1. [**0.5 point**] If $\Sigma = \{a, b, c\}$ and $L - \Sigma^* = \emptyset$, which of the following languages can be L?
   (a) $\emptyset$
   (b) $\{\Lambda, b^{100}\}$
   (c) Σ^*
   (d) $\{a^n b^n c^n \mid n > 0\}$

2. [**1 point**] Give a *regular expression* for each of the following languages:
   (a) $L = \{a^m b^n \mid n + m \text{ is even}\}$
   (b) $L = \{w \in \{0,1\}^* \mid w \text{ contains } \textit{exactly} \text{ one pair of consecutive 0's}\}$

3. [**1 point**] Suppose language L represented by the *regular expression* $(00)^*01$. Give a maximal set S of pairwise L-distinguishable strings. From the set S, what can we say about the number of states of a DFA M that accepts L?

4. [**1 point**] Languages L_1 and L_2 are represented by a^*baa^* and ab^*, respectively. Construct a DFA that accepts $L_1 - L_2$.

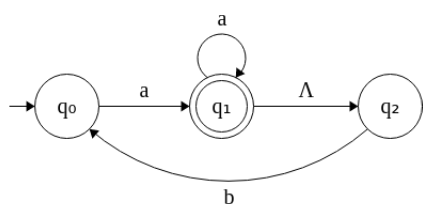
5. [**1 points**] Give a context-free grammar G generating the following language L:
$$L = \{a^n b^m c^k \mid k = |n - m|\}$$

6. [**1 point**] Prove the following grammars are ambigious:
   (a)
$$S \to T \mid Sa \mid a$$
$$T \to ab \mid \lambda$$
   (b)
$$S \to bSc \mid bbSc \mid a$$

7. [**2 points**] Suppose the following context-free grammar G:
$$S \to aSU \mid X$$
$$X \to bXU \mid \Lambda$$
$$U \to aY$$
$$Y \to aY \mid \Lambda$$
   (a) Give $L(G)$.

(b) Give a grammar in *Chomsky Normal Form* that generates $L(G) - \{\Lambda\}$.

8. **[1 point]** Construct a DFA that accepts the same language as the following NFA. Explain the steps.
Note: eliminate the Λ-transition and the resulting non-determinisim.



9. **[1.5 points]** Suppose the following PDA M, where q_0 is the initial state and q_2 is the accepting state:

$$\sigma(q_0, a, Z_0) = \{(q_1, AZ_0), (q_2, Z_0)\}$$
$$\sigma(q_1, b, A) = \{(q_1, B)\}$$
$$\sigma(q_1, b, B) = \{(q_1, B)\}$$
$$\sigma(q_1, a, B) = \{(q_2, \Lambda)\}$$

(a) give L(M).

(b) is M deterministic or not? Why?