Surname (print): _____

First Name: _____

Signature: _____

ID #: _____

University of British Columbia

CPSC 421/501 Introduction to Theory of Computation

Midterm Exam

October 19, 2012

8:00 a.m. - 8:50 a.m.

INSTRUCTIONS:

1: Write your name and ID# in the blanks above.

2: There are 6 pages in this exam, including the cover page and two blank pages at the back. Make sure that you have all the pages.

3: No textbooks, notes, cheatsheets or electronic devices are permitted.

Question	Value	Mark Awarded
1	20	
2	20	
3	20	
Total	60	

Question 1: True/False Questions. You do not need to justify your answer. You may assume that the alphabet is $\{a, b\}$.

1: If L_1 and L_2 are regular then $L_1 \setminus L_2$ must be regular. ($L_1 \setminus L_2$ is the set of strings that are in L_1 but not in L_2.)

2: The language $\{ ab^{3n}a : n \geq 0 \}$ is regular.

3: If L_1 and L_2 are context-free then $L_1 \cap L_2$ must be context-free.

4: The language $\{ w : |w|$ is odd and w's middle symbol is $a \}$ is context-free.

5: If L_1 and L_2 are decidable languages then $L_1 \cup L_2$ must be decidable.

Question 2: Consider the grammar $G = (V, \Sigma, R, E)$ where $V = \{E, T, F\}$ and $\Sigma = \{1, 2, 3, +, \times, (,)\}$. The rules are

$$\begin{aligned} E &\rightarrow \quad E + T \mid T \\ T &\rightarrow \quad T \times F \mid F \\ F &\rightarrow \quad (E) \mid 1 \mid 2 \mid 3 \end{aligned}$$

Draw a parse tree for the string $3 \times (1 + 2)$.

Question 3:

(a): State the Pumping Lemma for regular languages.

(b): Use the Pumping Lemma to prove that the language $L = \{ a^{2^n} : n \geq 0 \}$ is not regular. Here, a^{2^n} means a string of 2^n a's. (**Hint:** Very few integers are powers of two.)

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