به نام او

Quiz 1

Questions:

a) Suppose that all element values in an array are equal. What would be randomized quick-sort's running time in this case? Provide explanation.

b) The PARTITION procedure returns an index q such that each element of $A[p..q-1]$ is less than or equal to $A[q]$ and each element of $A[q+1..r]$ is greater than $A[q]$. Modify the PARTITION procedure to produce a procedure PARTITION′(A, p, r) which permutes the elements of $A[p..r]$ and returns two indices q and t where $p \leq q \leq t \leq r$, such that

- all elements of $A[q..t]$ are equal
- each element of $A[p..q-1]$ is less than A[q], and
- each element of $A[t+1..r]$ is greater than $A[q]$.

Answer:

a. (40 pts) Since all elements are equal, RANDOMIZED-QUICKSORT always returns $q = r$. We have recurrence $T(n) = T(n-1) + \Theta(n) = \Theta(n^2)$.

b. (80 pts)

```
PARTITION'(A, p, r) {
    pivot = A[r]
    q = p;
    t = r
    i = p
    while i <= t {
        if A[i] < pivot {
            swap(A[q], A[i])
            q = q + 1
            i = i + 1
        } else if A[i] > pivot {
            swap(A[t], A[i])
            t = t - 1
        }
        else {  // A[i] == pivot
            i = i + 1
        }
    }
    // A[p..q-1] < pivot, A[q..t] == pivot, and A[t+1..r] > pivot
    return q, t
}
```