Prove that each of the following languages is \textit{not} regular.

1. \( \{0^{2n} \mid n \geq 0\} \).

2. \( \{0^{2n}1^n \mid n \geq 0\} \).

3. \( \{0^n1^n \mid m \neq 2n\} \).

4. Strings over \( \{0, 1\} \) where the number of 0s is exactly twice the number of 1s.

5. Strings of properly nested parentheses (), brackets [], and braces {}. For example, the string ([]){} is in this language, but the string ([]) is not, because the left and right delimiters don’t match.

6. Strings of the form \( w_1\#w_2\#\cdots\#w_n \) for some \( n \geq 2 \), where each substring \( w_i \) is a string in \( \{0, 1\}^* \), and some pair of substrings \( w_i \) and \( w_j \) are equal.

\underline{Extra problems}

7. \( \{0^n \mid n \geq 0\} \).

8. \( \{w \in (0 + 1)^* \mid w \text{ is the binary representation of a perfect square}\} \)