recuresssionreleation

October 3, 2024

Assignment:- Recursssion Releation

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# 7$ Find the value of T(2) for the recurrence relation T(n) = 3T(n-1) + 12n,␣
↪given that T(0)=5
1 Calculate  (1):
T(1)=3T(0)+12*1
substitute T(0)=5:
T(1)=3*5+12*1=15+12=27
2 Calculate T(2):
T(2)=3T(1)+12*2
substitute T(1)=27:
T(2)=3*27+12*2=81+24=105
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# 2. Given a recurrence relation, solve it using the substitution method:

a. T(n) = T(n-1) + c

Base case: Assume T(1)=d for some constant d.
unrolling the recurrence:
T(n)=T(n-1)+c
    =(T(n-2)+c)+c
    =T(n-2)+2c
    =T(n-3)+3c
    :
    :
    =T(1)+(n-1)c
    =d+(n-1)c
        T(n)=d+(n-1)c
Assuning T(1)=d simplofies to :
           T(n)=O(n)

b. T(n) = 2T(n/2) + n

Base case: Assume T(1)=d
unrolling the recurrence:
T(n)=2T(n/2)+n
    =2(2T(n/4)+n/2)+n
    =4T(n/4)+n+n
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    =4T(n/4)+2n
    =4(2T(n/8)+n/4)+2n
    =8T(n/8)+n+2n
    =8T(n/8)+3n
    :
    :
    =2kT(n/2K)+kn
    we stop when n/2k=1
        T(1)=d=T(n)=2log2nT(1)+(log2n)n
                     T(n)=O(nlogn)
c. T(n) = 2T(n/2) + c
Base Case: Assume T(1)=d
unrolling the recurrence:
T(n)=2T(n/2)+c
    =2(2T(n/4)+c)+c
    =4T(n/4)+2c+c
    =4T(n/4)+3c
    =4(2T(n/8)+c)+3c
    =8T(n/8)+4c+3c
    =8T(n/8)+7c
    :
    :
    =2kT(n/2k)+(2k-1)c
stopping when n/2k=1
        T(1)=d=T(n)=2log2nT(1)+(2log2n-1)c
              =n.d+(n-1)c
                T(n)=O(n)

d. T(n) = T(n/2) + c
Base Case: Assume T(1)=d
Unrolling the recurrence
                  T(n)=T(n/2)+c
                      =(T(n/4)+c)+c
                      =T(n/4)+2c
                      =T(n/8)+3c
                      :
                      :
                      =T(1)+kc

            Stopping when n/2k=1
                        T(1)=d=T(n)=d+clog2n
                              T(n)=O(logn)
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# 3. Given a recurrence relation, solve it using the recursive tree approach:

a. T(n) = 2T(n-1) +1
Recursive Tree Analysis
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1. Tree Structure:
At the top level (level 0), we have T(n) with a cost of 1.
At level 1, we have 2 ( -1) with contributes 2*1=2
At level 2, when have 2T(n-1) which contributes 2square *1=4
this pattern continues down to level n, when we have 2 n calls to T(O)(the base
  case)
2. Levels
Level 0: Cost = 1
Level 1: Cost = 2
Level 2: Cost = 4
:
:
Level  :Cost =2k
3. Total levels: the number of levels in n (from T(n)down to T(0)).
4. Total cost:
the total cost can be calculated as the sum of the cost at each level
T(n)=1+2+3+4........+2n-1
this is a geometric series with n terms
5. Sum of the series
the sum of geometric seies is given by
S=a(rn-1)/r-1
where a is the first term r is the common ratio, and n is the number of terms.
  Here a=1,r=2and n=n
  S=1(2n-1)/2-1=2n-1

T(n)=2n-1=T(n)=O(2n)

b. T(n) = 2T(n/2) + n
Recursive Tree Analysis
Tree Structure:
At the top level (level 0), we have T(n) with a cost of
At level 1, we have two subproblems T(n/2), contributing 2 /2=
At level 2, we have four subproblems T(n/4), contributing 4. n/4=n
This pattern continues, and at each level, the total cost remains
Levels :
level 0:cost=n
level 1:cost=n
level 2:cost=n
:
:
total number of levels=log2n
Total cost
the total cost across all levels is:
T(n)=n+n+n+.....
T(n)=n.log2n
T(n)=O(nlogn)
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