Georgia State University
CSC 4520/6520
Homework 1

Please submit your assignment by **11:59 pm on February 18, 2026**.

Problem 1. (20 points)
For each of the following pairs of functions, indicate whether the first function of each of the following pairs has a lower, same, or higher order of growth (to within a constant multiple) than the second function.

a. $n(n + 1)$ and $2000n^2$

b. $100n^2$ and $0.01n^3$

c. $\log_2 n$ and $\ln n$

d. $\log^2 n$ and $\log_2 n^2$

e. 2^{n-1} and 2^n

Problem 2. (20 points)
List the following functions according to their order of growth from the lowest to the highest:

$$(n-2)!, \quad 5\log(n+100)^{10}, \quad 2^{2n}, \quad 0.001n^4+3n^3+1, \quad \ln^2 n, \quad \sqrt[3]{n}, \quad 3^n$$

Problem 3. (30 points)
Consider the following recursive algorithm for computing the sum of the first n cubes:
$S(n) = 1^3 + 2^3 + \ldots + n^3$

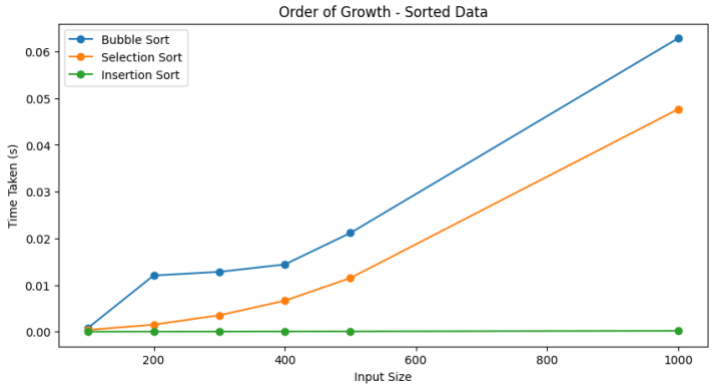
ALGORITHM S (n)
//Input: A positive integer n
//Output: The sum of the first n cubes
if n = 1 **return** 1
else return $S(n-1) + n * n * n$

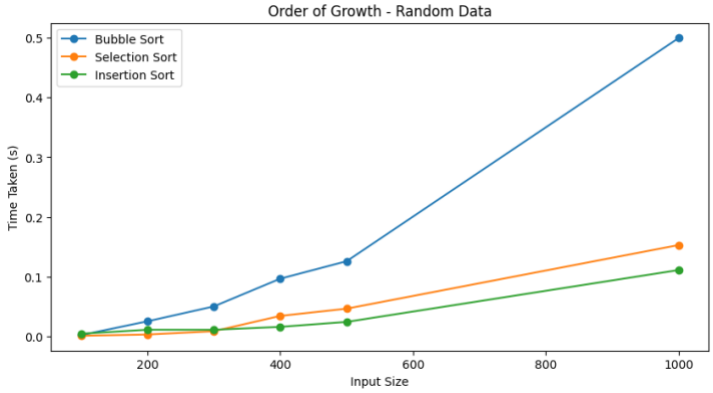
Set up and solve a recurrence relation for the number of times the algorithm's basic operation is executed.

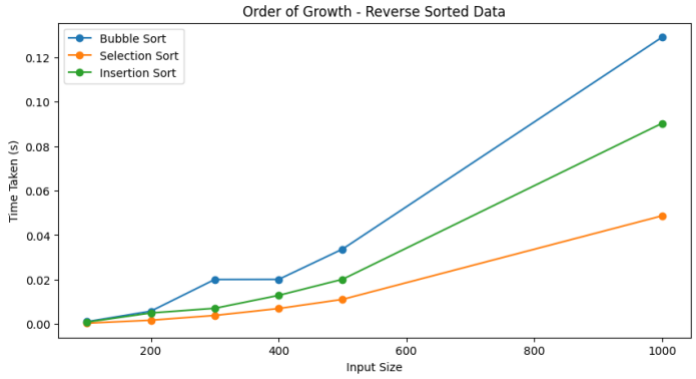
Problem 4. (30 points)

Develop a program in Python to implement Bubble Sort, Selection Sort, and Insertion Sort algorithms. Execute these algorithms on input arrays that are sorted, unsorted, and reverse sorted, with sizes of 50, 100, 200, 400, 500, and 1000 elements.

Additionally, generate plots visualizing the sorting performance results, similar to the reference figures shown below.







For submission, please provide:

1. A **PDF file** containing well-commented code and the figures.
2. A **Jupyter Notebook (.ipynb) file** with the implemented algorithms and results.