**Recurssion Releation**

# Assignment Questions

1. Find the value of T(2) for the recurrence relation T(n) = 3T(n-1) + 12n, given that T(0)=5.

Ans: To solve this, we can compute the values of T(1) and T(2) step by step:

* T(1)= 3T(0)+12(1)= 3(5) +12 =27
* T(2) = 3T(1)+12(2) = 3(27) + 24 = 81+24 = 105

So, the value of T(2) is 105.

2. Given a recurrence relation, solve it using the substitution method:

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

Ans: let’s apply the substitution method:

* For T(n) – T(n-1) + c , substituting repeatedly, we get:
* T(n ) = T(n-2) + 2c
* T(n) = T(n-3) +3c
* Continuing this, T(n) = T(0) +nc

Thus, T(n) = T(0) +nc is the solution.

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

Ans: We’ll expand this step by step:

* T(n) = 2T(n/2) + n
* T(n/2) = 2T(n/4) + n/2
* T(n) = 2[2T(n/4) + n/2] + n = 4T(n/4) +2n

Following this pattern, we get a series that sums up to O(n log n). So, the solution is T(n) = O(n log n) .

c. T(n) = 2T(n/2) + c:

Ans: This is similar to the previous problem but without the linear term:

* T(n) = 2T(n/2)+c
* T(n/2) = 2T(n/4) + c
* T(n) = 2[2T(n/4)+c] +c = 4T(n/4) + 3c

The solution will be T(n)=O(n) as the constant terms accumulate logarithmically.

d. T(n) = T(n/2) + c:

Ans: Here, the recurrence relation simplifies as we break down the terms:

* T(n) = T(n/2)+c
* T(n/2) = T(n/4) +c

This forms a logarithmic series, resulting in T(n) = O(log n).

3. Given a recurrence relation, solve it using the recursive tree approach:

a. T(n) = 2T(n-1) +1:

Ans: Using the recursive tree method, the structure expands as:

* T(n) = 2T(n-1)+1
* T(n-1) =2T(n-2) +1

This leads to a total depth of O(2^n), as the branching factor is 2 and the depth is n.

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

Ans: Using the recursive tree method:

* The root contributes n, and each level halves the problem size.
* The total number of levels is log n, and the work done at level is proportional to n.

Thus the total complexity is O(nlogn).