Name:_____

NetID:_____   **Lecture:**   A

Discussion: Monday & Wednesday   1:30   2:30

```
00 Flang(a₁, . . . , aₙ) : list of n positive integers, n ≥ 2)
01      if (n = 2) return |a₁ − a₂|
02      else
03            bestval = 0
04            for k = 1 to n
05                  newval = Flang(a₁, a₂, . . . , aₖ₋₁, aₖ₊₁, . . . aₙ)   \\ constant time to remove aₖ
06                  if (newval > bestval) bestval = newval
07            return bestval
```

1. (3 points) Describe (in English) what Flang computes.

   Solution: Flang computes the largest difference between two values in the list. Or, equivalently, the largest value minus the smallest value.

2. (5 points) Suppose that $T(n)$ is the running time of Flang on an input list of length n. Give a recursive definition of $T(n)$.

   Solution:

   $T(2) = c$

   $T(n) = nT(n − 1) + dn$

3. (3 points) What is the height of the recursion tree for $T(n)$?

   Solution: $n − 2$

4. (4 points) How many leaf nodes are there in the recursion tree for $T(n)$?

   Solution: $\dfrac{n!}{2}$

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(15 points) Check the (single) box that best characterizes each item.

$T(1) = d$
$T(n) = 2T(n/4) + c$

$\Theta(\log n)$ ☐ $\Theta(\sqrt{n})$ ☑ $\Theta(n)$ ☐ $\Theta(n \log n)$ ☐
$\Theta(n^2)$ ☐ $\Theta(n^3)$ ☐ $\Theta(2^n)$ ☐ $\Theta(3^n)$ ☐

Dividing a list in half

$\Theta(1)$ ☐ $\Theta(\log n)$ ☐ $\Theta(n)$ ☑ $\Theta(n \log n)$ ☐
$\Theta(n^2)$ ☐ $\Theta(n^3)$ ☐ $\Theta(2^n)$ ☐ $\Theta(3^n)$ ☐

$T(1) = d$
$T(n) = T(n/2) + d$

$\Theta(\log n)$ ☑ $\Theta(\sqrt{n})$ ☐ $\Theta(n)$ ☐ $\Theta(n \log n)$ ☐
$\Theta(n^2)$ ☐ $\Theta(n^3)$ ☐ $\Theta(2^n)$ ☐ $\Theta(3^n)$ ☐

Finding the chromatic number of a graph
with n nodes requires $\Theta(2^n)$ time.

true ☐   false ☐   not known ☑

Problems in class P (as in P vs. NP) can
be solved in exponential time

true ☑   false ☐   not known ☐