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Subject:

Section $\boxed{2}$

Date / /

A) $T(n) = 7T(\frac{n}{2}) + c(n^2)$ for $n > 1$ and $T(1) = 1$

$T(\frac{n}{2}) = 7(\frac{n}{4}) + c(\frac{n^2}{4}) \to T(n) = 7(7T(\frac{n}{4}) + c(\frac{n^2}{4})) + c(n^2)$

$T(n) = 7^2 T(\frac{n}{2^2}) + 7c(\frac{n^2}{2^2}) + c(n^2)$

$T(\frac{n}{4}) = 7T(\frac{n}{2^3}) + c(\frac{n^2}{2^4}) \to T(n) = 7^2(7T(\frac{n}{2^3}) + c(\frac{n^2}{2^4})) + 7c(\frac{n^2}{2^2}) + c(n^2)$

$7^3 T(\frac{n}{2^3}) + 7^2 c(\frac{n^2}{2^4}) + 7c(\frac{n^2}{2^2}) + c(n^2)$

$T(\frac{n}{8}) = 7T(\frac{n}{2^4}) + c(\frac{n^2}{2^6}) \to T(n) = 7^3(7T(\frac{n}{2^4}) + c(\frac{n^2}{2^6})) + 7^2 c(\frac{n^2}{2^4}) + 7c(\frac{n^2}{2^2}) + c(n^2)$

$7^4 T(\frac{n}{2^4}) + 7^3 c(\frac{n^2}{2^6}) + 7^2 c(\frac{n^2}{2^4}) + 7c(\frac{n^2}{2^2}) + c(n^2)$

$7^k T(\frac{n}{2^k}) + \boxed{7^{k-1} c(\frac{n^2}{4^{k-1}})} + 7^{k-2} c(\frac{n^2}{4^{k-2}}) + 7c(\frac{n^2}{4}) + \boxed{c(n^2)}$

$\frac{n}{2^k} = 1 \to n = 2^k \quad \boxed{\log_2 n = k}$

$7^{\log_2 n} + c(n^2)\left((\frac{7^{k-1}}{4^{k-1}}) + \frac{7^{k-2}}{4^{k-2}} + \frac{7}{4} + 1\right)$

$O(7^{\log_2 n}) + O(n^2 * \boxed{7^{\log_2 n}}) \to n^{\log_2 7}$

$n^{\log_2 7} + O(n^{2+\log_2 7})$

$\boxed{O(n^{2+\log_2 7})}$

→ inserting m elements into min-heap takes $\boxed{O(m\log m)}$

→ heap operations (extraction and insertion) take $\boxed{O(\log m)}$

since there are n elements total this step takes $\boxed{O(n\log m)}$

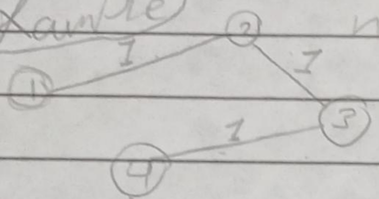
→ ~~complexity~~ total: $m\log m + n\log m = n\log m$

c) Huffman 1) Build heap → $O(n)$

2) rebuild heap → $O(\log n)$ the time complexity → $O(n\log n)$

store and remove $O(\log n)$

d) example



n vertices

n−1 edges

so weight = 1+1+1 = 3

e) input: Array M of k integers

output: pair (x, y) such that |x+y| is minimized

1) sort array M in non-decreasing order → $O(k\log k)$

2) initialize two pointers: set i=0 (left pointer)

set j=k−1 (right pointer)

3) set min_sum = infinity

set best_pair = (None, None)

4) while i<j

s = M[i] + M[j]

5) update min_sum = s

update best_pair = (M[i], M[j])

6) if s>0

j (j = j−1)

if s<0 i (i = i+1)

ret. best_pair

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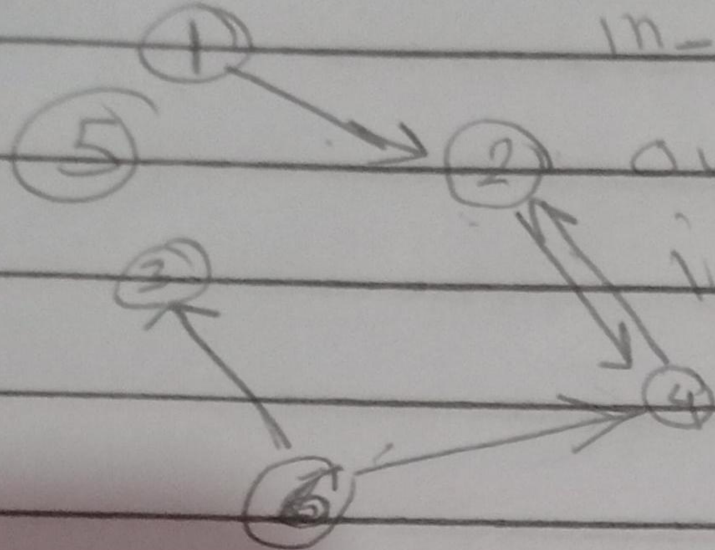

out-degree(2) = 1

in-degree(2) = 2

out degree(1) = 1

in degree(1) = 0

in degree(3) = 1

out-degree(3) = 0

in degree(4) = 2

out degree(4) = 1

in degree(5) = 0

out degree(5) = 0

in degree(6) = 0

out degree(6) = 2