$\boldsymbol{Divide\ And\ Conquer -}$
$\boldsymbol{Continuous\ Master\ Theorem\ or}$
$\boldsymbol{Generalized\ Master\ Theorem}$
$\boldsymbol{-Example - 1}$

$\boldsymbol{Example\ 1}$: $\boldsymbol{Solve\ the\ following\ recurrence\ using\ the\ generalized\ master\ theorem}$:

$$T(n) = 8T\left(\frac{n}{2}\right) + n^2$$

$\boldsymbol{Solution}$:

$f(n) = n^2$

$a = 8$

$b = 2$

$\therefore n^{log_b a} = n^{log_2 8} = n^{log_2 2^3} = n^3$ $[as\ log_a a = 1]$

$hence, \varepsilon = n^3 - n^2 = n^1$, $hence\ \varepsilon = 1.$

$Hence\ \ \varepsilon > 0$, $a > 0$, $b > 1$

$\boldsymbol{Now\ lets\ verify\ if\ there\ exists}$:

$$f(n) = O\left(\frac{n^{log_a b}}{n^{\varepsilon}}\right)$$

$$= O\left(\frac{n^3}{n^1}\right)$$

$$= O(n^{3-1})$$

$$= O(n^2)$$

$i.e. n^2 < n^3 \Rightarrow n^{log_a b - \varepsilon} < n^{log_a b}$

$\boldsymbol{Therefore, the\ given\ time\ complexity\ function\ belongs\ to\ Case\ 1,}$

$\boldsymbol{Hence}$ $, T(n) = \Theta\left(n^{log_a b}\right) = \Theta(n^3).$

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