

CAP 6515 HOMEWORK ASSIGNMENT 1
DUE ON 09-27-2022 3PM

Note: Any solution to an algorithm design question should contain the following four sections:

- (1) **Problem statement.** A clear unambiguous statement of the problem to be solved, which includes the input, the output, and the object function with the constraints.
- (2) **Algorithm description.** A clear, unambiguous description of the algorithm.
- (3) **Correctness proof.** A convincing mathematical argument that the algorithm described solves the computational problem described.
- (4) **Time analysis.** A time analysis of the algorithm, up to order, in terms of all relevant parameters.

You may use any algorithms and data structures from class. **Please acknowledge all the supplementary texts and other resources that you have consulted, and anyone who helped with assignments, except the instructor.**

1. KMP (35%)

Please prove that the KMP algorithm has a linear time complexity for finding all occurrences of pattern P in a string S .

2. Z-VALUE (35%)

Please formalize the pseudocode with comments for linear-time Z-value computation with detailed comments. Please analyze the time complexity of your pseudocode.

Please list left, right, z-value, and which case for each position of the text $S = \text{"aabcaabxaaz"}$.

3. PERIODIC STRINGS (30%)

For each of the n prefixes of P , we want to know whether the prefix $P[1..i]$ is a periodic string. That is, for each i , we want to know the largest $k > 1$ (if there exist one) such that $P[1..i]$ can be written as α^k for some string α . Of course, we also want to know the period. Give an algorithm to determine this for all n prefixes in time linear in the length of P .