

CSE680 Homework 3  
Due Friday, January 28 by class time

Write a recurrence relation describing the worst case running time of each of the following algorithms and determine the asymptotic complexity of the function defined by the recurrence relation. Simplify and express your answer as  $\Theta(n^k)$  or  $\Theta(n^k \log n)$  wherever possible.

1. **function** func1( $A, n$ )  
/\*  $A$  = array of  $n$  integers \*/  
  **if**  $n \leq 3$  **then return** ( $A[1]$ )  
  **else**  
    **for**  $i \leftarrow 1$  **to**  $\lfloor n/3 \rfloor$  **do**  
       $A[i] \leftarrow A[n - i + 1]$ ;;  
       $A[2i] \leftarrow A[i] + A[i + 1]$ ;;  
       $x \leftarrow x + \text{func1}(A, \lfloor n/3 \rfloor)$ ;  
    **return** ( $x$ );
2. **function** func2( $A, n$ )  
/\*  $A$  = array of  $n$  integers \*/  
  **if**  $n \leq 6$  **then return** ( $A[1]$ )  
  **else**  
    **for**  $i \leftarrow 1$  **to**  $n - 7$  **do**  
      **for**  $j \leftarrow i$  **to**  $n$  **do**  
         $A[i] \leftarrow A[j] + A[i + 3]$ ;  
       $y \leftarrow \text{func2}(A, n - 5)$ ;  
    **return** ( $y$ );
3. **function** func3( $A, n$ )  
/\*  $A$  = array of  $n$  integers \*/  
  **if**  $n \leq 9$  **then return** ( $A[1]$ )  
  **else**  
     $x \leftarrow 0$ ;  
    **for**  $i \leftarrow 1$  **to** 9 **do**  
      **for**  $j \leftarrow 1$  **to**  $\lfloor n/3 \rfloor$  **do**  
         $B[j] \leftarrow A[j] + i * A[2j] + i^2 * A[3j]$ ;  
       $x \leftarrow x + \text{func3}(B, \lfloor n/3 \rfloor)$ ;  
    **return** ( $x$ );
4. **function** func4( $A, n$ )  
/\*  $A$  = array of  $n$  integers \*/  
  **if**  $n \leq 3$  **then return** ( $A[1]$ )  
  **else**  
    **for**  $j \leftarrow 1$  **to**  $\lfloor n/3 \rfloor$  **do**  
       $B[j] \leftarrow A[j] + A[j + i]$ ;  
       $C[j] \leftarrow A[2j] + A[2j + 1]$ ;  
     $x \leftarrow \text{func4}(A, \lfloor n/3 \rfloor)$ ;  
     $y \leftarrow \text{func4}(B, \lfloor n/3 \rfloor)$ ;  
     $z \leftarrow \text{func4}(C, \lfloor n/3 \rfloor)$ ;  
    **return** ( $x + y + z$ );
5. Solve the following recurrences (using any method).
  - (a)  $T(n) = 2T(n/2) + \sqrt{n}$ .
  - (b)  $T(n) = 4T(n/2) + n^2$ .