Fast**National University of Computer & Emerging Sciences, Karachi  
Spring-2018 CS-Department  
Quiz 1  
22nd Feb 2018, 8:05 am – 8:35 am**

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| **Course Code:** CS301 | **Course Name:** Theory of Automata | |
| **Instructor Name / Names:** Subhash Sagar | | |
| **Student Roll No:** | | **Section: B** |

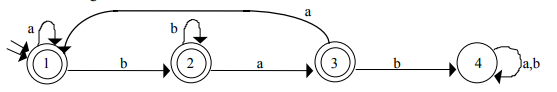
**Time**: 30 minutes. **Max Marks**: 10 points

**Question 1:** Give Regular Expression of the following languages (**5 points**)

1. Set of all string over {0, 1} that do not contain the substring 001

**Possible Solution: r = (1+01)\*0\***

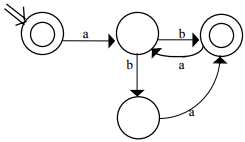
**Question 2:** (**5 points**)

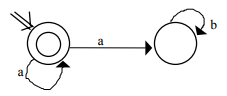
1. Consider the following DFA,
2. Find the regular expression of the above DFA

**Solution: a\*(b\*aaa\*)\*b\*a\***

1. Give the description of the language generated by R.E in (i)

**Solution:** **Set of all strings that do not contain the substring bab**

1. Which of the following strings are expected by NFA in (**Figure (a)**, **Figure (b)** or **both)**.
2. ε **Accept (both)**
3. a **Accept (a) Reject (b)**
4. aa **Accept (a) Reject (b)**
5. aab **Reject (both)**
6. ab **Reject(a) Accept (b)**
7. abab **Reject(a) Accept (b)**
8. aba **Reject (a) Accept (b)**
9. abaa **Reject (both)**



**Figure (b)**

**Figure (a)**

Fast**National University of Computer & Emerging Sciences, Karachi  
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22nd Feb 2018, 10:05 am – 10:35 am**

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| **Course Code:** CS301 | **Course Name:** Theory of Automata | |
| **Instructor Name / Names:** Subhash Sagar | | |
| **Student Roll No:** | | **Section: D** |

**Time**: 30 minutes. **Max Marks**: 10 points

**Question 1:** (**4 points**)

1. Which of the following are true? Prove your answer.
2. baa ∈ a\*b\*a\*b\*
3. b\*a\* ∩ a\*b\* = a\* ∪ b\*
4. a\*b\* ∩ c\*d\* = ∅
5. abcd ∈ (a(cd)\*b)\*

**Solution:**

(1) **True**. Consider the defining regular expression: a\*b\*a\*b\*. To get baa, take no a's, then one b, then two a's then no b's.

(2) **True**. We can prove that two sets X and Y are equal by showing that any string in X must also be in Y and vice versa. First we show that any string in b\*a\* ∩ a\*b\* (which we'll call X) must also be in a\* ∪ b\* (which we'll call Y). Any string in X must have two properties: (from b\*a\*): all b's come before all a's; and (from a\*b\*): all a's come before all b's. The only way to have both of these properties simultaneously is to be composed of only a's or only b's. That's exactly what it takes to be in Y. Next we must show that every string in Y is in X. Every string in Y is either of the form a\* or b\*. All strings of the form a\* are in X since we simply take b\* to be b0 , which gives us a\* ∩ a\* = a\*. Similarly for all strings of the form b\*, where we take a\* to be a0 .

(3) **False**. Remember that to show that any statements is false it is sufficient to find a single counterexample: ε ∈ a\*b\* and ε ∈c\*d\*. Thus ε ∈ a\*b\* ∩ c\*d\* , which is therefore not equal to ∅.

(4) **False**. There is no way to generate abcd from (a(cd)\*b)\*. Let's call the language generated by (a(cd)\*b)\* L. Notice that every string in L has the property that every instance of (cd)\* is immediately preceded by a. abcd does not possess that property.

**Question 2:**  **(6 points)**

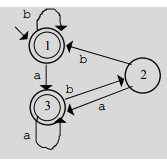
1. Find both Regular Expression and DFA of the language given below

**{w ∈ {a, b}\* : w has abab as a substring}**

**Solution (a): R.E (a+b)\*abab(a+b)\***

**DFA is**

1. Find DFA of the Regular Expression **r = ε ∪ b ∪ (a ∪ b)\* (a ∪ bb)**



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| **Course Code:** CS301 | **Course Name:** Theory of Automata | |
| **Instructor Name / Names:** Subhash Sagar | | |
| **Student Roll No:** | | **Section: F** |

**Time**: 30 minutes. **Max Marks**: 10 points

**Question 1:**   (**5 points**)

Give Regular Expression of the following languages

1. Set of all string over, that do not end with aab.

**Solution: (b+ba)\*a\***

1. Let L = {w ∈ {a, b}\*: w contains bba as a substring}.

**Solution:** **(a ∪ ba)\* (ε ∪ b ∪ bbb\*) = (a ∪ ba)\*b\***

**Question 2:** (**5 points**)

For the following **Languages**, find the equivalent DFA,

{w ∈ {a, b}\* : w has neither aa nor bb as a substring}