CS 173, Spring 2015
Examlet 9, Part B

NETID:

FIRST:

LAST:

Discussion: Monday   9   10   11   12   1   2   3   4   5

1. (8 points) Consider the following grammar G

$$S \to b\,a\,S \mid S\,S \mid c\,c \mid c\,a$$

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.

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

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

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

$2^{n+1} + 1$ ☐ $2^{n+2} - 1$ ☐ $2^{n+2} - 2$ ☐ $2^{n+1} - 1$ ☐

A tree with n nodes has

n edges ☐ $n - 1$ edges ☐ $\leq n$ edges ☐

$n/2$ edges ☐ $\log n$ edges ☐

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1. (8 points) Consider the following grammar G

$$S \to S\ S \ \mid \ a\ N \ \mid \ a\ a$$
$$N \to S\ a \ \mid \ a\ b$$

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

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.

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

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

Total number of leaves in a full and complete 5-ary tree of height h

5^h ☐ $\qquad$ $\leq 5^h$ ☐

$\geq 5^h$ ☐ $\qquad$ $5^{h+1} - 1$ ☐

The chromatic number of a full 3-ary tree

1 ☐ $\qquad$ 2 ☐ $\qquad$ ≤ 2 ☐

3 ☐ $\qquad$ ≤ 3 ☐ $\qquad$ can't tell ☐

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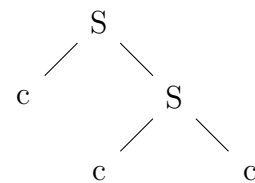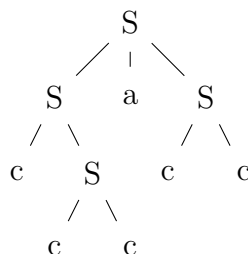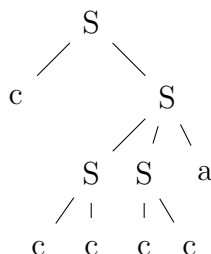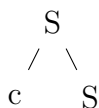
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1. (8 points) Here is a grammar, with start variable S and terminals a and c. Circle the trees that match the grammar.

$$S \to \ S\,S\,a \ \mid \ c\,S \ \mid \ c\,c$$

```
        S                    S                      S                    S
       / \                 /   \                  / | \                /   \
      c   S               c      S              S  a  S              c      S
                              / | \            / \    / \                  / \
                             S  S   a         c   S  c   c               c     c
                            /| |\             / \
                           c c c c           c   c
```

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

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

The root node of a tree is an internal node   always $\square$ sometimes $\square$ never $\square$

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1. (8 points) Consider the following grammar G

$$S \to b \, a \, S \mid S \, S \mid c \mid c \, a$$

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.

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

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

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

A full m-ary tree with i internal nodes has $mi + 1$ nodes total.   always ☐   sometimes ☐   never ☐

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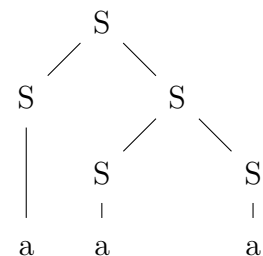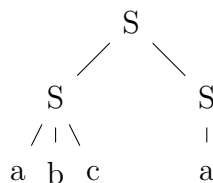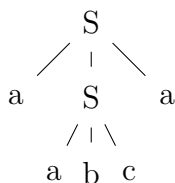
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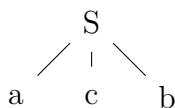
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Discussion: Monday   9   10   11   12   1   2   3   4   5

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

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

```
        S                    S                      S                     S
      / | \                / | \                  /   \                 /   \
     a  c  b              a  S  a                S      S             S       S
                           / | \               / | \    |            |     / | \
                          a b c               a b c     a            a    S     S
                                                                          |     |
                                                                          a     a
```

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

The number of nodes in a
binary tree of height h

$\geq 2^h$ ☐ $= 2^{h+1} - 1$ ☐

$\leq 2^{h+1} - 1$ ☐ $\geq 2^{h+1} - 1$ ☐

The level of the root node
in a tree of height h.

0 ☐   1 ☐

$h - 1$ ☐ h ☐ $h + 1$ ☐

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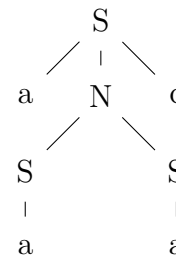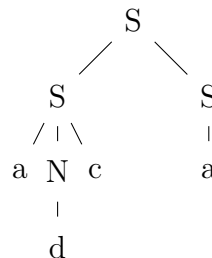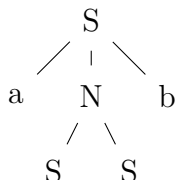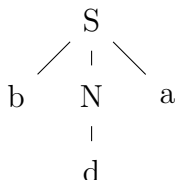LAST:

Discussion: Monday   9   10   11   12   1   2   3   4   5

1. (8 points) Here is a grammar with start symbol S and terminal symbols a, b, c, and d. Circle the trees that match the grammar.

$$S \to a\ N\ b \mid a\ N\ c \mid a$$
$$N \to S\ S \mid d$$

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 ☐

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