CS 4114
Midterm Exam

Given: March 1, 2001, 9:30–10:45  Time: 75 minutes

Name: 

Signature: 

Instructions

1. Before you start answering questions, fill in your name above. Before you turn in your exam, sign above testifying that you have neither given nor received aid on this exam. **Unsigned exams will not be accepted!**

2. The exam consists of four problems worth a total of 150 points.

3. Put your answers in the space provided on the exam sheets.

4. You may consult the textbooks, your notes, or the handouts.

5. Each solution must include an explanation of how the given solution was obtained or why it is correct. An answer, correct or incorrect, without an explanation is worth no credit.

Good luck!
[40] 1. Consider the following language:

\[ L_1 = \{ w \in \{a, b, c\}^* \mid \text{any substring } bb \text{ in } w \text{ is immediately followed by a } c \}. \]

1. Give examples of 5 strings that are in \( L_1 \) and of 5 strings that are not in \( L_1 \).
2. Give a regular expression that represents \( L_1 \).
3. Give a regular grammar that generates \( L_1 \).

\[ \text{Space for your solution to Problem 1:} \]
2. Consider the following language:

\[ L_2 = \{ uab^iuc^i \mid u \in \{a,b,c\}^*, 1 \leq i \}. \]

1. Give examples of 5 strings that are in \( L_2 \) and of 5 strings that are not in \( L_2 \).

2. Give a context-free grammar that generates \( L_2 \).

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Space for your solution to Problem 2:
3. The regular grammar $G_3$ is given by

\[
S \rightarrow aS \mid aA \\
A \rightarrow aA \mid bB \\
B \rightarrow aS \mid b.
\]

1. Identify a string $w \in L(G_3)$ that has at least two different derivations. Also, give two different derivations for $w$.

2. Find a regular expression that represents $L(G_3)$.
4. Context-free grammar $G_4$ is the following:

$$
S \rightarrow aabSA | \lambda \\
A \rightarrow abaA | bbaA | \lambda.
$$

1. Give a definition of $L(G_4)$ in set theoretic form.

2. Give a recursive definition of $L(G_4)$ that does not mention $G_4$.

3. Give a regular grammar $G'_4$ that is equivalent to $G_4$. (That is, you should be able to argue that $L(G'_4) = L(G_4)$.)