

Recurrence Relations - A Complete Guide

General Form of a Recurrence Relation:

$$T(n) = aT\left(\frac{n}{b}\right) + f(n)$$

Where:

- $T(n)$ is the time complexity of the problem of size n
- a is the number of subproblems
- b is the factor by which the problem size is reduced in each subproblem
- $f(n)$ is the cost of dividing the problem and combining the subproblems (the work done outside the recursive calls).

Methods for Solving Recurrence Relations

a) Substitution Method

b) **Recursion Tree Method** : The recursion tree method visualizes the recurrence as a tree, where each node represents a subproblem.

c) Master Theorem

The **Master Theorem** provides a direct way to solve recurrences of the form:

$$T(n) = aT\left(\frac{n}{b}\right) + f(n)$$

$T(n) = aT(n/b) + f(n)$ where $a \geq 1$ and $b > 1$