Feedback — Week 2: Properties of Regular Languages

Help Center

You submitted this homework on **Sun 4 Oct 2015 10:57 PM CEST**. You got a score of **5.00** out of **5.00**.

Question 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)*.

Now, identify the true statement below.

Your Answer		Score	Explanation
○ DM(L_2) is regular; it is the language of regular expression (0+1)*.			
○ DM(L_2) is not regular; it consists of all strings of the form $(0+1)^n00(0+1)^n$.			
○ DM(L_1) is regular; it is the language of regular expression (01)*(10)*.			
◉ DM(L_2) is regular; it is the language of regular expression ((0+1)(0+1))*.	✔	1.00	Notice that any even-length string of 0's and 1's can be constructed by deleting a 1 from an odd-length string.
Total		1.00 / 1.00	

Question 2

Which among the following languages is not regular (cannot be defined by a regular expression or finite automaton)?

Your Answer		Score	Explanation
◉ $L=\{x \mid x=a^k b^n c^k, n, k \text{ positive integers}\}$	✔	1.00	
○ $L=\{x \mid x=a^m b^n, n, m \text{ positive integers}\}$			
○ $L=\{x \mid x=a^m b^n c^k, n, m, k \text{ positive integers}\}$			
○ $L=\{x \mid x=(ab^2 c)^n, n \text{ a positive integer}\}$			
Total		1.00 / 1.00	

Question 3

Consider the languages.

(a) $\{0^{2n}1^n \mid n > 0\}$

(b) $\{0^{5n}1^n \mid n > 0\}$

(c) {w | w a string of 0's and 1's such that when interpreted in reverse as a binary integer it is a multiple of 5}

(d) $\{0^n1^n|n>0\}$

(e) {w | w a string of 0's and 1's such that its length is a perfect square}

(f) {w | w string of 0's and 1's such that when interpreted as a binary integer it is not a multiple of 5}

(g) {w | w a string of 0's and 1's such that its length is not a perfect cube}

(h) {w | w a string of 0's and 1's such that the number of 0's is not equal to twice the number of 1's}

Which is a regular language?

Your Answer		Score	Explanation
○ (d)			
◉ (f)	✔	1.00	We complement this language and then argue that the complement is regular as follows:

The trick is to realize that reading another bit either multiplies the number seen so far by 2 (if it is a 0), or multiplies by 2 and then adds 1 (if it is a 1). We don't need to remember the entire number seen --- just its remainder when divided by 5. That is, if we have any number of the form 5a+b, where b is the remainder, between 0 and 4, then 2(5a+b) = 10a+2b. Since 10a is surely divisible by 5, the remainder of 10a+2b is the same as the remainder of 2b when divided by 5. Since b, is 0, 1, 2, 3, or 4, we can tabulate the answers easily. The same idea holds if we want to consider what happens to 5a+b if we multiply by 2 and add 1.

- ○ (a)
- ○ (b)

Total	1.00 / 1.00

Question 4

The operation 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 Perm(w) is all strings with two 1's and one 0, i.e., Perm(w) = {101, 110, 011}. If L is a regular language, then Perm(L) is the union of Perm(w) taken over all w in L. For example, if L is the language L(0*1*), then Perm(L) is all strings of 0's and 1's, i.e., L((0+1)*).

If L is regular, 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 Perm(L(R)) is regular, context-free, or neither:

1. (01)*
2. 0*+1*
3. (012)*
4. (01+2)*

Your Answer		Score	Explanation
○ Perm(L((01+2)*)) is regular.			
○ Perm(L((012)*)) is context-free but not regular.			
○ Perm(L((01)*)) is not context-free.			
◉ Perm(L(0*+1*)) is regular.	✔	1.00	
Total		1.00 / 1.00	

Question 5

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)*).

Your Answer		Score	Explanation
(0+1)*11(0+1)*			
(0+10)*11(0+10)* + (0+1)*1			
(0+10)*(1+11(0+1)*)	✔	1.00	
(0+1)*1(ε+11(0+1)*)			
Total		1.00 / 1.00	