

## COMP 6651: Quiz 1

16 Minutes

Each question is worth 25 points. The questions may be single-choice or multiple-choice questions.

- 1 There are two algorithms A and B solving the same problem. For inputs of size  $n$ , algorithm A runs in  $1000n^2$  steps, algorithm B runs in  $2^n$  steps. Which algorithm runs faster on a given instance of input size  $n = 20$ ?
- (A) algorithm A (B) algorithm B  
(C) A and B are of the same speed (D) can not be determined.

Solution. A

- 2 Rank the following functions by order of growth:  $n^2, \log n^2, 2^n, n^{\log n}, n^n, n!$ .
- (A)  $n^2 = O(\log n^2) = O(2^n) = O(n^{\log n}) = O(n^n) = O(n!)$ .  
(B)  $\log n^2 = O(n^2) = O(2^n) = O(n^{\log n}) = O(n!) = O(n^n)$ .  
(C)  $n^2 = O(\log n^2) = O(n^{\log n}) = O(2^n) = O(n^n) = O(n!)$ .  
(D)  $\log n^2 = O(n^2) = O(n^{\log n}) = O(2^n) = O(n!) = O(n^n)$ .

Solution. D

- 3 Suppose  $T(n) = 4T(n/3) + n \log n$ . Select the correct order for  $T(n)$ .
- (A)  $\Theta(n)$  (B)  $\Theta(n \log n)$   
(C)  $\Theta(n^{\log_3 4})$  (D)  $\Theta(n^{\log_3 4} \log n)$

Solution. C

- 4 Recall the max subarray divide-and-conquer algorithm as follows, there are the left, right, and cross values computed in the algorithm.

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**procedure** *MaxSubarray*( $A, low, high$ )

**if**  $high = low + 1$  **then**

**return**  $A[low] + A[high]$

**if**  $high \leq low$  **then**

**return**  $-\infty$

$mid \leftarrow \lfloor \frac{low+high}{2} \rfloor$

$left \leftarrow \text{MaxSubarray}(A, low, mid)$

$right \leftarrow \text{MaxSubarray}(A, mid + 1, high)$

$cross \leftarrow \text{MaxCrossingSubarray}(A, low, mid, high)$

**return**  $\max(left, cross, right)$

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Given the following array 3, -1, 2, -4, -1, 7, -5, 6, what are the respective values for left, right, and cross that are computed in the call *MaxSubarray*( $A, 1, 8$ )?

- (A)  $(left, right, cross) = (4, 8, 7)$  (B)  $(left, right, cross) = (3, 7, -5)$   
(C)  $(left, right, cross) = (5, 13, -4)$  (D)  $(left, right, cross) = (3, 7, -1)$

Solution. A