Assignment #3

Date Due: November 17, 2025

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) $bb^*b(a^2+a^*+a+\varepsilon)^*bbb^*b$
   (b) $aa(a^*+\varepsilon)^*a(a^*+b)^*$
   (c) $(ab)^*ab(\varepsilon+a)+ba(ba)^*b+ba(ba)^*\varepsilon$
   (d) $b^*ab^*(b^*ab^*b^*b^*ab^*ab^*ab^*ab^*)^*$.

2. (10 marks each, 35 marks maximum) Prove that the following languages are regular languages:
   (a) $L=\{a^nb^ma^{kn} \mid n\leq 2, m\geq 1, k\geq 2\}$
   (b) $L=\{a^n \mid n\neq 1, \text{ and } n\not\equiv 1(\mod 4)\}$
   (c) $L=\{a^nb \mid n\geq 4\}\cup\{ab^m \mid m\geq 2\}$
   (d) Assume $L_1\subseteq\{a,b\}^*$ is a regular language and define $L=\{wcv\in\{a,b,c\}^* \mid (|w|_a+3|v|_b)\equiv 4 \mod 5,\ w,v\in L_1\}$,

3. (25 marks maximum) Are the following languages regular or not?
   (a) (10 marks)
   $$\{a^nb^la^m \mid |n-m|\leq 1, l>3\}.$$
   (b) (20 marks) What if $L_1\subseteq\{a,b,c\}^*$ and
   $L=\{wcv\in\{a,b,c\}^* \mid (2|w|_a=|v|_b)\ w,v\in L_1\cap\{a,b\}^*\}$. Discussion on L_1.

4. (10 marks each, 25 marks maximum) Prove that the following languages are not regular:
   (a) $\{c^mb^{2n}a^n \mid n>0, m\geq 0\}$
   (b) $\{cca^nb^{n-k+2}a^k \mid n>0, n>k>2\}$
   (c) $L=\{c^ma^nb^l \mid n\neq l+1, m>2\}$