22/9 Somesh 1910206

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Midsem exam

Q2. $T(n) = T\left(\frac{n}{2}\right) + T\left(\frac{n}{4}\right) + n \quad \forall\ n > 5$

$T(n) = 1 \quad \forall\ n \leq 5$

$T(n) = \left[T\left(\frac{n}{4}\right) + T\left(\frac{n}{8}\right) + \frac{n}{2}\right] + \left[T\left(\frac{n}{8}\right) + T\left(\frac{n}{16}\right) + \frac{n}{4}\right] + n$

$= \underset{A}{T\left(\frac{n}{4}\right)} + 2\underset{B}{T\left(\frac{n}{8}\right)} + \underset{C}{T\left(\frac{n}{16}\right)} + \underbrace{\left[\frac{n}{2} + \frac{n}{4} + n\right]}_{\frac{4+1+2}{4} \quad \frac{7n}{4}}$

(A) $= T\left(\frac{n}{8}\right) + T\left(\frac{n}{16}\right) + \frac{n}{4}$

(B) $= T\left(\frac{n}{16}\right) + T\left(\frac{n}{32}\right) + \frac{n}{8}$

(C) $= T\left(\frac{n}{32}\right) + T\left(\frac{n}{64}\right) + \frac{n}{16}$

$= \left(T\left(\frac{n}{16}\right) + T\left(\frac{n}{8}\right) + \frac{n}{4}\right)$

$+ 2\left(T\left(\frac{n}{16}\right) + T\left(\frac{n}{32}\right) + \frac{n}{8}\right)$

$+ \left(T\left(\frac{n}{32}\right) + T\left(\frac{n}{64}\right) + \frac{n}{16}\right)$

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$T(n) \leq 2 \cdot T(\frac{n}{2}) + n \quad n > 5$

$T(1), T(2)\ T(3)\ T(4)\ T(5) = 1$

$T(n) \leq 2(T(\frac{n}{2}) + n$

$T(n) \leq cn.$

$T(\frac{n}{2}) \leq c\frac{n}{2}$

$2 \cdot c\frac{n}{2} + n.$

$T\cancel{n} \leq cn + n$

$n(c + \cancel{1})$

$c + 1 < c \quad \times$

wrong assumption.

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$T(n) \leq 2T(\frac{n}{2}) + n.$ $\quad n > 5$

$T(n) = 1$ $\quad n \leq 5$

$T(n) = 2T(\frac{n}{2}) + n$

$T(n) = 2\left(2T\left(\frac{n}{4}\right) + \frac{n}{4}\right) + n$

$= 2^2 T\left(\frac{n}{4}\right) + 2 \cdot \frac{n}{4} + 2 \cdot \frac{n}{2}.$

$= 2^k T\left(\frac{n}{2^k}\right) + 2 \cdot \left(\frac{n}{2^k} + \cdots \frac{n}{2}\right)$

$\frac{n}{2^k} \leq 5$

$\frac{n}{5} \leq 2^k$

$\log(n/5) \leq k$

$k = \log_2(n/5)$

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$$2^{\log(n/5)} T\left(\frac{n}{2^k}\right) + 2\left(\frac{n}{2^k} + \cdots \frac{n}{2}\right)$$

GP: $\frac{n}{2} + \frac{n}{2^2} \cdots \frac{n}{2^k}$

$$\cancel{n\left(\frac{(1/2)\left((1/2)^k - 1\right)}{(1/2) - 1}\right)}$$

$$n\left(\frac{(1/2)\left(1-(1/2)^k\right)}{1-1/2}\right)$$

$$n\left(1-\left(\frac{1}{2}\right)^k\right)$$

$$\boxed{T(n) = 5 \cdot \frac{n}{5} + 2n\left(1-\left(\frac{1}{2}\right)^{\log_2 n/5}\right)}$$

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A)

1. We can create an array of size n+
where in $A[i] = i$, b is the no. of
elements already in the datastr.
For adding $x$, we can
simply do
$A[x] = x;$

For reporting the minimum
we can just print
$A[0]$ {0 based indexing]

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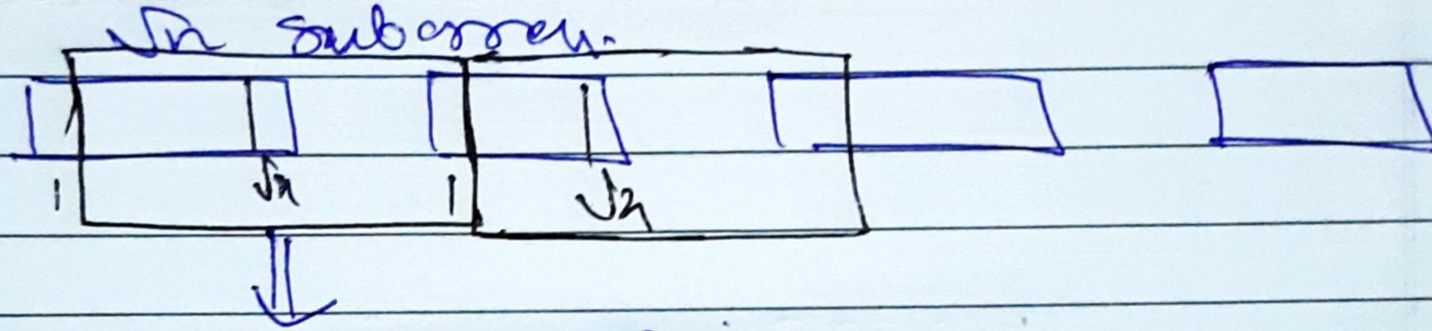
3. Take input parameter k.

```
for( int i = 0 to n-1) {

        tweak_quicksort (A, 0, i, k)
        printf A[k-1]

}

}

where tweak_quicksort is

void tweak_quicksort( A, low, high, k)
    if (low >= high)
        return
    pivot = partition (arr, low, high)      -> one pass
                                               partition
    if (pivot == k-1)                          function
        return;                                used in class
    }

    tweak_qs ( A, low, pivot-1, k);
    tweak_qs ( A, pivot+1, high, k)

}.
```

(4) First make $\sqrt{n}$ calls on ($\sqrt{n}$ no. of subarray, dividing the whole array into equal parts)

then include the first element of every subarray




Call on this

$(\sqrt{n}) + (\sqrt{n}-1) + (\sqrt{n}-2) \cdots (\sqrt{n}-k) = as.$

$(k \leq \sqrt{n})$