Prove that each of the following languages is not regular.

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

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

3. \( \{0^m1^n \mid m \neq 2n\} \)

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

5. Strings of properly nested parentheses \( (, [\), 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.

Work on these later:

7. \( \{0^{n^2} \mid n \geq 0\} \)

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