

Exercises

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

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

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

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

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) $T(n) = 3T(n/9) + \sqrt{n}$ for $n \geq 9$, and $T(n) = 1$ for $n < 9$.

(b) $T(n) = T(n-4) + n$ for $n \geq 4$, and $T(n) = 1$ for $n < 4$. (You may assume $n \bmod 4 = 0$.)

(c) $T(n) = 6T(n/4) + n^2$ for $n \geq 4$, and $T(n) = 1$ for $n < 4$.

(d) $T(n) = 5T(n/2) + n^2$ for $n \geq 2$, and $T(n) = 1$ for $n < 2$

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?

5. What is the output of the following function $?(n \geq 2)$ (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) $5^n + 6^n$

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) $T(n)= T(n-1)+T(n-2) + 2$