1/2$

∵ $a < 1$

Master's Th. is not applicable.

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

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

a & b are constant, $f(n)$ is +ve function

$c = \log_b a = \log_2 4 = 2$

$n^c = n^2$

$f(n) < n^c$

Case 1 applied

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

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

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

a & b are constant & $f(n)$ is +ve.

∴ Masters Th is applicable :-

$c = \log_b a = \log_2 3 = 0.158$.

$n^c = n^{0.158}$

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

Case 1 is applied

$\therefore T(n) = \Theta(n^{1.58})$