

Practice Assignment 4

Due: Thursday, November 12 at 10AM to TEACH

To get credit, each student must submit their own solutions (which need not be typeset) to TEACH by the due date above – no late submissions are allowed. Note that while you must each submit solutions individually, you are free to work through the problem sets in groups. Solutions will be posted shortly after class and may be discussed in class. These will be graded on the basis of *completion* alone, not *correctness*.

1. Try to solve the following recurrence relations and give a Θ bound for each of them. The base case for each is $T(n) = \Theta(1)$.

- (a) $T(n) = 2T(n/3) + 1$
- (b) $T(n) = 5T(n/4) + n$
- (c) $T(n) = 7T(n/7) + n$
- (d) $T(n) = 9T(n/3) + n^2$
- (e) $T(n) = 8T(n/2) + n^3$
- (f) $T(n) = T(n-1) + 2$
- (g) $T(n) = T(n-1) + n^c$, where $c \geq 1$ is a constant
- (h) $T(n) = T(n-1) + c^n$, where $c > 1$ is some constant
- (i) $T(n) = 2T(n-1) + 1$
- (j) $T(n) = T(\sqrt{n}) + 1$

2. (a) Explain why the following algorithm sorts its input.

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STOOGESORT( $A[0 \dots n-1]$ )
  if  $n = 2$  and  $A[0] > A[1]$ 
    swap  $A[0]$  and  $A[1]$ 
  else if  $n > 2$ 
     $k = \lceil 2n/3 \rceil$ 
    STOOGESORT( $A[0 \dots k-1]$ )
    STOOGESORT( $A[n-k \dots n-1]$ )
    STOOGESORT( $A[0 \dots k-1]$ )
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- (b) Would STOOGESORT still sort correctly if we replaced $k = \lceil 2n/3 \rceil$ with $m = \lfloor 2n/3 \rfloor$? (*Hint: what happens when $n = 4$?*)
- (c) State a recurrence for the number of comparisons executed by STOOGESORT.
- (d) Solve the recurrence. Simplify your answer.