Prove that each of the following languages is not regular.

1. Binary palindromes: Strings over \{0, 1\} that are equal to their reversals. For example: 00111000 and 01000100, but not 01100. \[Hint: \text{We did this in class.}\]

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. \(\{0^{2^n} \mid n \geq 0\}\) — Strings of 0s whose length is a power of 2.

7. 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.