King Fahd University of Petroleum and Minerals
College of Computer Science and Engineering
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ICS 202-01: Data Structures
Spring Semester 2017-2018
Quiz#3, Sunday March 4th 2018

Name:

ID#:

1. (8 points) Consider the following recursive version of SELECTION SORT algorithm:

```
1. public static void selectionSort(int[] x) {
2.     selectionSort(x, x.length);}
3. private static void selectionSort(int[] x, int n) {
4.     int minPos;
5.     if (n > 1) {
6.         maxPos = findMaxPos(x, n - 1);
7.         swap(x, maxPos, n - 1);
8.         selectionSort(x, n - 1);
9.     }
10. }
11. private static int findMaxPos (int[] x, int j) {
12.     int k = j;
13.     for(int i = 0; i < j; i++)
14.         if(x[i] > x[k])  k = i;
15.     return k;
16. }
17. private static void swap(int[] x, int maxPos, int n) {
18.     int temp=x[n]; x[n]=x[maxPos]; x[maxPos]=temp;
19. }
```

Form the recurrence relation describing the number of *element assignments* carried out by the algorithm. Note that the element assignments are in Line 18.

Line 18 has 3 element assignments.
Let $T(n)$ be the number of element assignments carried out by Algorithm SelectionSort when given an array of sije n.

$T(1) = 0$

$T(n) = 3 + T(n-1)$ $\quad n > 1$

Useful Formulas:

$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$ $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$ $\sum_{i=1}^{n} i^3 = \left(\frac{n(n+1)}{2}\right)^2$

$\sum_{i=0}^{n} x^i = \frac{x^{n+1}-1}{x-1}$ $\sum_{i=1}^{n} \left(\frac{1}{2}\right)^i . i = 2 - \frac{n+2}{2^n}$ $2^{\lg n} = n$,

$\log_b a = \frac{\log_c a}{\log_c b}$ where $c, b \neq 1$ $\log a^b = b \log a$ $\log ab = \log a + \log b$

2. (12 points) Solve the following recurrence and express it in terms of Big O() notation:

$$T(n) = 1 \qquad n = 1$$
$$= T(n-1) + n \qquad n > 1$$

$$T(n) = [T(n-2) + n-1] + n$$
$$= T(n-2) + (n-1) + n$$
$$= [T(n-3) + (n-2)] + (n-1) + n$$
$$= T(n-3) + (n-2) + (n-1) + n$$
$$= T(n-k) + (n-k+1) + (n-k+2) + \dots + (n-1) + n$$

will continue until $n-k=1$, $k=(n-1)$

$$= T(n-(n-1)) + (n-(n-1)+1) + \dots + (n-1) + n$$
$$= T(1) + 2 + 3 + 4 + \dots + n$$
$$= 1 + 2 + 3 + \dots + n$$
$$= \frac{n(n+1)}{2}.$$