

Design and Analysis of Algorithms

Lecture-5

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Recurrence relation

Recurrence equations will be of the following form:-

$$(1) T(n) = aT(n/b) + f(n)$$

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

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

$$(4) T(n) = T(n-1) + T(n-2)$$

Some approaches to solve recurrence relations

(1) Iterative method

(2) Substitution method

(3) Recurrence Tree

(4) Master theorem method

Substitution method

The *substitution method* for solving recurrences comprises two steps:

1. Guess the form of the solution.
2. Use mathematical induction to find the constants and show that the solution works.

Substitution method

Example: Find the upper bound of following recurrence relation $T(n) = 2T(\lfloor n/2 \rfloor) + n$(1)

Solution:

Substitution method

Example: Find the upper bound of following recurrence relation $T(n) = 2T(\lfloor n/2 \rfloor + 17) + n$

Solution:

Substitution method

Example: Solve the following recurrence relation

$$T(n) = 2T(\lfloor \sqrt{n} \rfloor) + \lg n$$

Solution:

Substitution method

Example: Solve the following recurrence relation

$$T(n) = T(\lfloor n/2 \rfloor) + T(\lceil n/2 \rceil) + 1$$

Solution: