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. \(\{0^m1^n \mid m \neq 2n\}\)
4. Strings over \(\{0, 1\}\) where the number of 0s is exactly twice the number of 1s.
5. Strings of properly nested parentheses \(()\), 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.

Extra problems

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