Algorithm Design 3992
April 2021
Instructor : Dr.Shafiei

Exercises

We suggest you do these on your own. As with any homework problem, though, you may ask the TAs for help.

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1. Write pseudo code for maximum subarray of a given array.

- **The maximum sum subarray problem** is the task of finding a contiguous subarray with the largest sum, within a given one-dimensional array A[1...n] of numbers.

Example:

Input: [−2, 1, −3, 4, −1, 2, 1, −5, 4]

Output: [4, -1, 2, 1]

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2. Use Strassen's algorithm to compute the matrix product.

$$\begin{bmatrix} 1 & 3 \\ 7 & 5 \end{bmatrix} \begin{bmatrix} 6 & 8 \\ 4 & 2 \end{bmatrix}$$

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3. Use any of the methods we've seen in class so far to give big-Oh solutions to the following recurrence relations. You may treat fractions like n/2 as either bn/2c or dn/2e, whichever you prefer.

(a) T(n) = 3T n 9 + √ n for n ≥ 9, and T(n) = 1 for n < 9.

(b) T(n) = T(n − 4) + n for n ≥ 4, and T(n) = 1 for n < 4. (You may assume n mod 4 = 0.)

(c) T(n) = 6T n 4 + n 2 for n ≥ 4, and T(n) = 1 for n < 4.

(d) T(n) = 5T n 2 + n 2 for n ≥ 2, and T(n) = 1 for n < 2

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4. Consider the following algorithm, which takes as input an array A:

```
def printStuff(A):
    n = len(A)
    if n <= 4:
        return
    for i in range(n):
        print(A[i])
    printStuff(A[:n/3])       # recurse on first n/3 elements of A
    printStuff(A[2*n/3:])     # recurse on last n/3 elements of A
    return
```

What is the asymptotic running time of printStuff?

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5. What is the output of the following function ?(n>=2)(justify your answer)

```
g(n){
    if( n < =  1) then g(n) = n;
    Else g(n)= 5*g(n-1)-6*g(n-2);
}
```

a)$5^n - 6^n$ b)$3^n - 2^n$ c)$3^n + 2^n$ d)$5^n + 6^n$

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6. Consider the Hanoi Towers problem where A,B and C are the rods . In this problem we can’t move a disc directly from rod A to B . This action should be done by an auxiliary rod C . If we have N disks placed on rod A at the beginning and T(n) is the minimum number of actions to move N disks from A to B . Which option is equal to T(n) ?(justify your answer)

a)T(n)=3*T(n-1) + 2
b)T(n) = 6*T(n-1) + 3
c)T(n) = T(n-1) + T(n-2) + 1
d)T(n)= T(n-1)+T(n-2) + 2