BLG 335E - Analysis of Algorithms I, Fall 2017

Project 2

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a) It can be proved that cost of partitioning is Θ(n). It is obvious that in each call of partition for finding the place of pivot n different checks are done.

Recurrunce of Quick sort:

$$T(n) = T(n-1) + T(0) + \Theta(n)$$

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

Solving the recurrence by iteration:

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

$$= \Theta(n) + \Theta(n-1) + \Theta(n-2) + \Theta(n-3) + \ldots + \Theta(1)$$

$$= \Theta(\sum k)$$

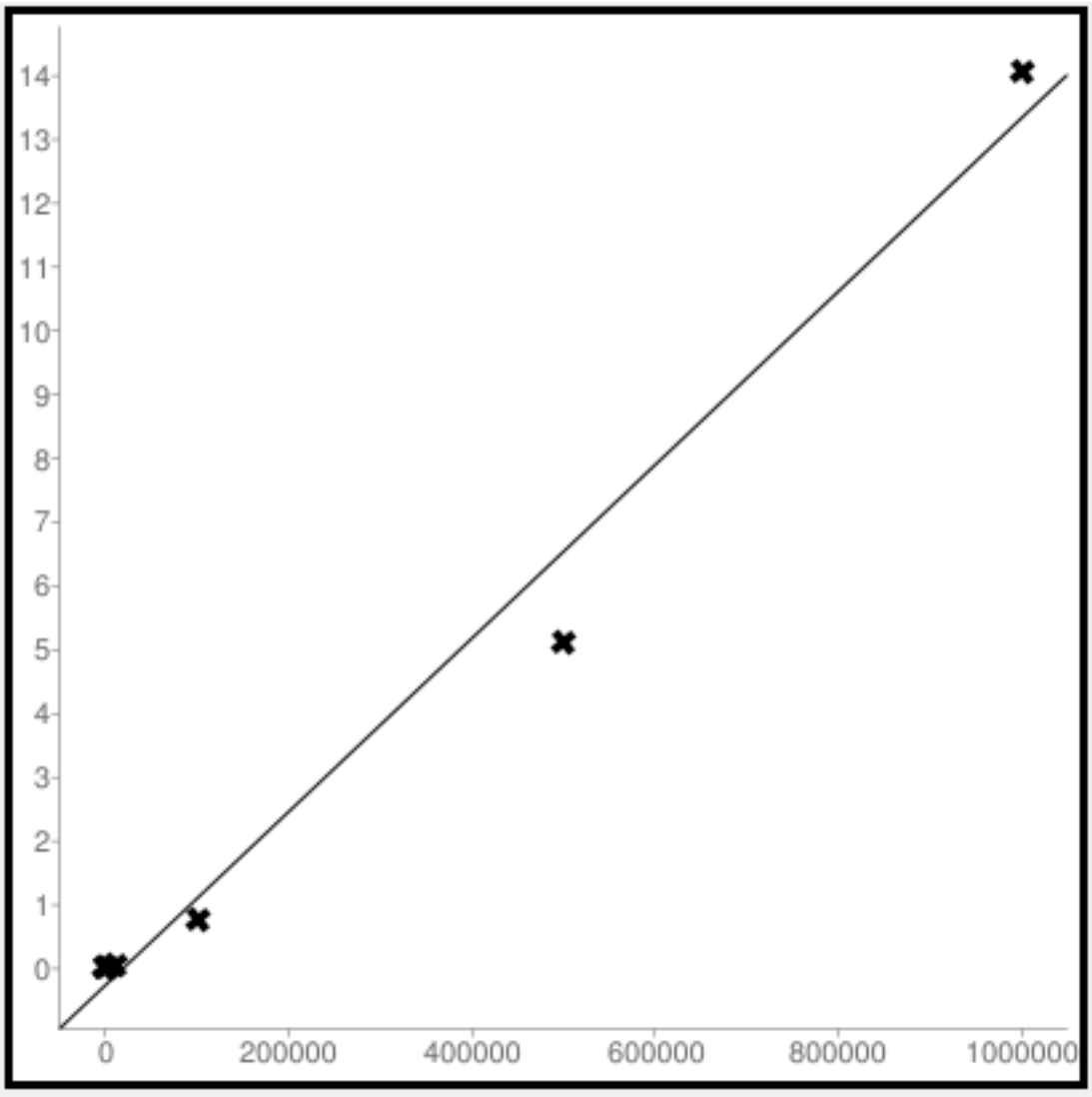
$$= \Theta(n^2)$$

Therefore asymptotic upper bound on the running time for Quick sort is n^2.

b)

N	Clicks	Seconds
10	331	0.000331
100	531	0.000531
1000	5114	0.005114
10000	77029	0.077029
100000	787561	0.787561
500000	5129247	5.129247
1000000	14072784	14.072784

The graph is as follows. Input size and time(seconds) is plotted. Also linear regrassion is drawn.

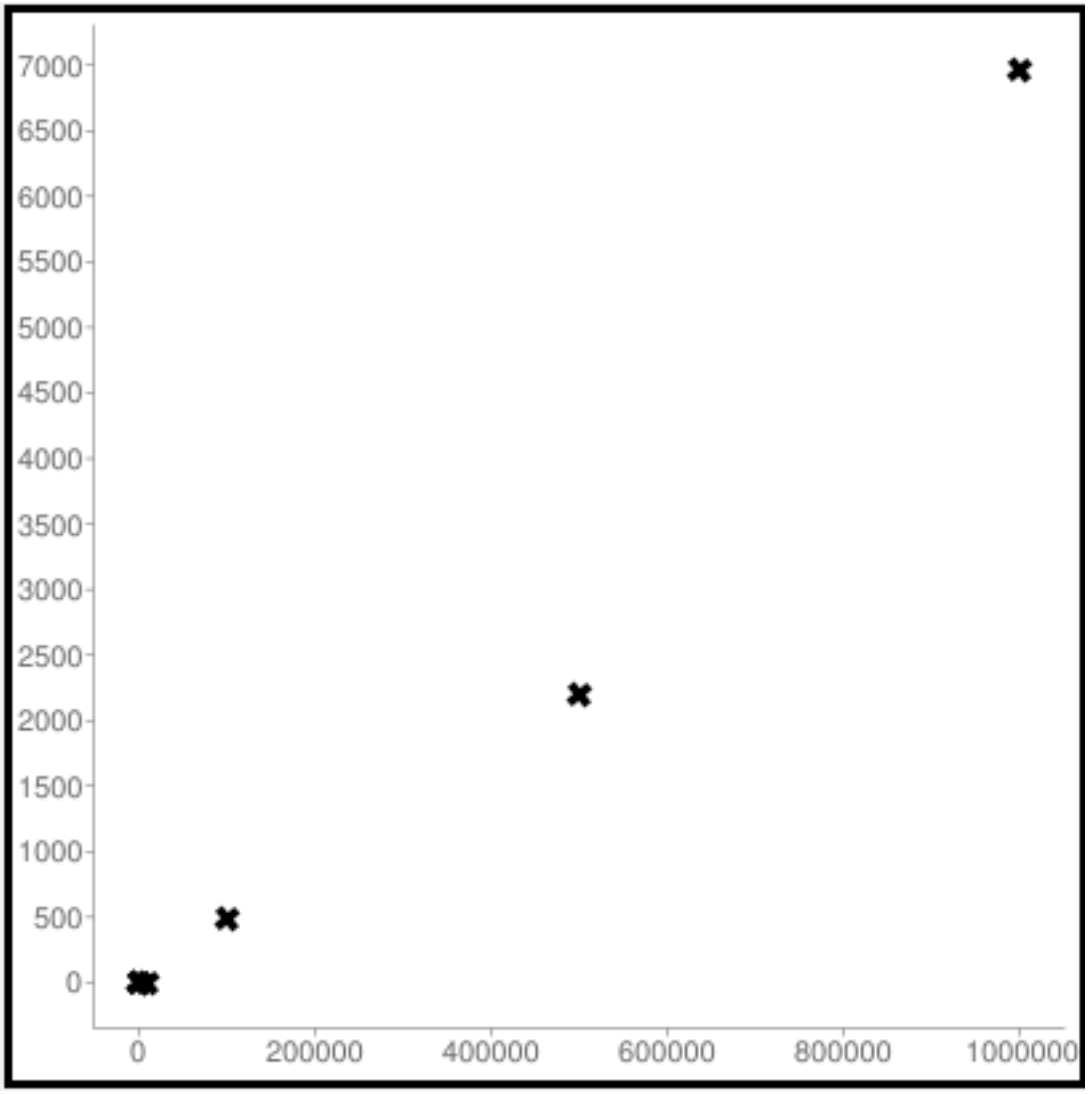


We can see also from linear regression that it is smaller than quadratic. So it is always smaller than n^2

c) When the array is already sorted this is the worst scenario for quicksort. In this time it takes n^2 time. When we give already sorted array, duration will be as follows.

N	Clicks	Seconds
10	398	0.000398
100	1268	0.001268
1000	35003	0.035003
10000	2699571	2.699571
100000	494.754794	490.754794
500000	2207385439	2207.385439
1000000	6962156743	6962.156743

Graph is as follows :



For solving that we need to choose the pivot randomly. In that case it will not split the array to 1 and n-1. So it will not be worst case. Again it will be average case Θ(nlogn).

d) Quick Sort is not a stable algorithm. When we are sorting by multiple parameters, in the case that first parameter is same, the order of the entities in the orginal file and sorted file will be different. For example if we will have this input

1389,30,34,male,95117,8600000US95117
50,30,34,female,61747,8600000US61747
231,60,61,female,74074,8600000US74074
50,85,,male,64120,8600000US61747
56,0,4,female,58042,8600000US58042

the result is like this :

50,85,,male,64120,8600000US61747
50,30,34,female,61747,8600000US61747

56,0,4,female,58042,8600000US58042
231,60,61,female,74074,8600000US74074
1389,30,34,male,95117,8600000US95117

so first order of this 2 entry is changed.