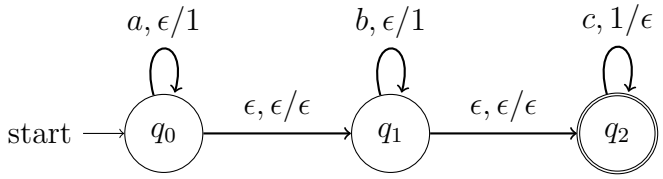
Homework 7 - Computer Science 461 **Name:** _____

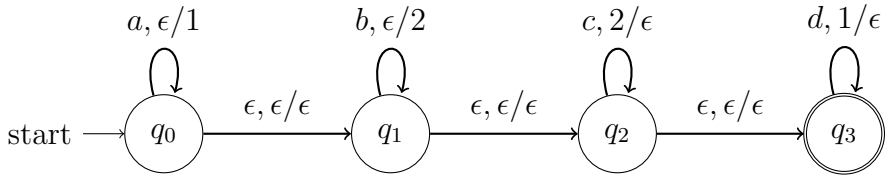
Due Monday, March 17.

1. Identify the context-free language that is accepted by each of the following pushdown automata (PDA). Explain (briefly) you answer for each.

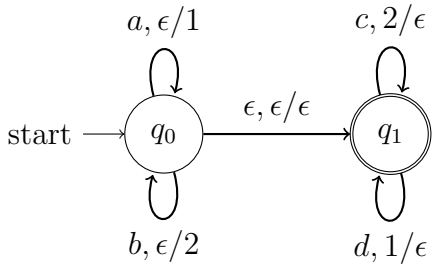
(a)



(b)



(c)



2. Let $\Sigma = \{\texttt{(},\texttt{)},\texttt{[},\texttt{]}\}$. That is, Σ is the alphabet consisting of the four symbols `(`, `)`, `[`, and `]`. Let L be the language over Σ consisting of strings in which both parentheses and brackets are balanced. For example, the string `([][()()])([])` is in L but `[(])` is not. Find a PDA that accepts this language. Hint: *you should only need one state!*

3. Use the pumping lemma to prove that the language $\{a^n b^n a^n b^n : n \in \mathbb{N}\}$ is not context-free.

4. Is the language $\{a^m + a^n = a^{m+n} : m, n \in \mathbb{N}\}$ over the alphabet $\Sigma = \{a, +, =\}$ context-free? Explain why or why not.

5. For any languages A and B, let $A \diamond B = \{xy : x \in A, y \in B, \text{ and } |x| = |y|\}$. If A and B are regular languages, prove that $A \diamond B$ is a context-free language by describing how you could use NFAs for A and B to construct a PDA for $A \diamond B$.