CS 261 - Data Structure **Spring 2017**

HomeWork 6

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Problem 1 **Solution:**

For every node, we record how many leaves in its subtree.

Then we found the corresponding node of q, the number of leaves is same as the numebr of match postion.

Problem 2 **Solution:**

Assume tree size is n and it is 0-index.

If n is an odd number, unrank($\lfloor \frac{n}{2} \rfloor$) will return the answer.

Otherwise, the median of unrank($\lfloor \frac{n}{2} \rfloor$) and unrank($\lfloor \frac{n}{2} \rfloor - 1$) is the answer.

Problem 3 **Solution:**

$s > t$: when $s > t$, s operations at most change s different memory cells. Thus the lower bound is $\Omega(s \log s)$.

$s < t$: Assume $x = t \mod s$.

Decompsing t opeations into several different group each with size s and a extra one group with size x. Then for group with size s, it is $\Omega(s \log s)$. For the group with size x, from $s < t$, we konw it is $\Omega(x \log x)$. Thus the final answer is $\lfloor \frac{t}{s} \rfloor * s \log s + x \log x = \Omega(s \log t)$ Therefore it is $\min(s \log s, s \log t)$

Problem 4 **Solution:**

$$\sum_{x=1}^{i} \sum_{y=x}^{i} 2^y = \sum_{x=1}^{i} x 2^x = (i-1)2^{i+1} + 2$$