CSCI 430: Homework 7

John E. Buckley III

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1 7.1-3

The lines of code within the for loop for partition are executed r-p-1 times, which makes the running time a+bn=$\Theta(n)$

2 7.2-1

Let us represent $\Theta(n)$ as C_2n and assume that T9n))$\leq c_1n^2$

T(n)=T(n-1)+c_2n

$leqc_1(n-1)^2 + C_2n$

]tab =$C_1n^2 - 2c_1n + c_1 + C_2n$

$leqc_1n^2$

3 7.2-2

If array A contains elements of the same value then the partition will return q=r which means that the problem with size n is reduced to the size n-1. Thus T(n)=T(n-1)+n and by the iteration method: T9n)=$\Theta(n^2)$

4 7.2-3

In this case, the pivot will always be the smallest element. Each partition will produce two subarrays, one will only contain the smallest element, and the other will contain the remaining elements. Thus, T(n)=T(n-1)+n = $\Theta(n^2)$

5 7.2-4

InsertionSort does less work the more sorted the array is, in other words will be faster the more sorted the array is. InsertionSort is $\Theta(n + d)$ where d is the number of inversions in the array and the example in the problem tends to have a small number of inversions thus InsertionSort will be closer to linear than QuickSort.

6 7.3-1

We are not interested in the worst-case running time because it is triggered randomly and we can not reproduce it reliably, however we still factor it into the analysis of the expected running time.

7 7.3-2

Worst Case: T(n)=T(n-1)+1=n=$\Theta(n)$
Best Case: T(n)=2T($\frac{n}{2}$) $+ 1 = \Theta(n)$

8 7.4-2

QuickSorts best case running time happens when the partition is even: T(n)=2T(n$\frac{n}{2}$)+$\Theta(n)$ and using the sweet sweet master method, we get $\Theta(nlgn)$

9 7.4-5

In theory: If k is too large then the cost of InsertionSort becomes larger than $\Theta(nlgn)$ thus k must be $O(lgn)$
In Practice: $O(nk + nlg(\frac{n}{k})) = O(nlgn)$. We have constant facotrs c_1 and c_2 for QuickSort and InsertionSort. k must be chosen s.t. $c_2nk + c_1nlg(\frac{n}{k})$¡$c_1nlgn$.
$\rightarrow c_2nk + c_1n(lgn - lgk)$¡$c_1nlgn$
$\rightarrow C_2k$¡c_1lgk
k just so happens should be chosen experimentally.