(41)

Date No

الاسم: حازم عادل حسين أحمد
20210269 : ID

Algorithm #H.W 3

1)

```
Function Find_largest (arr, start, end)
        if start = end
            return start
        else
            mid = (start + end) / 2
            left_index = Find largest (arr, start, end)
            right_index = Find largest (arr, mid+1, end)
            if arr( arr[left_index] > arr[right index] )
                    return left_index
                else
                    return right index
```

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

$T(n) = O(n^0 \cdot \log(n)) = O(\log(n))$

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2)

```
Function min max(arr, start, end)

    if start == end
     return(arr[start], arr[end])

    elseif end - start == 1
    if arr[start] < arr[end]
        return (arr[start], arr[end])
    else
     return (arr[end], arr[start])

    else
     mid = (start + end) / 2
   left_min = left_max = min_max(arr, start, mid)
   right_min, rightmax = min max(arr, mid+1, end)

   return (min(left_min, right_min), max(left_max, right_max
```

$t(n) = 2T(n/2) + C$

$t(n) = O(n^{\log_b(a)} \cdot \log(n)) = O(n \log(n))$

(3)

حازم عادل سعيد أحمد

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4) yes it's a stable sorting algorithm, A sorting algorithm is said to be stable if it maintains the relative order of equal elements in the input array.

6) Solve the Following

a) $x(n) = x(n-1) + 5$ for $n > 1$, $x(1) = 0$

$$x(n-1) = x(n-2) + 5$$

$$x(n) = x(n-2) + 10$$

$$x(n-2) = x(n-3) + 5$$

$$x(n) = x(n-3) + 15$$

$$x(n) = x(n-k) + 5k \qquad n-1 = k$$

$$= x(1) - 5(n-1)$$

$$= 5n - 5 \Longrightarrow \Theta(n)$$

b) $x(n) = 3x(n-1)$ for $n > 1$, $x(1) = 4$

$$x(n) = 3^2 x(n-2)$$

$$x(n) = 3^3 x(n-3)$$

$$n - k = 4$$

$$n - 4 = k$$

$$x(n) = 3^k x(n-k)$$

$$x(n) = 3^{n-4} x(1) = 4 \cdot 3^n \Longrightarrow \Theta(3^n)$$

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c) $x(n) = x(n-1) + n$ for $n > 0$, $x(0) = 0$

$x(n) = x(n-1) + n$

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

$x(n) = x(n-3) + (n-2) + (n-1) + n$

$x(n) = n(n+1)/2 \implies \Theta(n)$

d) $x(n) = x(n/2) + n$ for $n > 1$, $x(1) = 1$

$\therefore n = 2^K$

$x(2^K) = x(2^{(K-1)}) + 2^K$

let $y(K) = x(2^K)$

$y(K) = y(K-1) + 2^K$

$= y(K-2) + 2^{(K-1)} + 2^K$

$= 2^{K-1} - 2$

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7)

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

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

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

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

$= n \Rightarrow \Theta(n)$

B) Both have the same Complexity

8) A) it returns the smallest Value in an array

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

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

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

$k = n-1$

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

$T(n) = T(1) + 2(n-1) = 2n-1 \Rightarrow \Theta(n)$