

# College of Computing and Information Technology



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**Course:** Computing Algorithms (CS312)  
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## Sheet 6

1. Write a recursive function (divide and conquer) that evaluates  $x^n$  using the formula ( $x^n = x^{n/2} * x^{n/2}$ ). Write the recurrence that describes the cost of your algorithm and evaluate its time complexity.
2. Given a list of  $n$  elements, write an algorithm, using divide and conquer, to get the minimum and maximum elements in the list. What is the complexity of your algorithm?
3. Given 2  $n$ -digit numbers, use divide and conquer to multiply the two numbers, given that you can only multiply digits, not whole numbers.
4. Explain Strassen's algorithm for matrix multiplication, and state its complexity. Compare Strassen's method to the brute-force matrix multiplication in terms of the number of additions and subtractions.
5. Apply Strassen's algorithms to compute:

$$\begin{bmatrix} 1 & 0 & 2 & 1 \\ 4 & 1 & 1 & 0 \\ 0 & 1 & 3 & 0 \\ 5 & 0 & 2 & 1 \end{bmatrix} * \begin{bmatrix} 0 & 1 & 0 & 1 \\ 2 & 1 & 0 & 4 \\ 2 & 0 & 1 & 1 \\ 1 & 3 & 5 & 0 \end{bmatrix}$$

6. The closest pair problem is a problem of computational geometry: given  $n$  points in 2D space, find a pair of points with the smallest distance between them. A naive algorithm requires  $O(n^2)$ . Use divide and conquer to obtain better time complexity. |What is the complexity of your algorithm?