1. PDA: definition and few basic operations:
\[ M = (Q, \Sigma, T, \delta, q_0, z, F) \] be a non-deterministic PDA where 
\( T \) is the stack alphabet 
\( z \) is the initial stack symbol 
\( \delta : Q \times (\Sigma \cup \{\lambda\}) \times T \to 2^{Q \times T^*} \)

Replacing TOS with \( a \): \((p, u, v) \to (q, a)\)
Stack always starts with the symbol \( z \).

2. Construct PDAs for the following languages
   (a) \( L = \{w \text{ such that } w \in \{a,b\}^* \text{ and } n_a(w) = n_b(w)\} \)
   (b) \( L = \{w \text{ such that } n_a(w) + n_b(w) = n_c(w)\} \)

3. Pumping Lemma for CFL:
   (a) Adversary chooses \( m \). (\forall)
   (b) You choose a string \( w \in L \) such that \(|w| \geq m\). (\exists)
   (c) Adversary provides an arbitrary decomposition \((uvxyz)\) such that 
   \(|vxy| \leq m\) and \(|vy| \geq 1\). (\forall)
   (d) Find \( i \) such that \( uv^i xy^i z \notin L \). (\exists)

4. Prove that \( L = \{ww \text{ such that } w \in 0^*, 1^*\} \) is not context free.

5. Is PDA with a queue strictly stronger than PDA with a stack?
   (a) Does there exist a language that can be accepted by a PDA with a queue but not by PDAs with a stack?
   (b) What about \( L = \{ww \text{ such that } w \in \{a,b\}^*\} \)?
   (c) Is the converse true?

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

7. Turing Machine for the following language for \( L = \{a^n b^n c^n \text{ such that } n \geq 0\} \)