

CS323 Assignment 1

1 Requirements

You are expected to complete all required homework exercises and encouraged to complete the optional ones (if there are). For submission, please put all your answers in a single PDF file and submit it via the assignment channel on BlackBoard. The name of the file should follow the format “**studentID_A#**” (e.g., 30003554_A1). **The submission deadline is 10:00 PM, September 29, 2024.** Late submissions are allowed within three days after the deadline (grace period). If you submit your assignment during the grace period, your score will be 80% of the score you could get if the submission was made in time. Assignments submitted after the grace period will not be graded.

2 Required Exercises (100 points)

Exercise 1: Given the following three strings: $S_1 = \text{“}abcde\text{”}$, $S_2 = \text{“}bc\text{”}$, $S_3 = \text{“}abcdabcde\text{”}$, please answer the questions below:

- Is S_2 a proper substring of S_1 ? [5 points]
- Is S_2 a subsequence of S_1 ? [5 points]
- How many proper substrings does S_1 have? [5 points]
- How many subsequences does S_1 have? [5 points]
- If we insert S_1 into a position in S_3 , we can get a new string S_4 . Can we find ways to generate an S_4 such that S_1 is not a proper substring of it (here, “it” refers to S_4)? Please justify your answer. [5 points]

Exercise 2: Given the regular expression $R = (abc|def)^*$, identify all substrings of the string “ $abcdefabcdef$ ” that match the language described by R . [10 points]

Exercise 3: Identify all suffixes of the string “ $abcde$ ” that belong to the language generated by the regular expression $R = (a|b|c|d|e)^*$. [10 points]

Exercise 4: Write a regular definition for a valid IPv4 address. [15 points]

Exercise 5: Given an alphabet $\Sigma = \{a, b, c\}$, are the following two regular languages equivalent? Besides saying yes or no, please also justify your answer. [20 points]

1. $L_1 = L((ab)^*ac)$

2. $L_2 = L(a(ba)^*c)$

Exercise 6: Consider the regular expression $ba^+|ab^*$. Please provide a state transition diagram that can recognize the strings in the corresponding regular language. Can the transition diagram recognize the string $baab$? If yes, please give the sequence of state transitions. Otherwise, please explain the reason. [20 points]