1. (25 points) Prove that the following languages are not regular.
   (a) \( \{0^n1^m0^n+m|m, n \geq 0\} \).
   (b) \( \{w|w \in \{0, 1\}^* \text{ is not a palindrome}\} \). Here a palindrome is a string that reads the same forward and backward.

2. (25 points)
   (a) Let \( B = \{1^ky|y \in \{0, 1\}^* \text{ and } y \text{ contains at least } k \text{ 1s, for any } k \geq 1\} \). Is \( B \) a regular language? Prove your answer.
   (b) Let \( C = \{1^ky|y \in \{0, 1\}^* \text{ and } y \text{ contains at most } k \text{ 1s, for any } k \geq 1\} \). Is \( C \) a regular language? Prove your answer.

3. (25 points) Consider the language \( F = \{a^ib^jc^k|i, j, k \geq 0 \text{ and if } i = 1 \text{ then } j = k\} \), where \( \Sigma = \{a, b, c\} \).
   (a) Show that \( F \) is not regular. **Hint:** Assume \( F \) is regular, use the closure properties of regular languages to convert \( F \) into another language, and show that language is not regular.
   (b) Show that \( F \) acts like a regular language in the pumping lemma. In other words, give a pumping length \( p \) and demonstrate that \( F \) satisfies the three conditions of the pumping lemma for this value of \( p \).
   (c) Explain why parts (a) and (b) do not contradict the pumping lemma.

4. (25 points) Give a context-free grammar that generates the following language, where the alphabet \( \Sigma \) is \{0, 1\}: \( \{w|w \text{ is not empty and starts and ends with the same symbol}\} \).