CP-414 Winter 2025, Assignment 2
Due: Monday, February 24

1. Give regular expressions generating the following languages over the alphabet **Σ = {0,1}**:

a) L1 = the set of all strings that start with **1** or have odd length
b) L2 = the set of all strings that start with **0** and have even length
c) L3 = the set of all strings that end with **1** and have even length
d) L1 ∩ L2
e) L2 ⋃ L3
f) L2 ∩ L3
g) The set of all strings such that every occurrence of **1** is followed by at least two **0**s, e.g., **0001000100, 100, 0, 00000000010000000100100** are in this language, but **1011, 1, 101** are not.
h) The set of all strings that does not contain pattern **0110**.
i) The set of all strings except **100** and **01**.

2. Use the procedure described in Lemma 1.60 to convert the following NFAs to regular expressions:

(a) start state q_1, accepting state q_2

	0	1	ε
-> q_1	{ q_2}	{ q_1, q_2}	Ø
* q_2	{q_1}	Ø	Ø

(b) start state q_1, accepting state q_2

	0	1	ε
-> q_1	Ø	Ø	{q_3}
* q_2	{q_2, q_3}	{q_3}	Ø
q_3	{q_3}	{q_2}	{q_3}

Show your work (including GNFA and intermediate results after each state removal).

3. Convert the following regular expressions to NFAs using procedure given in Theorem 1.54. In all parts **Σ = {0,1}.**

a) **1(110)* ⋃ 010**
b) **110^+ ⋃ $(010)^*$**
c) **(1⋃0*)0*1^+**

4 (a). Consider language **L = {10^n10^n | n >0}** over alphabet **Σ={0,1}**. Using Pumping Lemma prove that this language is not regular.

(b) Using result of **(a)** prove that language **B = {ww | w from Σ^*}** is not regular. DO NOT USE PUMPING LEMMA! Use **closure** properties of regular languages instead.

5. Variation of Problem 1.53

Let **Σ={0,1,2,3,…,9,-,=}** and

SUB = {x-y=z | x,y,z are unsigned integers, and z is the difference of x and y}.

For example, string "**99-21=78**" is in **SUB**, while string "**99-21=77**" is not in **SUB**.

Prove that **SUB** is not a regular language.

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