**ECE374 Assignment 3**

Due 02/13/2023

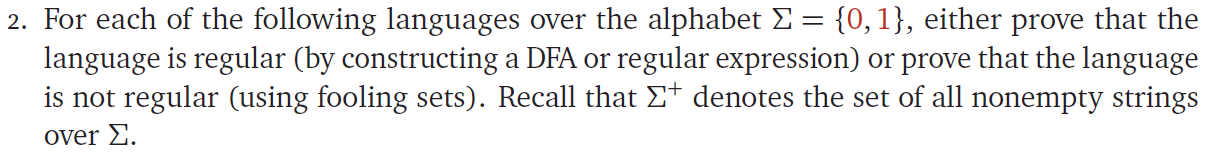
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**Problem 2**

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(a) 

Solution:

Let F be the language that .

Let *x* and *y* be arbitrary different strings in F.

Then we have and for some non-negative integers .

Let

Then we have and because .

Thus, F is a fooling set of .

Therefore, as F has infinite length, is not regular.

(b) 

Solution:

Let F be the language that .

Let *a* and *b* be arbitrary strings in F.

Then we have and , for some non-negative integers .

Let .

Then we have and because .

Thus, F is a fooling set of .

Therefore, as F has infinite length, is not regular.

(c) 

Solution:

The language is regular.

Consider the language , which is the set of all strings not in the form , where .

Assume there exists a string with , we could represent it in the form that where and are both single symbols ().

Thus, , and

(i) There are no consecutive **00**s or **11**s in .

If there are occurrences of **00**s or **11**s, we could treat them as forms of and the rest symbols to be in the prefix *x* or suffix *z* of , which would make . Thus, there should be no occurrences of consecutive **00**s or **11**s in .

(ii) Without consecutive **00**s or **11**s in , we could deduce that *y* must be composed of alternating single **0**s or **1**s. As , *y* must start with **0101**s or **1010**s. We could always treat or to be the repeating part and the rest symbols to be in the prefix *x* or suffix *z* of , which doesn’t fit the definition of and the assumption that .

Thus, we couldn’t have such strings in the language .

Therefore, we could prove that doesn’t contain strings with length greater than or equal to 6.

As the number strings composed of {0,1} with length less than 6 is finite, we could determine that has a finite size and is thus regular (given that every finite language is regular).

As and inversely , and also that regular languages are closed under complement, we could prove that is also regular.

(d) 

Solution:

Let F be the language that .

Let *a* and *b* be arbitrary strings in F.

Then we have and for some non-negative integers .

Let .

Then we have and because .

Thus, F is a fooling set of .

Therefore, as F has infinite length, is not regular.