CS350 – Lab 8
Due Date: April 4

Purpose: Since regular languages appear everywhere in computer science it is worth spending some time examining the properties and limits of these languages. The purpose of this lab is for you to prove some properties of regular languages and also prove that some languages are not regular.

Knowledge: This lab will help you become familiar with the following content knowledge:

- How to use prove closure properties of regular languages.
- How to use the pumping lemma to show that a language is not regular.

Task: Follow the steps in this lab carefully to complete the assignments.

Assignment 1:
Using the closure properties that we proved in class, show that regular languages are closed under the symmetric difference operator $\ominus$. The symmetric difference of languages L_1 and L_2 is defined as

$$L_1 \ominus L_2 = \{x \mid x \in L_1 \text{ or } x \in L_2 \text{ but } x \text{ is not in both } L_1 \text{ and } L_2\}$$

Criteria for Success: You have a clear proof on why the symmetric difference of two regular languages is also regular.

Assignment 2:
Using the closure properties that we proved in class, show that if L is a regular language then so is

$$L_1 = \{uv \mid u \in L \text{ and } |v| = 2\}$$

Criteria for Success: You have a clear proof on why L_1 is also regular.

Assignment 3:
Use the pumping lemma to show each of the following languages is not regular.

1. $L = \{a^n b^m \mid n \geq m\}$
2. $L = \{ww \mid w \in \{a, b\}^*\}$
3. $L = \{a^n \mid n = k^3 \text{ for some } k \geq 0\}$

Criteria for Success: You have a full pumping lemma proof for each language.

Assignment 4:
For each of the languages, either prove that it is regular (using the techniques we already know) or using the pumping lemma to show it is not regular.

1. $L = \{a^n b^m \mid n \leq m \leq 2n\}$
2. $L = \{a^n b^m \mid n \geq 100, m \leq 100\}$

Criteria for Success: You have a proof for each language.

Written answers may be submitted in Canvas or on paper for grading.