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Homework 01
CS 4110
Due September 7, 2016

Consider the language S *, where S = {aa aba baa},

P01.a (3 points) is "baaabaaa" in the language? Why?
yes
because **baa aba aa** are in the language. Concatenating these together we get **baa aba aa** which equals **baaabaaa**

P01.b (3 points) is "baaaaababaaaa" in the language? Why?
yes
because separated out **baa aa aba baa aa** are in the language

P01.c (3 points) is "abaabaabaaaa" in the language? Why?
no
because **aba aba aba aa** are in the language but **a** is not, or
because **aba aba aba** are in the language but **aaa** is not.
There is no way to make this string of letters.

P01.d (3 points) is "baaaaaaaabbabaaaaa" in the language? Why?
no
baa aa aa aa are in the language but there is no way to make the next part, **bbabaaaaa**, using this language, cannot make **bb** using this language

P01.e (3 points) Can any word in this language have a substring of "bb" or an odd total number of a's? why?
no you cannot make **bb** because there are no substrings that end in **b** and there are only single **b**s in these substrings
no you cannot have an odd total number of **a**s because all substrings have an even number of **a**s

P02. Recursive Definition (8 points)

On page 13 in the Textbook, a language called **PALINDROME** is defined over the alphabet Σ = {a, b}:

PALINDROME = { Λ , and all strings x such that reverse(x) = x }

When asked to give a recursive definition for the language **PALINDROME** over the alphabet Σ ={a, b} , a student wrote:

Rule 1: **a** and **b** are in PALINDROME

Rule 2: If x is in **PALINDROME**, then so are **axa** and **bxb**

Unfortunately, all the words in the language defined above have an odd length and so it is not all of PALINDROME.

Fix this problem (4 points) and explain why (4 points).

There are 2 ways to fix this.

First: Rule 1 should also denote **Λ** as being in the alphabet Σ

Rule 1: **a**, **b**, **and Λ** are in PALINDROME

If you start with a null string, rule 2 can make even PALINDROMES

Second: Rule 2 should read "all strings **x** in **PALINDROME** must equal the reverse of itself aka **x** = reverse(**x**)"

this will take care of all even and odd cases.

P03. Regular Expression (7 points)

Construct a regular expression for all words in which **a** appears tripled, if at all. This means that every clump of **a**'s contains 3 or 6 or 9 or 12… a's. For example, b, bb, bbb, baaa, aaabbaaa, aaaaaaaaa, are all in this language.

$(a^3)^*$ - can contain any number of 3 groupings of **a**, including no clumps

$(b^* (a^3)^*)$ - can contain any number of **b**s before the **a** clumps, including none

$(b^* (a^3)^*)^*$ - can be repeated any number of times, or no times