Response by: **TODO: replace this with your name (and computing id)**

Week 6: Automata Tune — Writeup Problem

Collaboration: You should work on this problem yourself. **You may not collaborate on the assigned writeup with your cohort-mates or anyone else, but you may use notes taken before or during your assessed cohort meeting.** You may also use other published resources you find, but if you use any materials that were not provided by the course, you should cite them in your solution.

Finite State Automata and Regular Expressions

For each of the languages described below, either (1) explain why it cannot be computed using any finite state automaton, or (2) give both a finite state automaton *and* a regular expression that describes the language. You may use either a drawing or a description to describe your finite state automaton.

1. $\texttt{XOR} : \{0,1\}^* \to \{0,1\}$ (the language $\{x \in \{0,1\}^* \mid \texttt{XOR}(x) = 1\}$). Recall that infinite XOR is defined as outputting 1 when the input contains an odd number of 1's, so $\texttt{XOR}(\varepsilon) = 0$.
2. $\{\}$ (the empty language)
3. $0^n 1^n$ for any $n \in \mathbb{N}$ (the language of all strings where the string starts with any number of 0s, and is followed by the same number of 1s)
4. $\{0,1\}^*$ (the set of all finite binary strings)