1. What is a turing machine?
   \[ M = (Q, \Sigma, \Gamma, \delta, q_0, F) \]
   - \( Q \) is the set of internal states
   - \( \Sigma \) is the input alphabet
   - \( \Gamma \) is the stack alphabet
   - \( \delta \) is the transition function
   - \( \epsilon \in \Gamma \) is a blank
   - \( q_0 \in Q \) is the initial state
   - \( F \subseteq Q \) is the set of final states
   where \( \delta : Q \times \Gamma \to Q \times \Gamma \times \{L, R\} \)
   - \( \delta(q, a) \) is undefined for all \( q \in F \)

2. Describe a TM that transforms an input string from \( \{0, 1 \}^* \) to a string where all \( a \)'s come before \( b \)'s. (strings are of finite length).

3. Describe a TM that computes the \( n^{th} \) Fibonacci number on \( \Sigma = \{1\} \).

4. Describe a TM that computes \( \text{double}(w) \) for \( w \in \{a, b\}^* \).

5. Review: Halting problem is undecidable.

6. Reductions:
   - (a) Multiplication \( \leq \) Addition
   - (b) Squaring \( \leq \) Multiplication
   - (c) Multiplication \( \leq \) Squaring
   - (d) GCD \( \leq \) factoring

7. Fill up the TA evaluations! :D