Tuesday, 3 March 2021 9:24 PM

Q.1 Given an array of integers (A)

(n) → present ??

3	2	1	5	6

(n)

O(n)

boolean is_present (Y, A) {
  for i → 0 : length(A)
    if (A[i] == x) {
      return true;
    }
}

→ array is sorted [in ↑ order]

O(n) → (some optimals)

→ Binary Search

(1) Search space
(2) find mid
(3) Take decision based on middle element

(n) (n/2) (n/4) (n/8) (n/16) (n/32) (n/64) (n/128) (n/256) (n/512) (n/1024)

start end

(n/2^k) = 1

n/2^k = 1

n = 2^k

log n = log 2^k

log n = k

→ (n/2^k) = 1

n/2^k = 1

n = 2^k

→ (n/2^k) = 1

n/2^k = 1

n = 2^k

→ monotonic order

increasing / decreasing order

Pseudocode

l = 0
h = arr.length - 1 } search space

while (l ≤ h) {
  int mid = (l + h)/2
  if (arr[mid] == x) {
    return mid;
  }
  if (arr[mid] < x) {
    l = mid + 1;
  } else {
    h = mid - 1;
  }
}
return -1;
}

overflow

→ Alternative Implementation

int mid = (l + h)/2 → l + (h - l)/2 → x

overflow

x

(2)

(n)

l

h

mid

(l)

(h)

overflow

T(n) = T(n/2) + c — (1)

T(n/2) = T(n/2²) + c — (2)

Substitute (2) in (1),

T(n) = T(n/2²) + 2c — (3)

T(n/2²) = T(n/2³) + c — (4)

→ T(n) = T(n/2³) + 3c — (5)

T(n) = T(n/2^k) + kc

At some point, as n/2^k diminishes, we reach only 1 element.

T(n/2^k) = T(1) → n/2^k = 1

T(n) = T(n/2^k) + kc → (6)

n = 2^k

Take log₂

log₂ n = log₂ 2^k

log₂ n = k — (7)

T(n) = T(N/2^(log N)) + log₂ N + c

= T(N/N) + c log₂ N

T(n) = T(1) + c log₂ N

T(n) = (1) + c log₂ n

→ T(n) = log₂ n

TC → O(log n)

SC → O(1)

---

binary Search [int [] A, int low, int high, int x) {

  if (low > high)
    return -1;

  int mid = (low + high)/2
  if (x == A[mid]) {
    return mid;
  }
  else if (x < A[mid]) {
    return binary Search
    (A, low, mid - 1, x);
  } else {
    return binary Search
    (A, mid + 1, high, x);
  }
}

TC → log n

SC → log n

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