Assignment #3

Date Due: November 20, 2024

Total: 100 marks

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1. (10 marks each, 35 maximum) Describe in English, as simple as possible, the languages generated by the following regular expressions:

   (a) $bbb^*(a + a^* + a)^*bb^*b$

   (b) $(a^* + b)^*aa(a^*)^*a$

   (c) $(ab)^*ab(\varepsilon + a) + ba(ba)^*(b + \varepsilon)$

   (d) $b^*ab^*(b^*ab^*b^*b^*ab^*ab^*ab^*)^*$.

2. (10 marks each, 35 marks maximum) Prove that the following languages are regular languages:

   (a) $L = \{a^n b^m a^k \mid n \geq 3, m \geq 1, k \geq 2\}$

   (b) $L = \{a^n \mid n \neq 3, \text{ and } n \not\equiv 4(\mod 5)\}$

   (c) $L = \{a^n b \mid n \geq 2\} \cup \{ab^m \mid m \geq 5\}$

   (d) Assume L_1 is a regular language and define $L = \{wcv \in \{a, b, c\}^* \mid (|w|_a + 2|v|_b) \equiv 3 \mod 5,\ w, v \in L_1\}$,

3. (25 marks maximum) Are the following languages regular or not?

   (a) (10 marks)
   $$\{a^n b^l a^m \mid |n - m| \leq 2, l > 4\}.$$

   (b) (20 marks) What if $L_1 \subseteq \{a, b, c\}^*$ and
   $L = \{wcv \in \{a, b, c\}^* \mid (3|w|_a = |v|_b)\ w, v \in L_1 \cap \{a, b\}^*\}$. Discussion on L_1.

4. (10 marks each, 25 marks maximum) Prove that the following languages are not regular:

   (a) $\{c^m b^n a^n \mid n > 0, m \geq 0\}$

   (b) $\{cca^n b^{n+k+2} a^k \mid n > 0, n > k > 2\}$

   (c) $L = \{c^m a^n b^l \mid n \neq l, m > 1\}$