CSC 226 Assignment IV
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Dewei Xu
V00 897211

Q1)
a)

1. median of median analysis

analysis for n/9 subsequence of size 9

- Find element in each group O(1) time, gathering all group takes n times.
- 36 comparison to sort 9 element take n/9 · 36 = 4n time.
- Finding the median of a sorted group takes O(1) time, gathering all median take n time
- If T(n) is running time of linear select, find the median of n/9 element takes T(n/9) time. Time complexity of Median of median takes 6n + T(n/9) time.

2. Linear Select Analysis.

Using the median of median as pivot, we guarantee that 5n/18 element are smaller than the pivot

So, As is worst case 5n/18 in L, 13n/18 in G.

The 'conque' step takes T(13n/18).

In Summary, Linear Select Time complexity $T(n) = T(\frac{13}{18}n) + T(\frac{1}{9}n) + 6n$.

b) Guess $T(n) \le cn$

Based on the guess, we can get

$$T(n) \le c(\frac{13}{18}n) + c(\frac{1}{9}n) + 6n$$

convert for $c \geqslant 36$

thorefore $T(n) \leq 3bn \in O(n)$

Q2)

a) HHHH
HHHT
HHTH
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HTHH
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b) $pr(A) = 1/2$ See above List in a.

c) $pr(B) = 3/8$ See above List in a.

d) $pr(A \wedge B) = 3/16$ see above list in a

e) $X = 2$ See above list in a.

Q3) consider that the compute have 1/2 possibility return -1 and 1/2 possibility return 0 and 1. what is the expected time it need to get a 0 and 1?

Time	1	2	3	...	n
P	1/2	1/4	1/8	...	$1/2^n$

$E(\text{times}) = \frac{1}{2} + \frac{1}{2^2} + \cdots \frac{n}{2^n} = 2 - \frac{2+n}{2^n}$

then: $\lim_{n\to\infty} E(\text{times}) = 2$

So we only need 2 times of operation, then we can get a 0 or 1

The algorithm is same with QuickSort implementation in Median of Medians

```
function QuickSort (A)
    if left<right
      pivot = Median of median (A)  #run in O(n)
      L,E, G = partition (A, pivot)
      QuickSort (L)
      QuickSort (G)
    end if
  end function
```

Each time we compare 2 elements, we can repeat comparing by this computer until we get 0 or 1

the algorithm run in $O(n \log n)$

Q4)

a: seperate chaining b: Linear probing

c: Quadratic probing d: Double Hashing using the secondary Hash function

$h'(k) = 7 - (k \bmod 7)$

(a)

0	
1	20
2	26
3	
4	16,5
5	11,44
6	94,39
7	23,12
8	
9	13
10	

(b)

0	39
1	20
2	26
3	5
4	16
5	11
6	94
7	23
8	12
9	13
10	44

(c)

0	5
1	20
2	26
3	44
4	16
5	11
6	94
7	23
8	12
9	13
10	39

(d)

0	12
1	20
2	26
3	5
4	16
5	11
6	94
7	23
8	39
9	13
10	44