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Sem – 4th

Tutorial 4

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

$\rightarrow T(n) = aT(n/b) + f(n)$

$a \geq 1, b > 1$

on comparing

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

$c = \log_b a = \log_2 3 = 1.584$

$n^c = n^{1.584} < n^2$

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

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

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

$a = 4, b = 2$

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

$n^c = n^2$

as $f(n) = n^c = n^2$

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

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

$a = 1$

$b = 2$

$f(n) = 2^n$

$c = \log_b a = \log_2 1 = 0$

$n^c = n^0 = 1 \quad f(n) > n^c$

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

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

$a = 2^n$

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

$c = \log_b a = \log_2 2^n = n$

$n^c = n^n$

as $f(n) = n^c = n^n$

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

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

$a = 16, b = 4$

$f(n) = n$

$c = \log_4 16 = \log_4 (4)^2$

$= 2\log_4 4 = 2$

$n^c \Rightarrow n^2$

$f(n) < n^c$

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

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

$a = 2, b = 2$

$f(n) = n\log n$

$c = \log_2 2 = 1$

$n^c = n^1 = n$

$n\log n > n$

$f(n) > n^c$

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

7. $T(n) = 2T($

as

$n/\log n$

function

can not

it can be

$T(n) = 2$

$a = 2$

$n^c = 1$

using

$T(n) =$

$a = b^d$ if

So

$TC(n$

TC

8: $T(n)$

$c =$

n

$f(n$

classmate

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

as

$n/\log n$ is not a polynomial function so master theorem can not be apply on it

It can be written as

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

$a = 2 \quad b = 2$

$n^c = n^1 = n$

using

$T(n) = aT(n/b) + \theta(n^d \log^p n)$

$d = 1 \quad p = -1$

$a = b^d$ if $p < -1 \quad TC = \theta(n^{\log_b a})$

$p = -1 \quad TC = \theta(n^{\log_b a} \log\log n)$

$p > -1 \quad = \theta(n^{\log_b a} \log^{p+1} n)$

so

$TC(n) = \theta(n^{\log_b a} \log(\log(n)))$

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

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

$c = \log_b a = \log_4 2 = 0.5$

$n^c = n^{0.5}$

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

$f(n) > n^c$

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

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

as $a < 1$ so we cannot apply master theorem

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

$c = \log_b a = \log_4 16 = 2$

$n^c = n^2$

As $n! > n^2$

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

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

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

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

$n^c = n^2$

$f(n) = \log n$

$\therefore \log n < n^2$

$f(n) < n^c$

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

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

$a = \sqrt{2},\ b = 2$

$c = \log_b a = \log_b \sqrt{n} = \frac{1}{2} \log_2 n$

$f(x) > n^c$

$T(n) = \theta(f(n))$

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