CS 301 Theory of Automata

Tuesday, Dec 12, 2017

Course Instructor

Dr Waseem Shehzad, Dr Labiba Fahad and Ms. Mehreen Alam

Serial	No:

Final Exam Section II

Total Time: 2 Hours Total Marks: 100

(Part II)

		S	Signature of Invigilator
Student Name	Roll No	Section	Signature

DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

- 1. This is Part II, the design part of the exam.
- 2. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
- 3. No additional sheet will be provided for rough work. Use the back of the last page for rough work.
- 4. After asked to commence the exam, please verify that you have **fourteen (14)** different printed pages including this title page. There are total of **10 questions**.
- 5. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	1	2	3	4	5	6	7	8	9	10	Total
Total Marks	10	10	10	10	10	10	10	10	10	10	100
Marks Obtained											

Vetted By:	Vetter Signature:

School	of	Com	outing
	· UI	COIII	puui,

Fall 2017

Islamabad Campus

Q1. [5+5 pts] Write regular expression for the following languages defined over $\Sigma = \{a,b\}$ where:
1. no word ends on aa
2 we would enabeling the substitute be
2. no word contains the substring ba
Q2. [10 pts] Construct a Context Free grammar over $\Sigma = \{a,b\}$ whose language is:
 MOREA where all strings have more a's than b's MOREA = {a,aa,aab,aba,baa,aaaa,aaab,}
111011211 - [ajaajaabjabajbaajaaaajaaabj]

1. Every word has even number of substrings 'ab'.

School of Computing

Fall 2017

Islamabad Campus

Q3. **[10 pts]** Convert the following grammar to Chomsky Normal Form Grammar. Show all the intermediary steps in the order clearly to score all the marks.

S → aAbB | ABC | a

A → aA | a | CD

B → CbC | b

C → **S** | **∆**

D→CC | Db

E →**S** | Δ

School of Computing	Fall 2017	Islamabad Campus

School of Computing

Fall 2017

Islamabad Campus

Q4. [10 pts] Convert the following grammar to its equivalent Greibach Normal Form.

S → aAb|a

A →SS|b

School of Computing	Fall 2017	Islamabad Campus

School of Computing

Fall 2017

Islamabad Campus

Q5. **[10 pts]** Use Pumping Lemma to prove that the following language is not Context-Free $A = \{ 0^n 1^m 0^k 1^{n+m} \mid n,m,k > 0 \}$

School of Computing Fall 2017 Islamabad Campus

Q6. [10 pts] Design a PDA for EVEN PALINDROME = $\{\Delta, aa, bb, aaaa, abba, baab, bbbb, ...\}$

School of Computing Fall 2017 Islamabad Campus

Q7. [10 pts] Design a Post Machine for the language $\mathbf{a}^n \mathbf{b}^n \mathbf{a}^n$ for $n \ge 0$.

School of Computing	Fall 2017	Islamabad Campus

Q8. [10 pts] For the language $a^nb^nc^nd^ne^nf^n$, where $n \ge 0$, design a 2-PDA.

Page **10** of **14**

School of Computing

Fall 2017

Islamabad Campus

Q9. **[10 pts]** Let L be some regular language in which all the words happen to have an even length. Let us define the new language Twist(L) to be the set of all the words of L twisted, where by twisted we mean the first and second letters have been interchanged, and so on. For example, if

L = { ba abba babb}

Twist(L) = { ab baab abbb}

Build a Turing Machine that accepts Twist(L). You are also **allowed** to use the sub programs of **INSERT** and **DELETE**. You may assume after **INSERT** operation, tape head points at the newly added cell while after **DELETE** operation, tape head points at the same location. You may leave the tape head at any location on the output string when the computation is done.

Status of tape on input is: # a b b b a b a a Δ Δ Δ .							S	tat	us c	of ta	ре	at t	he (out	out	is:										
#	а	b	b	b	а	b	а	а	Δ	Δ	Δ			#	b	а	b	b	b	Α	а	а	Δ	Δ	Δ	
	1																				个					

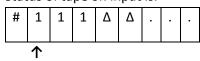
School of Computing

Fall 2017

Islamabad Campus

Q10. **[10 pts]** Design a Turing machine that takes input a non-negative number x and performs the computable function f(x) = 2x. Assume the input is in unary notation, the tape head points in the start of the input. However, you may leave the tape head at any location on the output string when the computation is done. You are also **allowed** to use the sub programs of **INSERT** and **DELETE**. You may assume after **INSERT** operation, tape head points at the newly added cell while after **DELETE** operation, tape head points at the same location. An example is given below for your understanding:

Status of tape on input is:



Status of tape at the output is:

	1			1				
"	_	_	_	_	_	_	Δ	•
		l	l			个		

School of Computing	Fall 2017	Islamabad Campus