

A D SHAH INSHHHAMHD OD HOCHNOLOGY

(Approved by AICTE New Delhi & Govt. of Maharashtra, Affiliated to University of Mumbai)
(Religious Jain Minority)

Subject :- ADSAA

SEM -V (I.T)

Recursive Tree Method

This method is used to solve the recurrence relation with multiple recursive calls (more than 1).

The Same recurrence relation can be solved using Substitution but for multiple recursive relations many mathematical calculations are required so we will get the result slower.



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Recursive Tree Method

Example 1 Given recurrence relation is T(n) = T(n/2) + T(n/2) + h

Step 1:- Now other than recursive calls whatever is left, assign that as a root of the tree.

In our case we have 2 recursive calls

T(n/2) & T(n/2) & what is remaining is n.

So n becomes root of the tree.

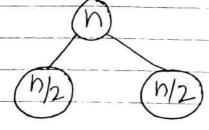
Step 2:- Now check how many recursive calls

we have, we have 2 recursive calls

50, root mode n will have 2 child

The smaller recursive call goes on left side of root node 4 larger recursive call goes to the right side.

In our case both recursive calls are n/2





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Stenzia	- Chapterite 116 colo late the computation to
<u> </u>	- Compate the calculate the computation time for each level of tree
	Time required
	for completion
	(n/2) $(n/2)$ $(n/2)$
	(112)
Step4:	Go on substitution till we identify the
<u> </u>	Go on substituting till we identify the pattern of our equation.
	Time required for completion
	$\binom{n}{n}$
15	
	(n/2) $(n/2)$ $(n/2)$ $(n/2)$
	$\binom{h/4}{4}$ $h/$
	n n
2	(n/8)
bound	Upper Bound
Donn	(元) · · · · · · · · · · · · · · · · · · ·
Q	How long this will continue 2
?£	This will continue till in becomes 1
	i.e. till the recursive function terminates.
Step 5:-	Total no of steps are K
	Time required for completion of each step is h
3.	C 1:
	So time required to solve the given recurrence relation = n*k
	recurrence relation = n * k
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5tep6:- Let's find out value of k
Assume $n = 1$ 2^k
2'
$50, n = 2^k$
Taking Jug both sides
V •
$\log n = k \cdot \log 2$ As to
K = log n as $log 2 = 1$
Step 7:-
The time complexity of the given recurrence relation is
The state of the s
n*K n*Jogn
· · · · · · · · · · · · · · · · · · ·
which is O(n logn)
V
$T(n) = O(n \cdot \log n)$
8



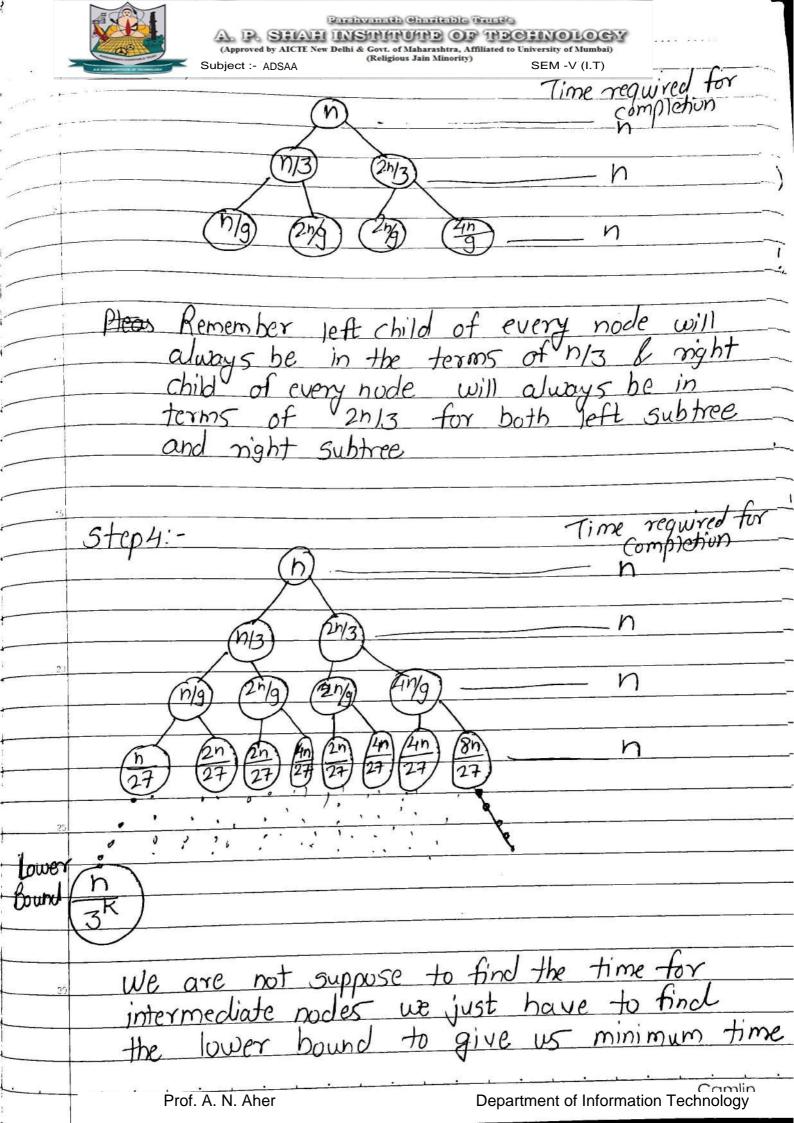
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	The second of th
i	Example 2
	F 100101716 2
	Given recurrence relation 15
	T(n) = T(n/3) + T(2n/3) + h
1	Salve this equation is
	Solve this equation using recursive tree
	1.1011/00:
	T(h) = T(n/3) + T(2n/3) + h
	1 (3) 1 (-13) 711
	Step 1: - Other than recursive terms we have
	Discharge terrors we have
	n so n is root node of tree
	(h)
15	Cten a. 1.2 1 a
	Step 2: - We have 2 recursive cults n/3 & 2n/3
	so n/3 will be left child of n as it
	is Smaller. And 2n13 is a right child
	of n Time required
	for completion
) n
	(h/2) (h/2)
	(h/3) (2h/3) — n
	Step 7: 6 1 1:11:
	Step3: - Go on substituting till we find a pattern
	ot our equation.





Prof. A. N. Aher

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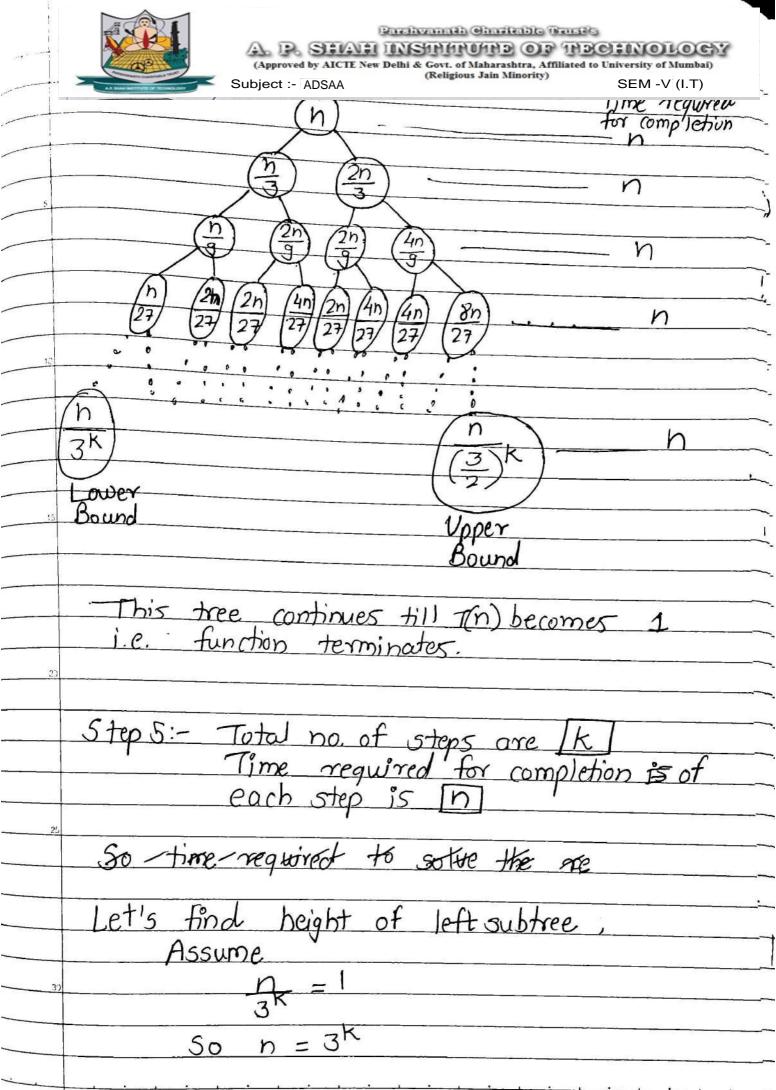
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	Zamjosti jaborat
	and upper bound to find out mercimum time of execution
	Here lower bound which we have got is
	Y
	3K
	Now let's find out upper bound which is $\frac{2n}{3}$
10	$\frac{3}{3}$ $\left(\frac{3}{2}\right)$
	50 for first step can we say
	V ,
	$\frac{h}{c=20}=0$
15	$\left(\frac{3}{2}\right)^0$
	F. C. I I
	For Second step we have 2n so we can say
x	$\frac{h}{(3)!} - \frac{2h}{3}$
<u>2c</u>	$\left(\frac{3}{2}\right)$
	For third step we have 4n so we can say
	9 50 We can say
	n _ 4n
. 25	(9) 9
	(4)
	h = 4n
	$\left(\frac{3}{2}\right)^{2}$ 9
30	
	So for kth Step we will have n as
	upper bound. $(\frac{3}{2})^k$
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Taking log at both sides gives us
$\log n = k \log 3$
$K = \log_3 n$ Height of left subtree
Now let's find height of night subtree
10
Assume $n = \frac{3}{2}k$
50, $n = (3)^{K}$
Taking log at both sides
$\log n = K \log \left(\frac{3}{2}\right)$
$\log_3 n = K$
$K = \log_{\frac{\pi}{2}} n$ Height of right subtree
Jog n this value is always bigger than
Jog3n
30



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We know that total time required to
Solve the given regimence relation is
n * K
For worst case the time required is
,
T(n)= n * log3 n This is max m time required for execution.
time required for
execution.
For best case the time required is
101 Dest Case The Thick required to
T(n) = n * log n This is the
minm time
required for execution
execution
$T(n) = O(n * log_3 n)$
1 1 1 1 1 2 2 2 1

/) / ! !	,
T(n) = 12/n log3V	1)