Lecture Section: **Monday, Sep 15, 2025**

Student Name: **PSU Email ID:**

1. (2 pts.)   We can apply the Master Theorem to recurrences of the form $T(n) = a \cdot T(\frac{n}{b}) + O(2^{n \cdot d})$ (where $a > 0$, $b > 1$ and $d \geq 0$) and conclude that:

$$T(n) = \begin{cases} \Theta(n^d) & \text{if } d > \log_b a \\ \Theta(n^d \log n) & \text{if } d = \log_b a \\ \Theta(n^{\log_b a}) & \text{if } d < \log_b a \end{cases}$$

   (a) True

   (b) False

   Answer

2. (2 pts.)   The recurrence relation for the median-of-medians algorithm can be approximated as $T(n) = T\left(\frac{n}{5}\right) + T\left(\frac{7n}{10}\right) + O(n)$. What is the overall time complexity derived from this recurrence?

   (a) $O(n^2)$

   (b) $O(n \log n)$

   (c) $O(n)$

   (d) $O(\log n)$

   Answer

3. (2 pts.)   Given two arrays of numbers $x = [2, 4, 12]$ and $y = [3, 4, 5]$. What would be the result of $Merge(x, y)$ in the merge-sort algorithm?

   (a) $[2, 3, 4, 5, 4, 12]$

   (b) $[2, 5, 4, 4, 3, 12]$

   (c) $[3, 4, 4, 2, 5, 12]$

   (d) $[2, 3, 4, 4, 5, 12]$

   Answer

4. (2 pts.)   What is the role of the pivot in the QuickSort algorithm?

   (a) To sort the entire array in one step.

   (b) To partition the array into two subarrays for recursive sorting.

   (c) To compute the median of the array elements.

   (d) To merge two sorted subarrays.

   Answer

5. (2 pts.)   What is the time complexity of the standard divide-and-conquer algorithm for matrix multiplication?

   (a) $O(n^4)$

   (b) $O(n^3)$

   (c) $O(n^2)$

   (d) $O(n \log \log n)$

   Answer