



Gradiane Online Accelerated Learning

Zayd

- [Home Page](#)
- [Assignments Due](#)
- [Progress Report](#)
- [Handouts](#)
- [Tutorials](#)
- [Homeworks](#)
- [Lab Projects](#)
- [Log Out](#)

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Based on Section 4.2 of HMU.

Help

1. The operation $DM(L)$ is defined as follows:

1. Throw away every even-length string from L .
2. For each odd-length string, remove the middle character.

For example, if $L = \{001, 1100, 10101\}$, then $DM(L) = \{01, 1001\}$. That is, even-length string 1100 is deleted, the middle character of 001 is removed to make 01, and the middle character of 10101 is removed to make 1001.

It turns out that if L is a regular language, $DM(L)$ may or may not be regular. For each of the following languages L , determine what $DM(L)$ is, and tell whether or not it is regular.

- L_1 : the language of regular expression $(01)^*0$.
- L_2 : the language of regular expression $(0+1)^*1(0+1)^*$.
- L_3 : the language of regular expression $(101)^*$.
- L_4 : the language of regular expression 00^*11^* .

Now, identify the true statement below.

- a) $DM(L_3)$ is not regular; it consists of all strings of the form $(101)^n11(101)^n$.
- b) $DM(L_2)$ is not regular; it consists of all strings of the form $(0+1)^n00(0+1)^n$.
- c) $DM(L_4)$ is regular; it is the language of regular expression 0^*1^* .
- d) $DM(L_2)$ is regular; it is the language of regular expression $(0+1)^*$.

Answer submitted: **d)**

Your answer is incorrect.

This regular expression's language includes odd-length strings, while $DM(L)$ can only have even-length strings, regardless of what L is. You need to interpret each of the four regular expressions, using the definitions from Section 3.1.2 (p. 87). The pumping lemma for regular languages in Section 4.1 (p. 128) may be useful in

showing certain languages not to be regular.

2. The language of regular expression $(0+10)^*$ is the set of all strings of 0's and 1's such that every 1 is immediately followed by a 0. Describe the complement of this language (with respect to the alphabet $\{0,1\}$) and identify in the list below the regular expression whose language is the complement of $L((0+10)^*)$.
- $(0+10)^*11(0+10)^*$
 - $(0+1)^*1(\epsilon+1(0+1)^*)$
 - $(0+10)^*1(\epsilon+11(0+1)^*)$
 - $(0+1)^*(11+1+\epsilon)^*$

Answer submitted: **b)**

You have answered the question correctly.

3. h is a homomorphism from the alphabet $\{a,b,c\}$ to $\{0,1\}$. If $h(a) = 01$, $h(b) = 0$, and $h(c) = 10$, which of the following strings is in $h^{-1}(010010)$?
- $cbcb$
 - $bcab$
 - $cbbc$
 - $bach$

Answer submitted: **b)**

You have answered the question correctly.

4. Let h be the homomorphism defined by $h(a) = 01$, $h(b) = 10$, $h(c) = 0$, and $h(d) = 1$. If we take any string w in $(0+1)^*$, $h^{-1}(w)$ contains some number of strings, $N(w)$. For example, $h^{-1}(1100) = \{ddcc, dbcc\}$, i.e., $N(1100) = 2$. We can calculate the number of strings in $h^{-1}(w)$ by a recursion on the length of w . For example, if $w = 00x$ for some string x , then $N(w) = N(0x)$, since the first 0 in w can only be produced from c , not from a .

Complete the reasoning necessary to compute $N(w)$ for any string w in $(0+1)^*$. Then, choose the correct value of $N(01100110)$.

- 34
- 128
- 16
- 8

Answer submitted: **c)**

You have answered the question correctly.

5. The homomorphism h is defined by $h(a) = 01$ and $h(b) = 10$. What is $h(abbb)$?
- 011010

01101010

- b) 01010101
- c) abbb
- d) 01101010

Answer submitted: **d)**

You have answered the question correctly.

6. If h is the homomorphism defined by $h(a) = 0$ and $h(b) = \varepsilon$, which of the following strings is in $h^{-1}(000)$?
- a) aababb
 - b) babab
 - c) abbbabaaab
 - d) aabbaa

Answer submitted: **a)**

You have answered the question correctly.

7. The operation $\text{Perm}(w)$, applied to a string w , is all strings that can be constructed by permuting the symbols of w in any order. For example, if $w = 101$, then $\text{Perm}(w)$ is all strings with two 1's and one 0, i.e., $\text{Perm}(w) = \{101, 110, 011\}$. If L is a regular language, then $\text{Perm}(L)$ is the union of $\text{Perm}(w)$ taken over all w in L . For example, if L is the language $L(0^*1^*)$, then $\text{Perm}(L)$ is all strings of 0's and 1's, i.e., $L((0+1)^*)$.

If L is regular, $\text{Perm}(L)$ is sometimes regular, sometimes context-free but not regular, and sometimes not even context-free. Consider each of the following regular expressions R below, and decide whether $\text{Perm}(L(R))$ is regular, context-free, or neither:

1. $(01)^*$
 2. 0^*+1^*
 3. $(012)^*$
 4. $(01+2)^*$
- a) $\text{Perm}(L((01+2)^*))$ is not context-free.
 - b) $\text{Perm}(L(0^*+1^*))$ is not context-free.
 - c) $\text{Perm}(L((01)^*))$ is regular.
 - d) $\text{Perm}(L((01)^*))$ is context-free but not regular.

Answer submitted: **d)**

You have answered the question correctly.

8. Find, in the list below, a regular expression whose language is the reversal of the language of this regular expression: $10(2+3)$. Recall that the reversal of a language is formed by reversing all its strings, and the reversal of a string $a_1a_2\dots a_n$ is

$a_n \dots a_2 a_1.$

- a) 1(2+3)0
- b) 0(2+3)1
- c) 01(2+3)
- d) (2+3)01

Answer submitted: **d)**

You have answered the question correctly.