

King Saud University
College of Computer and Information Sciences
Computer Science Department



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Course Code:	CSC 339	/ 10
Course Title:	Theory of Computation	
Semester:	2 nd (1443)	
Exercises Cover Sheet:	Homework#1	
Due-Date :	Thursday 24 March 11:59	

Name	ID			
Course Learning Outcomes		Relevant Question No	Full Mark	Student Mark
CLO 1	Identify regular and non-regular languages (K1)	Part 1	3	
CLO 2	Identify decidable and non-decidable, NP-complete, and reducible problems (K1)			
CLO 3	Produce computing-based solutions using regular expressions, and context free grammar (K2)	Part 2	4	
CLO 4	Design different machine models (DFA, NFA, PDA, TM) (S1)	Part 3	3	
CLO 5	Evaluate the language accepted by a machine, a regular expression, and a context free grammar (S1)			
CLO 6	Evaluate the time and space complexity of a Turing machine (S1)			

Question 1

Prove that $L = \{w \in \{0,1\}^* \text{ and } w \text{ has more 1's than 0's}\}$ is not a regular language using the pumping lemma.

Assume that L

Since L is an, we can use the pumping lemma.

Let m be

Pick a string w such that $w \in L$ and length

We choose $w =$

We can write $w =$

such that: $|xy|$

$|y|$

Complete the prove:

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Question 2

- a. Answer each part for the following context-free grammar G.

$$\begin{aligned}R &\rightarrow XRX \mid S \\S &\rightarrow aTb \mid bTa \\T &\rightarrow XTX \mid X \mid \lambda \\X &\rightarrow a \mid b\end{aligned}$$

1. What are the variables of G?
2. What are the terminals of G?
3. Which is the start variable of G?
4. Give three strings in $L(G)$
5. Give three strings *not* in $L(G)$
6. True or False: $T \Rightarrow^* aba$.
7. True or False: $T \Rightarrow aba$.
8. True or False: $T \Rightarrow T$.
9. True or False: $T \Rightarrow^* T$.
10. True or False: $XXX \Rightarrow^* aba$.
11. True or False: $X \Rightarrow^* aba$.
12. True or False: $T \Rightarrow^* XX$.
13. True or False: $T \Rightarrow^* XXX$.
14. True or False: $S \Rightarrow^* \epsilon$.
15. Give a description in English of $L(G)$

- b. Construct a CFG to generate the following languages over $\Sigma = \{0,1\}$:

1. $L = \{w \mid w \text{ contains at least three } 1\text{s}\}$
2. $L = \{0^{2n}1^n \mid n > 0\}$

- c. Give a CFG that generates the same language as the regular expression

$$(a + b)^*(a^* + (ba)^*)$$

Question 3

Design push-down automaton that recognises the following languages.

- a. $L1 = \{ a^n b a^n \mid n \geq 0 \}$
- b. $L2 = \{ a^{2n} b^{3n} \mid n \geq 0 \}$
- c. $L3 = \{ a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i + j = k \}$