CS 173, Fall 2016
Examlet 9, Part B

NETID:

FIRST: **LAST:**

Discussion: **Thursday 2 3 4 5** **Friday 9 10 11 12 1 2**

1. (8 points) Here is a grammar with start symbol S and terminal symbols a and b. Draw three parse trees for the string $a\ b\ b\ a$ that match this grammar.

$$S \ \rightarrow \ \ S\ S \ \mid \ a\ S \ \mid \ S\ a \mid \ b$$

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{k=1}^{n-1} 2^k$ $\quad 2^n + 1$ ☐ $\quad 2^n - 1$ ☐ $\quad 2^n - 2$ ☐ $\quad 2^n$ ☐

A tree with n nodes has $\quad n$ edges ☐ $\quad n-1$ edges ☐ $\quad \leq n$ edges ☐ $\quad n/2$ edges ☐ $\quad \log n$ edges ☐

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1. (8 points) Consider the following grammar G

$$\begin{aligned} S &\rightarrow a\ S \mid a\ N \\ N &\rightarrow N\ N \mid b\ c \mid c\ c \end{aligned}$$

S is the only start symbol. The terminal symbol are a, b, and c.

Here are two sequences of leaf labels. For each sequence, either draw a tree from grammar G whose leaves have this sequence of labels, or else explain briefly why G cannot generate this sequence of leaf labels.

$a\ c\ c\ b\ c$ $a\ b\ c\ c\ c\ a$

2. (4 points) Check the (single) box that best characterizes each item.

$\sum_{k=0}^{n+1} 2^k$ $2^{n+1}+1$ ☐ $2^{n+2}-1$ ☐ $2^{n+2}-2$ ☐ $2^{n+1}-1$ ☐

The root node of a tree is an internal node always ☐ sometimes ☐ never ☐

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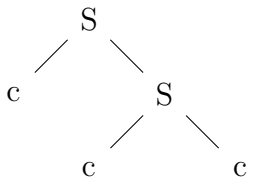
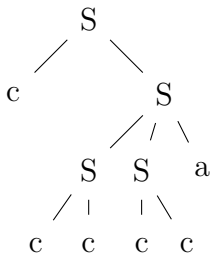
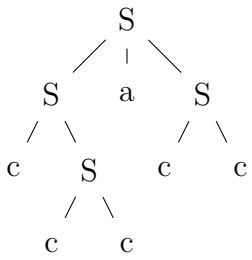
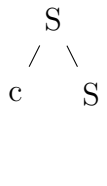
1. (8 points) Here is a grammar, with start variable S and terminals a and c. Circle the trees that match the grammar.

$$S \rightarrow S\,S\,a \mid c\,S \mid c\,c$$









2. (4 points) Check the (single) box that best characterizes each item.

The mathematical symbol for an empty (zero-length) string

$\emptyset$ ☐ e ☐ ϵ ☐ NULL ☐

A binary tree of height h has at least $2^h - 1$ vertices (nodes).

true ☐ false ☐

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1. (8 points) Here is a grammar with start symbol S and terminal symbol b. Draw three parse trees for the string $b\ b\ b$ that match this grammar.

$$S \ \rightarrow \ \ S\ S \ \mid \ S \ \mid \ b$$

2. (4 points) Check the (single) box that best characterizes each item.

The diameter of a full, complete tree of height h.

$\leq h$ ☐ h ☐ $h+1$ ☐

$2h$ ☐ $\leq 2h$ ☐

$\sum_{k=1}^{n+1} 2^k$ $2^{n+1}+1$ ☐ $2^{n+2}-1$ ☐ $2^{n+2}-2$ ☐ 2^n-2 ☐

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1. (8 points) Consider the following grammar G

   $S \rightarrow S\ b\ S \mid a \mid c\ d$

   S is the only start symbol. The terminal symbols are a, b, c, and d.

   Here are two sequences of leaf labels. For each sequence, either draw a tree from grammar G whose leaves have this sequence of labels, or else explain briefly why G cannot generate this sequence of leaf labels.

   $a\ a\ a\ c\ d$ $\qquad\qquad$ $a\ b\ c\ d\ b\ a$

2. (4 points) Check the (single) box that best characterizes each item.

   The level of a leaf node in a tree of height h.

   0 ☐ $\quad 1$ ☐ $\quad h-1$ ☐ $\quad \leq h$ ☐ $\quad h$ ☐

   $\sum_{k=0}^{n-1} 2^k$ $\quad 2^n - 2$ ☐ $\quad 2^n - 1$ ☐ $\quad 2^{n-1} - 1$ ☐ $\quad 2^{n+1} - 1$ ☐

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1. (8 points) Consider the following grammar G

   $S \rightarrow b\ S\ a \mid b\ S\ b \mid c$

   S is the only start symbol. The terminal symbols are a, b, and c.

   Here are two sequences of leaf labels. For each sequence, either draw a tree from grammar G whose leaves have this sequence of labels, or else explain briefly why G cannot generate this sequence of leaf labels.

   $b\ b\ c\ a\ b\ a\ b$ $\qquad\qquad$ $b\ a\ b\ c\ b\ b\ b$

2. (4 points) Check the (single) box that best characterizes each item.

   The number of paths between two distinct nodes in an n-node tree. Paths in opposite directions count as different.

n	☐	$2n$	☐	$\frac{n(n-1)}{2}$	☐
$n(n-1)$	☐	n^2	☐		

   The chromatic number of a full 3-ary tree

1	☐	2	☐	≤ 2	☐
3	☐	≤ 3	☐	can't tell	☐