Theory Assignment 2.2

Due on 3/19/2025 (Wednesday)

Remember to include the following statement at the start of your answers with a signature by the side. "I have done this assignment completely on my own. I have not copied it, nor have I given my solution to anyone else. I understand that if I am involved in plagiarism or cheating I will have to sign an official form that I have cheated and that this form will be stored in my official university record. I also understand that I will receive a grade of 0 for the involved assignment for my first offense and that I will receive a grade of "F" for the course for any additional offense."

Please handwrite or type your answer to each question, scan or save your answers into a pdf file (with a vertical orientation so that we do not need to rotate your file to grade), and upload it to the homework submission site.

1.   (14 points) Use the radix sort algorithm to sort the following numbers. Treat every data as a 3-digit integer.
456, 329, 478, 59, 52, 447, 380, 126, 237, 599, 626, 255.

   a)   Draw a figure to show the actions step by step (see example figure in slide 50 or 51 of Ch6-sorting-heap-linear lecture notes) by treating each digit as a "digit". (5 points)

   b)   Explain why stable sorting at each step is important. You just need to state that correctness cannot be guaranteed (by giving an example) if you did not apply stable sorting at that step (5 points).

   c)   Describe what conditions should be met for radix sort to be O(n)? (4 points)

2.   (14 points) Suppose we want to apply Radix Sort to sort 100,000 4-letter words with each letter taken from the English alphabet (26 letters, all lower cases). Assuming that the running time for sorting n elements within range $1..k$ using Counting Sort is $2n+2k$, calculate the running time for each of the following strategies a), b) and c). Show the justification.
   a) treat letters at each of the four positions as a digit. (4 points)
   b) treat 2-letter subwords at positions 1-2 as a digit and 2-letter subwords at positions 3-4 as another digit. (4 points)
   c) treat all 4 letters as a digit. (4 points)
   d) which strategy is the best strategy to minimize the running time? (2 points)