CS 205, Formal Languages, Automata Theory and Computation
Quiz 5 Solutions, Winter 2020-21
Department of CSE, IIT Guwahati

1. Is the following grammar ambiguous?

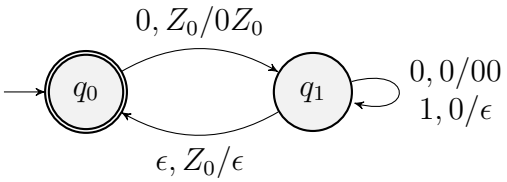
$$S \to \epsilon \mid 0S \mid 0S1S$$

Justify your answer by either giving a string and showing it has two leftmost derivations or proving that the grammar is unambiguous.

Solution: The grammar is ambiguous as 001 has two leftmost derivations:

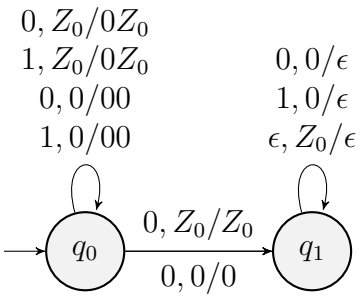
$$S \Rightarrow 0S \Rightarrow 00S1S \Rightarrow 001S \Rightarrow 001$$
$$S \Rightarrow 0S1S \Rightarrow 00S1S \Rightarrow 001S \Rightarrow 001$$

2. Describe in English the language accepted by the PDA in the figure below. The PDA accepts by final state.



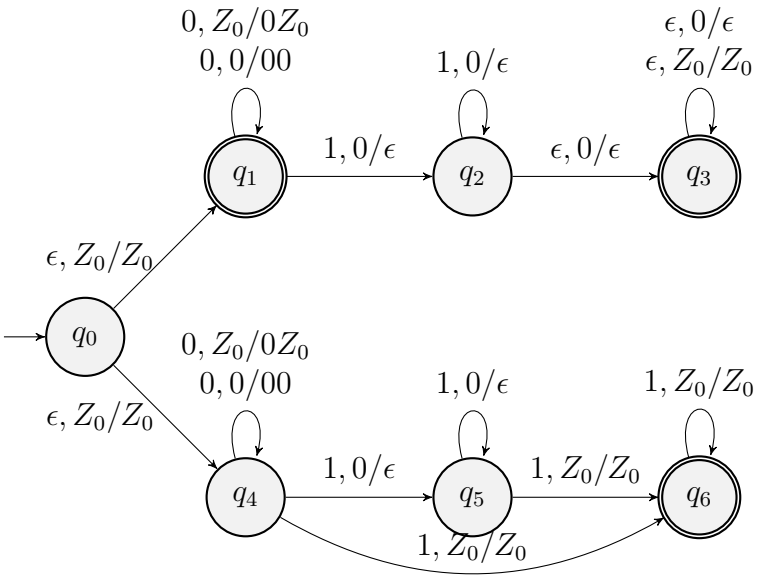
Solution: The set of all strings over $\{0, 1\}$ with an equal number of 0s and 1s and such that any proper prefix of the string has more 0s than 1s.

3. Describe in English the language accepted by the PDA in the figure below. The PDA accepts by empty stack.



Solution: The set of all odd-length strings where the middle symbol is 0.

4. Describe in English the language accepted by the PDA in the figure below. The PDA accepts by final state.



Solution: The set of all strings of the form 0^i1^j where $i \neq j$ along with ϵ.