1. Use the pumping lemma to show the following languages are not regular.
   a. \( L = \{ w \in \{a, b\}^* \mid \text{no prefix of } w \text{ has more } b\text{'s than } a\text{'s.}\} \)
   b. \( L = \{ a^n b^m c^n m \mid n \geq 0, m \geq 0 \} \)

2. Show that the following languages are not regular. You may should consider the reverse of \( L \) in your proof:
   a. \( L = \{ a^{100+n} b^m a^m \mid n \geq 0, m \geq 0 \} \)

3. Indicate whether each of the following languages is regular or not, and prove your answer. You can use the pumping lemma or closure properties to prove a language is non-regular. To prove a language is regular, you can use closure properties, give a regular expression for the language, or construct a DFA that accepts it.
   a. \( L = \{ a^i b^j a^k \mid i + j + k > 5 \} \)
   b. \( L = \{ u w w^R v \mid u, v, w \in \{a, b\}^+ \} \)
   c. \( L = \{ a^n \mid n \text{ is even} \} \)

4. Indicate whether each statement below is true or false and justify your answer.
   a. If \( L_1 \) & \( L_2 \) are not regular, then \( L_1 \cup L_2 \) is not regular.
   b. If \( L_1 \) is regular and \( L_2 \) is not regular, then \( L_1 \cup L_2 \) is not regular.